



**SOUTH PACIFIC COMMISSION AND FORUM FISHERIES AGENCY
WORKSHOP ON THE MANAGEMENT OF SOUTH PACIFIC
INSHORE FISHERIES**

**VOLUME III
REPORT OF THE WORKSHOP AND MANUSCRIPT COLLECTION OF
KEYNOTE PAPERS**

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Integrated Coastal Fisheries Management
Technical Document No. 13

by Tim Adams,
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and Steve Roberts

ODA

South Pacific Commission
Nouméa, New Caledonia

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1 Background

1.1 *Pacific Island Inshore Fisheries*

Not a great deal is known, in terms of the information required for administration, about the coastal fisheries of most of the Pacific Islands¹. These are multispecies (even multiphyllum) fisheries, carried out mainly at the village level from a multitude of landing points, and the great majority of production does not pass through the cash economy. Quantification is thus extremely difficult, given the financial resources available to Pacific Island fisheries administrations. Indeed, most Pacific islands did not have any government service dedicated to fisheries until the 1960s or >70s, and we are only now starting to get an idea of the extent of the subsistence component of these fisheries².

It is similarly difficult to get an idea of the exploitation status of coastal fisheries in the various Pacific Islands, and this was one of the reasons behind the convention of a previous meeting at SPC headquarters in August 1988: to make a first attempt to draw together the available knowledge about inshore resources. The Inshore Resources Workshop was an event that enabled a great deal of information to reach Pacific Island fisheries administrations, but which also provided considerable guidance to the future work programmes of the relevant sections of SPC and FFA.

A review of fisheries research capabilities in the Pacific Islands³ in 1986 had been fairly pessimistic about the capabilities of the newly-localised Pacific Islands fisheries administrations to assess the state of their fisheries. Given the small size of most of these nations, and the commonality of many of the resource problems they faced it was clear that shared facilities via the regional fisheries organisations could be of benefit to all. There was not the same international mandate for cooperation in coastal fisheries as there was for highly migratory fishes through the Law of the Sea Conferences that would not come until the United Nations Conference on Environment and Development in 1992, and Agenda 21—but it was felt that the region could benefit from the same economies of scale that had already benefitted regional research and development of tuna fisheries.

In 1987 the SPC Fisheries Programme and the FFA implemented projects designed to address the need for management-oriented research on coastal fisheries. These were, respectively, the Inshore Fisheries Research Project and the Research Coordination Unit, with the SPC concentrating on assisting and training member country fisheries departments in describing and evaluating fisheries where information was grievously lacking, and the FFA concentrating on providing linkages and drawing together already-available information. The 1988 Inshore Fisheries Resources Workshop was a major defining event in the direction of both these projects.

The early and mid-1980's were a period of great optimism in tropical fisheries science. The development of length-based methods appeared to solve many of the problems holding back tropical fish stock

¹ The Pacific Islands are defined here as those islands which are within the work-area of the South Pacific Commission (see Figure 1)—an area which implicitly includes all of the Forum Fisheries Agency member countries.

² See Dalzell, P. J., Adams, T. J. H. and Polunin, N. V. C. (1996) Coastal Fisheries in the Pacific Islands. *Oceanography and Marine Biology: an Annual Review*, **34**, 395-531

³ See Fakahau S. T. & M. P. Shepard (1986) *Fisheries research needs in the South Pacific: Information requirements for the effective management and development of the fisheries of Island States of the South Pacific. Volume I: Cook Islands, Kiribati, Niue, Papua New Guinea, Solomon Islands, Tonga, Tuvalu, Vanuatu and Western Samoa*. 91pp + 200pp appendices. Working paper 21, 18th Regional Technical Meeting on Fisheries, South Pacific Commission, Noumea, New Caledonia. **And** Evans D. (1986) *Fisheries research needs in the South Pacific: Information requirements for the effective management and development of the fisheries of Island States of the South Pacific. Volume II: Federated States of Micronesia, Marshall Islands, Nauru and Palau*. Forum Fisheries Agency, Honiara, Solomon Islands.

assessment, and the computerisation of these methods promised to put these tools into the hands of all. Given the concurrent thrust towards economic development by national fisheries departments it appeared that, within the near future, we would see a much more industrialised type of coastal fishery in the Pacific Island, using rigorous stock assessment to actively manage a mainly commercial harvest.

That perception has changed dramatically. With the realisation of limited resources and limited business growth potential in coastal fisheries, as well as the shift in general economic philosophy away from government-led development, most Pacific Island fisheries administrations are now far more management and custodially oriented towards the resources under their control. In addition, with the acceptance that the great majority of the catch is landed for subsistence purposes in most islands, many governments are coming to recognise the value of devolving aspects of resource ownership back down to the community level, where they have functioned for centuries. On top of this has come the news of management failures in many of the great industrial fisheries of the world, and the realisation that stock assessment is not yet, after all, an exact science.

Figure 1 - SPC fisheries work-area

[insert C:\Adams\Mapinfo\workarea.WMF here]

Thus the other major purpose behind the 1988 SPC Workshop on Inshore Fisheries Resources was to reflect the change from a development focus to a management focus, and to give Pacific Island fisheries departments some of the information necessary to manage this change.

Currently, Pacific Island coastal teleost food-fisheries are not generally perceived to be a major cause of management concern, judging by the level of production they continue to sustain and the general scarcity of complaints that filter up from fishing communities to national governments and regional organisations. However, there are concerns in a few small island areas where local population densities are very high, particularly where a large non-local population has become resident and is disenfranchised from customary marine tenure. But the most extreme management concern, judging by the amount and type of requests made to regional organisations for assistance, is with fully commercial fisheries, particularly those for export. These are fisheries which have developed outside the scope (in most cases) of community management, and are thrown onto ill-equipped government departments for resolution. As a result, exploitation tends to be driven by commercial factors (particularly insatiable Asian market demand) and over-exploitation is almost always the result. These are the fisheries where most current management activity and research is focussed.

The subject of this report, the 1995 Inshore Fisheries Management Workshop, is an attempt to define "Stage II" on the road towards the goal of effective management of Pacific Island Inshore Fisheries. In the 7 years since the 1988 Inshore Fisheries Resources Workshop it is hoped that enough information has been compiled about the resources of common concern to enable consideration of the best ways to manage them. In reality, of course, progress does not go by such easy stages. It is incremental, and moves at a different pace in different countries. Progress in national capabilities towards fisheries management in the Pacific Islands has been generally rendered invisible by other overwhelming changes, particularly the aftermath of de-colonialisation with its effects on the availability of technical skills, and the diversion of external resources to countries of the former Warsaw Pact. Unfortunately for Pacific marine resources, external assistance is based on the number of people in the region, not on the proportion of the Earth's oceans that those people must look after.

However, despite the unevenness of progress towards better institutional management of fisheries in the islands, it is clear that basic knowledge has improved and that there is a much more realistic attitude in place concerning the workability of different resource-maintenance strategies. Indeed, in certain areas, particularly mechanisms of resource-ownership, the Pacific Islands could have a great deal to teach the

rest of the world. The workshop is intended to share and compare different experiences in coastal fisheries management, not only between Pacific Island countries, but between the Pacific Islands and the outside world.

It should perhaps be noted in passing that the workshop is also the culmination of the work of both the FFA Research Coordination Unit and the SPC Inshore Fisheries Research Project, which have now both reached the end of their cycles. The SPC IFRP is succeeded by the UK-funded Integrated Fisheries Management Project, which funded the publication of this report, and is an evolutionary progression of the IFRP intended not so much to put information necessary for fisheries management into the hands of Pacific Island administrations as to help administrations and communities to actually implement management regimes. The Forum Fisheries Agency meanwhile, in the interest of focussing its resources on its primary mandate—the management of the region’s tuna stocks—has withdrawn from the coastal fisheries arena.

1.2 *Workshop definition and sponsorship*

A great number of financial sources contributed to the running of this workshop, but the most significant were the United Nations Development Programme (for sponsoring the majority of the Pacific Island participants and other invited experts through the SPC/FFA National Capacity Building and Support Project) and the Overseas Development Administration of the United Kingdom (for sponsoring the operation of the SPC Integrated Coastal Fisheries Management project staff through the many months it took to organise the workshop).

Additional support came from the Australian Centre for International Research (via SPC), the Japan International Cooperation Agency (via their Tongan aquaculture project), from FAO, and from numerous other agencies and government departments too numerous to mention, who sponsored their individual participants to this workshop.

The aim of the workshop structure was not to organise the agenda “vertically” (with each topic pertaining to a different fishery resource) as in the 1988 Workshop, but “horizontally” (with each topic pertaining to a different management strategy, for any resource). It was hoped that this would enable the participants to judge the pros and cons of different management methods, and to be able to go home and to tailor different measures to different resources based on a knowledge of their strengths and weaknesses. In hindsight, this organisation of the agenda did not work as well as hoped, because almost all of the case studies presented made use of more than one management strategy per resource, and it became difficult to assign places in the agenda to some of the contributions.

In addition, few of the contributions, apart from the keynote presentations, were able to critically assess the management measures in use, and many were still organised towards a resource-specific format. Rather than conclude that few people had read the agenda we prefer to think that it is perhaps not meaningful to compartmentalise Pacific Island fisheries by management type. Most Pacific Island fisheries are also multispecies⁴, as well as “multi-management”, and perhaps the most useful compartmentalisation should be by “fishery”. Note that, when the issue of management is under consideration it is preferable to consider “fisheries” rather than “resources”. “Fisheries” contain the human component that is so important in management, whereas “resources” do not.

It was originally intended to hold the workshop in Suva, Fiji, which would be equally convenient (or equally impractical) to both the FFA co-organisers in Solomon Islands and the SPC co-organisers in

⁴ For example, the bêche-de-mer export fishery consists of up to 22 species, and the artisanal reef-fishery up to 200.

Nouméa. There would also be some saving in air-fares for participants due to Fiji's more central location on the trans-Pacific air-routes. However, on receiving quotes, it turned out that any savings in air-fares would be offset by the need to hire a suitable conference facility and equipment, and to pay for the expenses of the SPC French/English interpreters and, with the announcement by FFA of its withdrawal from all coastal fisheries activities early in 1995 it was decided to hold the workshop instead at the SPC headquarters conference room in Nouméa.

On timing:— the original date set for the workshop in financial planning had been October 1994, to coincide with the formal end of the SPC Inshore Fisheries Research Project. This date was postponed by mutual agreement between SPC and FFA in order to accommodate the postponed submission of the SPOCC⁵ Review of Institutional Arrangements in the Pacific Islands Marine Sector, which was due to be presented to the region at the Forum Fisheries Committee meeting in May 1995. The Workshop would thus have been an opportunity for member countries to discuss this Institutional Review from the aspect of coastal fisheries, and for FFA to develop a regional strategy for coastal fisheries research to be considered under the global Strategy for International Fisheries Research (SIFR). A review of fisheries research in the region⁶ was compiled to provide a context for these planned deliberations. In the event, however, FFA had decided to withdraw from active participation in the coastal fisheries issues early in 1995, and the SPOCC Institutional Review did not turn out to be available by the date of the Workshop anyway.

The written input to the workshop was implemented primarily in the English language, since this was the language in which the majority of papers were submitted and spoken by the great majority of participants, but the entire proceedings of the plenary sessions were simultaneously interpreted into French and English. It was unfortunately impossible to translate all of the papers into both languages, both because of their large number and because many were submitted at the last minute. However, an abstract of each paper was provided in both languages, and it was possible to translate several of the keynote papers in advance.

⁵ South Pacific Organisations Co-ordinating Committee:- an occasional voluntary meeting between the heads of several Pacific Island regional organisations for the purpose of coordinating work-programmes, avoiding either omission or overlap. Member countries are not represented.

⁶ See Adams T. J. H., Richards, A., Dalzell, P. J. & Bell, L. (1995) *Research on Fisheries in the Pacific Islands Region*. SPC and FFA Workshop on the Management of South Pacific Inshore Fisheries, Volume II, Manuscript collection of country statements and background papers, 87-165 (BP.36). SPC, New Caledonia

2 Workshop Proceedings

2.1 Agenda

WEEK 1

Day	08.30-10.00	10.30-12.00	13.30-15.00	15.30-17.00
Monday 26 June	Registration and opening formalities	Why and when is management needed?	Why and when is management needed?	Why and when is management needed?
Tuesday 27 June	Stock assessment and biological information	Stock assessment and biological information	Stock assessment and biological information	Stock assessment and biological information
Wednesday 28 June	Closed seasons	Closed seasons	Restricted entry & quotas	Restricted entry & quotas
Thursday 29 June	Deciding financial and human resources for management	Deciding financial and human resources for management	Protected areas, sanctuaries and reserves	Protected areas, sanctuaries and reserves
Friday 30 June	Protected areas, sanctuaries and reserves	Feedback from the fishing community	Feedback from the fishing community	Feedback from the fishing community

WEEK 2

Day	08.30-10.00	10.30-12.00	13.30-15.00	15.30-17.00
Monday 3 July	Resource ownership (CMT & ITQ)	Resource ownership (CMT & ITQ)	Artificial enhancement/re-seeding & introduced species management	Artificial enhancement/re-seeding & introduced species management
Tuesday 4 July	Post harvest: a fisheries management tool?	HACCP and fisheries management	Improving returns from conventional fisheries products	New resources and new techniques
Wednesday 5 July	Size limits and gear restrictions	Size limits and gear restrictions	Country statements (Eastern Pacific)	Country statements (Northwest/Central Pacific)
Thursday 6 July	Country statements (Southwest Central Pacific)	Country statements: general discussion	Crisis management, emergency measures and prioritisation of response	Integrating fisheries management into coastal zone management
Friday 7 July	Discussion of reports of relevant special sessions		Clearing of record of discussion	

2.2 *Secretary-General's Opening Address*

by Ati George Sokomanu

Honoured guests, friends, Ladies and Gentlemen

It is with great pleasure that I welcome you to this workshop. Whilst we are used to holding large international meetings at the South Pacific Commission, it has been a long time since we had so many overseas participants at a purely technical meeting. It is also the last major meeting that we will hold at the old headquarters site before moving to the new buildings across the road. This building, which was the US Army headquarters during the war, has stood us in good stead during the forty-eight year life of the South Pacific Commission but, as will see during the next two weeks, it is becoming a little threadbare.

This workshop is a follow-up to a very successful workshop that we held in March 1988, on Pacific Island Inshore Fisheries Resources. That workshop also ran for two weeks, and attracted over 100 original papers on subjects such as *bêche-de-mer* and coral harvesting;- topics which were of great significance to Pacific Island fisheries administrations, but on which very little written information was available.

The 1988 workshop also coincided with the start-up of two major new fisheries projects in the region:- the "FFA Research Coordination Unit" and the "SPC Inshore Fisheries Research Project". Both of these projects worked from different angles over the following years, but towards the same aim:- to assist Pacific Island nations to acquire the information necessary to improve the management of coastal fisheries.

In years gone by, the decision on what to fish; when to fish; and how to fish; was made by local communities and chiefs. The catch from the reef and lagoon was used within the village, or bartered to other villages, and because the fishing grounds were owned absolutely at the local level, they could also be managed effectively at the local level.

Things are more difficult nowadays. With the advent of colonialism and the concept of State ownership of the seabed, not to mention the introduction of the cash economy, this local control has been severely eroded in many places, and a great deal of traditional knowledge lost. With the more recent upsurge of foreign investment in export fisheries, both the eroded village systems, and the over-stretched government systems that replaced them, have been unable to cope effectively with the management of resources such as *bêche-de-mer*, trochus shell, and groupers. This situation has been still further complicated by growing general environmental problems due to overpopulation, pollution and potential climate change. A new approach, or a synthesis of the old approaches, is needed.

Both the SPC and the FFA, in their own ways, have tried to assist member countries with this problem. Seven years down the track after the 1988 "Workshop on Inshore Fisheries Resources", which tried to bring together all the available relevant knowledge about the inshore fishery resources critical to Pacific Islands economies and lifestyles, we are holding this 1995 "Workshop on Inshore Fisheries Management". The aim now, is not so much to draw together knowledge on the resources themselves, but to gather together all we can on how to manage those resources:- how to ensure that these fisheries will continue to contribute to our lives, far into the future.

Both the SPC Inshore Fisheries Research Project and the FFA Research Coordination Project have come to the end of their funding cycles recently, and this workshop is both a summing up of this era, and a lead-in to the next phase of activity with the SPC Integrated Coastal Fisheries Management Project.

All of you are here because you are considered to be experts in your particular field, whether that field be knowledge of a particular fishery, knowledge of a particular management measure, or knowledge of the conditions in a particular country. And I hope that all of you will be encouraged to participate fully in the discussions and conclusions of this meeting. Some of you are senior, and some of you are more junior, but all of you are important to the success of this workshop.

Ladies and Gentlemen. I wish you all the best in your forthcoming deliberations. If my secretariat can assist you in any way, please do not hesitate to ask.

2.3 *Session summaries*

2.3.1 *The foundation — Why and when is fisheries management necessary?*

Daniel Pauly was the keynote speaker and moderator for the session, which was intended to discuss the reasons for making, or not making, management interventions. The editors are indebted to Dr Pauly for providing a synopsis of the various presentation, included below.

2.3.1.1 *Keynote & background papers*

Nick Polunin	Verbal presentation
Being Yeeting	Verbal presentation
Peter Craig	BP001: Are tropical nearshore fisheries manageable in view of projected population increases? ⁷
Claude Chauvet	BP020: La protection du milieu marin et la gestion des stocks exploités
Daniel Pauly	KP010: When is fisheries management needed? (see this volume)
Suesan Saucerman	BP018: Assessing the management needs of a coral reef fishery in decline

2.3.1.2 *Summary of presentations and discussion*

The keynote paper, by Daniel Pauly, was structured around a metaphor from military medicine, the concept of “triage”, which provides criteria for selecting, from three groups of wounded, who should and who need not receive immediate help. This corresponds to three groups of fisheries:-

☞ *“Those who will survive without help”*—Small-scale fisheries with low catches relative to overall potential and a strong tradition of local management were suggested to require little attention by fisheries departments, and this was supported by Nick Polunin, who presented fieldwork by Andrew Cooke on the local management of Fijian customary fishing rights areas (*qoliqoli*) subject to varying fishing intensities;

☞ *“Those who will die without help”*—Expanding fisheries, or those at the brink of major transitions were identified as those most requiring the intervention of fisheries management units, and it was emphasised that such intervention should remain punctual (e.g. in the form of field surveys plus report) rather than be repeated annually (to provide an annual fisheries

⁷ Note: The background papers (BPxxx) and country papers (CPxxx) were published in 1995 in the first two volumes of the series containing this current volume, by the South Pacific Commission. The keynote presentations that were written are published later in this volume.

target, e.g. as a total allowable catch in developed country laboratories). This is due to the substantial cost of maintaining a “critical mass” of fishery scientists in a small country (for which some figures were provided);

☞ *“Those who will die anyway”*—The fisheries in the third group are those in which fisheries management alone cannot help to stabilise or rehabilitate fisheries. One key factor here, emphasised by the contribution of Peter Craig with respect to American Samoa (presented by Suesan Saucerman) and by Being Yeeting with respect to Tarawa in Kiribati (and also in other papers presented later in the workshop), is population growth which generates both:

- (i) increased fishing pressure and demand for fisheries products;
- (ii) increased stress for coral reefs and the fisheries they support through production of trash, sewage and soil runoff from cultivation of sloping lands.

The latter part was more fully developed by Suesan Saucerman, who pointed out that solution of the problem required collaboration of fisheries managers with institutions responsible for management of agricultural practises and soils.

The contribution of Being Yeeting showed how a multi-sectoral “council” was established for the management of Tarawa lagoon, Kiribati. Pauly emphasised that such multisectoral bodies are required as an element of “new governance” arrangements when fisheries and the habitats they rely on need rehabilitation, i.e. when fisheries management in the narrow sense becomes insufficient.

Discussion

The following summary was compiled from notes made by the rapporteurs during the course of the session.

Considerable discussion between the scientists was engendered after the presentation by Claude Chauvet concerning the old dispute about the relationship (or not) between parental stock size and recruitment. The meeting agreed to cut this short since it was not contributing to the general understanding about the need for management.

There was some discussion of the decline in the American Samoan artisanal fishery and whether this could be attributed purely to environmental degradation or whether overfishing played some part. John Munro reckoned that American Samoa was probably not overfished, but that it might be on the “slippery slope”. He raised comparative examples in the Caribbean of definite overfishing, particularly Jamaica, where the cumulative effects of overfishing, a subsequent booming sea-urchin population and declining coral cover have led to a 70% decrease in landings. Suesan Saucerman pointed out that people in American Samoa do not appear to be fishing very hard, due to social changes and increasing employment moving people out of the subsistence sector. However, John Munro remained to be convinced that fishing effort in American Samoa had declined so dramatically in such a short space of time.

To clarify matters Moses Amos asked if it would be correct to say that American Samoa has a high birthrate, but that this increasing population has no effect on fish stocks directly? Suesan Saucerman replied that the biggest problem facing American Samoan reef fishery resources is trash and sediment (a study is presently being carried out on sedimentation). The available reef is small and there is no lagoon. Even though the population is growing, there are actually fewer people fishing.

Paul Dalzell raised parallels with Western Samoa, which will be investigated as part of a major AusAID

fisheries management project in collaboration with the Western Samoan Fisheries Division. There appear to be definite social changes influencing fishing activity here as well, with rural electrification and problems in agriculture caused by the taro blight. One of the main points to emerge from the discussion was that it is important to distinguish between the fishing itself and the effects of social and environmental factors. For fisheries management purposes it is not sufficient to monitor fishing effort and catches alone.

Garry Preston was concerned about the relevance of community-government “co-management” to the management of fisheries where the unit stock is larger than the management unit—for example the traditional traditional fishing rights areas of Fiji where several registered fishing rights owners may share a single reef. It is obviously useful when researching the best strategy to have a number of different management strategies working on a common resource, but it would appear that the more conservative resource managers would be disadvantaged by comparison, and that the lowest common denominator would emerge. Why try to conserve when the village next door is overfishing? Should the management unit be larger?

Daniel Pauly stated that he was actually not convinced that co-management was an all-encompassing solution. Co-management does not necessarily give authority to traditional fishers. Also central Government often doesn't play the central guardianship rôle that it should, which is why the alternative concept of “governance and counterweight” was brought out in the keynote paper to this session. This has arisen from the “green movement” which is gradually imposing the basic concept that it is not the fishers who own the stocks, but the people. Government needs to find allies which are going to be conservative and restrain the exploitative nature of the fishers.

Richard Farman said that he understood how the counterweight system could work, but who would be the authority to monitor what is happening? The user community? Daniel Pauly replied that in the USA it is the users who pay for such things as monitoring, but that then gives them too much of a voice on the management councils. The system needs to be unlinked in some way, so that “user pays” does not necessarily mean “user says”.

Several other questions and comments relating to the presentations were entertained during this session, which was concluded by the delegate from Fiji, Saimone Tuilaucala, who stated, with reference to the initial question (“*when is management needed?*”) that the time was “*now!*”

2.3.2 Management Information needs and sources — Stock Assessment

John Munro was the keynote speaker and moderator for the session, which aimed to provide workshop participants with an idea of the current rôle of stock assessment in Pacific Islands fisheries management.

2.3.2.1 Keynote & background papers

John Hampton	BP059 Case study of fishery interaction in a Pacific Island country: Kiribati. (with Lawson, T, Williams, P, & Sibert, J.)
Nick Polunin	Verbal presentation
Chris Evans	BP002: Stock Assessment and status of the ornate lobster <i>Panulirus ornatus</i> in reef areas of Torres strait fished by Papua New Guinea divers, (with Polon, P)
Tadashi Kimura	BP009: Habitat of juvenile mullet along the northern coast of Tongatapu Island, Tonga, (with U.Fa'anunu, U & Vi, F)
Chris Evans	BP024: Fisheries Ecology of the White Banana Prawn <i>Penaeus merguensis</i>

	in the Gulf of Papua: estimates of sustainable yields and observations on trends in abundance, (with Opnai, J)
Michel Kulbicki	BP044: Estimating the demersal lagoon stock in Ouvea, an atoll of New Caledonia
Kitty Simonds	BP046: Federal-State cooperation in Managing Inshore Deepwater Bottomfish in Hawaii.
Paul Dalzell	BP047: Something old, something new: an approach to obtaining fisheries management information from a remote Pacific atoll, (with Smith, A.)
Michel Kulbicki	BP053: Experimental fishing for demersal fishes in the northern lagoon of New Caledonia - first results, (with Labross, P, and Letourneur Y.)
Michel Kulbicki	BP058: Survey of the reef fish resources by visual censuses in the northern lagoon of New Caledonia - first results. (with Labrosse, P & Letourneur, Y.)
John Munro	KP002: Stock Assessment and Biological Information Needs (see later this volume)
Ray Lari	BP025: Results of investigations into aspects of the ecology of the mudcrab, <i>Scylla serrata</i> , in Western Province, Papua New Guinea
Dave Williams	BP074: Recent advances in the ageing of coral reef fishes

2.3.2.2 *Summary of presentations and discussion*

John Munro opened the session with a paper entitled 'Stock Assessment and Biological Information Needs' which reviewed the various data required for fisheries stock assessment and management and some of the methods by which these can be obtained. Population pressure drives fishing pressure in the most of the region and fish stocks close to major urban centres are already heavily fished. Dr Munro also emphasised the importance of the growing economic power of China (and to a lesser extent Southeast Asia) where increasing industrialisation and national wealth will lead to substantial growth in the demand for seafoods and marine products. This insatiable demand has already had an impact on fisheries in the region, such as *bêche-de-mer* and will increase in the future as these economies grow.

The various data required for stock assessment include physical and environmental data, catch and effort statistics, socio-economic data and a range of biological information. A great deal of the basic information necessary for broad-brush stock assessment already exists, in the form of a knowledge of various morphometric and other parameters, which are being collected together in FISHBASE, and which can be broadly extrapolated from the fisheries in which they were estimated, particularly for making indicative first stock assessments in unassessed fisheries. Natural mortality rates remain the "prime unknown", but if the sampling gear can be designed to sample pre-recruits to the fishery this leads to a biphasic catch curve, and the regression over the pre-recruit phase can give an estimate of this natural mortality. Dr. Munro warned that the selectivity of fishing gear must be taken into account, and that tropical fishes often exhibit marked seasonality:- factors which are often ignored in stock assessment. At the present time, the tools and methodologies to analyse available data on micro-computers already exist and are either freely available or at a minimal cost.

The conventional wisdom of 20 years ago, which reckoned that if a resource becomes scarce then it becomes uneconomic to exploit it thus saving the stock from excessive depletion, is now accepted even by economists to be false following the assessment that the current global fisheries catch actually has a lower financial market value than the cost of running the world's fishing fleets. Governments will often heavily subsidise fishing to avoid social disruption. Even in developing countries, where governments may not be able to afford to subsidise fishing, Dr Munro pointed out that the multi-species nature of these fisheries

means that individual stocks can still be extinguished since it is economic to keep fishing based on the commoner species. Dr Munro's final point was that if there is no implementation of stock assessment and management, then long-term disaster is certain.

There was a question from the floor about the feasibility of estimating natural mortality from pre-recruits, since larval surveys were difficult, and Dr Munro pointed out that it was important for the meeting to recognise the different terminologies used by ecologists and fisheries scientists. To a fisheries scientist, recruitment is the point in the life cycle at which the average individual in a stock of fish becomes liable to capture. Depending on the gear used, a pre-recruit may actually be an adult fish, and one of the principles behind fisheries management by minimum size limits is to ensure that recruitment to the fishery does not occur until after sexual maturity. By contrast, ecologists use the word recruitment to define the time at which fishes settle out of the plankton onto the reef. Thus a "pre-recruit survey" to a fisheries scientist does not often mean larval sampling.

Rudolf Hermes appreciated the data needs for stock assessment, but pointed out that Papua New Guinea has a fishery that is limited in financial value and that any data collected is thus relatively very expensive. Dr Munro pointed out that he had this sort of question in mind when writing his paper, which tries to illustrate a range of options, based on cost and ease of execution. Tim Adams said that it is ultimately a question of priorities, but that no Pacific Island fishery is completely valueless in national terms. Even where the majority of fish passes into the subsistence, non-cash, economy it should be noted that this is still an "economy", and can be given a value in the national accounts in terms of import substitution, or in terms of the cost of supporting people's protein needs if they were no longer able to fish.

Various participants presented papers on aspects of fisheries stock assessment or related research in the region (the full text is contained in Dalzell and Adams, 1995). John Hampton of the Commission's Oceanic Fisheries Programme presented a summary of work that suggested some interaction between an artisanal troll fishery for tuna in the coastal waters around Kiribati and an industrial-scale purse seine tuna fishery in the offshore waters of the Kiribati exclusive economic zone. For the 1990-93 data the analysis suggests that there is a positive correlation between declining artisanal troll catches and increasing purse-seine catches within 60 miles from shore, perhaps from competitive effects due to localised depletion. However, it is also possible that since fish were more catchable by purse seine fleets in the Kiribati zone due to the stage of the El Niño Southern Oscillation cycle, this same ENSO effect may have increased the widespread abundance of forage and thus fish were less catchable over the seamounts on which the artisanal troll fishery operates. One management option for Kiribati would be to close areas to purse-seine fleets within 60 miles from shore, but the value of the potential troll catch would have to be weighed against the loss of licence revenue to the country. The question is moot at the present time because the purse seine fleets have now moved west and the cpue of the small-scale fishery has gone way up. In fact the local market appears to have collapsed because of the low price of fish. Management interventions, if they are to be made in this fishery, will need to be carefully thought out.

Chris Evans of the PNG Department of Fisheries & Marine Resources made two presentation under this session. The first of these concerned a preliminary stock assessment of the ornate rock lobster (*Panulirus ornatus*) fishery in Torres Strait fished by divers from Papua New Guinea, where catches from the fishery have continued to increase since the 1970s. Dr Evans discussed the methods of estimating the MSY for the lobster fishery with respect to environmental variables and the measures to manage the fishery through banning of hookah gear. Dr Evans' second presentation under this session concerned the trawl fishery for the banana prawn *Penaeus merguensis* in the Gulf of Papua, where yields from this fishery appear to strongly influenced by rainfall. Management measures for the fishery included a closed season between February and April to maximise recruitment and a permanant closure to fishing of nearshore nursery areas.

Nick Polunin from the University of Newcastle upon Tyne in the UK presented the results of a study conducted on artisanal reef fisheries in Fiji. The information from the study was based on a voluntary logbook scheme and showed for the fisheries examined that catch rates varied very little over a wide range of fishing effort and that all were capable of sustaining yields at least up to 10 t/km² of coral reef/yr. Michel Kulbicki of ORSTOM, Noumea, presented the results and conclusions from a detailed study of the fisheries resources of Ouvea atoll, one of the Loyalty Islands off the coast of New Caledonia. Standing stocks were estimated by a combination of experimental fishing and underwater visual census. The estimated potential yield from the lagoon of this atoll is about ten times the current levels of production. Mr Kulbicki also gave two presentations of the preliminary results of a similar study in the northern lagoon of New Caledonia.

Tadashi Kimura and Uluqa Fa'anunu presented the findings of a study of mullet resources around the main island of Tongatapu in the Kingdom of Tonga. Mullet are highly esteemed in Tonga and stocks have been severely overfished leading to stock decline. A number of management measures were proposed to re-habilitate the mullet stocks including bans on fish corrals, conservation of mullet fry and their nursery grounds, and the culture of mullet to meet the high local demand.

Paul Dalzell gave a description of experimental fishing project conducted at Woleai atoll in the outer islands of Yap State. The objective of this study was to demonstrate that traditional community fishing methods could be used to generate stock assessment and management information from depletion fishing experiments. Sylvester Diake asked if the stock assessment provided total biomass, since a lot of fish probably escape, and Paul Dalzell replied that adults of only two families were picked out (surgeonfish and parrotfish) since there was a reasonable chance that enough of these were retained to give accurate results. Todd Pitlik asked if the different behaviour of different parrotfish species caused problems, and Paul Dalzell replied that the same list of species was adhered to in each of the experiments and fishing occurred at the same state of the tide every day to minimise the effects of different behaviour.

Nick Rawlinson pointed out that a very similar spear fishing depletion experiment had been carried out in the Solomon Islands, but that they were able to cross-check the biomass estimates by using poison at the end to stun the fish in the area. Paul Dalzell admitted that it would have been useful to do this at Woleai, if it had been socially acceptable. In hindsight the methodology would have been different, and used finer-mesh nets for example. It would be useful to replicate this sort of experiment in an area where logistics and communications are a little less onerous.

Daniel Pauly pointed out that the Leslie plots used by Dalzell and Smith in analysing their data produce an estimate of catchability (from the slope) and that catchability is one of the hardest fishery stock assessment parameters to accurately estimate, thus this methodology can be extremely valuable. Of course, it does not catch all the fish, but it gives a good parameters for the fish that it does catch. These estimates can also be extrapolated to other areas, adding to the value of the approach. John Munro supported this, and suggested that it is useful to design your experimental gear with broader applicability in mind.

David Williams of the Australian Institute of Marine Science made a presentation on recent advances in ageing reef fishes from otolith annuli, based on unfished stocks on the Great Barrier Reef. Dr Williams showed that small and medium sized reef fishes such as damsel fishes (Pomacentridae) and surgeon fishes (Acanthuridae) could have considerable life spans of between 20 and 40 years, something which is not evident from assessments based on regularly fished stocks elsewhere, where older individuals are usually absent from the population even though the size-structure is much the same. A most interesting aspect of this work was the strong correlation demonstrated between age and otolith weight and thus the possibility of making it much easier and cheaper to accurately estimate age and growth of fish in the region.

A number of other papers were tabled in this session, were read by participants, and are published in the manuscript proceedings (Dalzell & Adams 1995) but were not presented as the authors could not be present in Nouméa to participate in the workshop. These include two contributions from Papua New Guinea on the stock assessment and biology of nemipterid breams and mudcrabs, and a paper by the Western Pacific Regional Fisheries Management Council on the management of the bottomfish resource in Hawaii.

Discussion in this session focussed on the methods available and the costs of conducting stock assessment investigations. Some doubts were expressed about the utility of underwater visual census (UVC) estimates of biomass, and of the relationship between UVC-derived densities and catch rates but the minimal information presently available makes conclusions uncertain. Michel Kulbicki for example obtained good correlation between UVC and longline fishing-derived estimates of biomass for the New Caledonia southern lagoon, but this wasn't the case in Ouvea where the catch was very low in comparison to the UVC observed biomass, even though the species composition was similar to the southern lagoon. In the northern lagoon survey the data is not yet fully analysed, but it seems that a much higher biomass of certain lethrinids is apparent from fishing whilst they are not often seen in UVC work. At the opposite end of the scale, a lot of *Monotaxis* were seen but not many caught. But there was a good correlation for *Gymnocranius* and some serranids, and perhaps for the total biomass when all families are lumped together.

Nick Polunin stated that there are some clear constraints on the use of UVC for fisheries stock assessment, particularly for the Lethrinidae, and particularly for fishes that range into deeper water. Dave Williams accepted this but emphasised the undoubted need to have some fisheries-independent techniques available. UVC has its place. For example, in a fishery where *Plectropomus* is 50% or more of the catch, the stock can be well censused using UVC in shallow water. There have been cases where the fisheries administration reckons an area has been fished out, but where UVC reveals a higher density of target species than in a lightly-fished area. In one case it was discovered that only 25% of the total population of this species was vulnerable to fishing, due to behavioural and other factors.

It appears that in certain circumstances UVC is appropriate but that some guidelines are required about when to use this technique. Also, other abundance estimation techniques such as depletion fishing may be only applicable to certain sections of the total standing stock: for example line-fishing will catch mainly predatory species such as groupers and snappers. However, since these are actual fishing methods, the applicability of the derived catch rate estimates to fisheries are at least not in question.

Interest was expressed by Fiji in the methods used to estimate standing stocks in New Caledonia, as outlined by ORSTOM, but it was reckoned that these would be prohibitively expensive for most Pacific Islands countries. For example, the survey at Ouvea carried out for the fisheries administration covered 128 stations and cost around US\$12,000, not including the cost of the boat⁸. Saimone Tuilaucala also commented on the apparently good cooperation of the fishermen in this survey—something not commonly seen in other Pacific Islands. However, as became clear, a feature of the ORSTOM technique was not to rely on local fishermen to obtain catch information but to standardise this by employing their own team of fishermen (the efficiency of each boat and man was calculated and used to weight results, but the total difference was only around 10%).

Some discussion centered on the the application of results in one location to other areas, for example biomass and catch rate correlations from Noumea being used to generate standing stock information in

⁸It should be noted however that New Caledonia wage rates are far higher than most Pacific Islands. SPC, following from ICLARM, has also promoted the use of regular standardised trial fishing by government fisheries officers as a cost-effective method of generating accurate information for stock assessment in several countries.

the Maldives. Some caution was expressed as geographic variation may also be reflected in behavioural differences between populations of the same species, and Michel Kulbicki found that size at first reproduction for some Lutjanids can differ in different areas or habitats in New Caledonia. Dave Williams stated that geographic variation is sometimes great, and one or two extremely different sizes at maturity have been found in different areas.

John Munro concluded the session with the comment that conventional stock assessment is now in disarray if all fish behave very differently in different areas or amongst different assemblages. An afterthought from Paul Dalzell was that perhaps fishermen only catch the stupid fish.

2.3.3 Management Information needs and sources — Assessing human and financial needs and allocating responsibilities for management

Hugh Walton was the keynote speaker and moderator for the session, which aimed to develop some aspects of the institutional foundation of Pacific Island fisheries management..

2.3.3.1 Keynote & background papers

Rudolf Hermes	BP023: Artisanal fisheries development in Papua New Guinea, by Jarchau, P, Hermes, R, Nagai, R & Kaupa, B
Patricia Tuara	BP040: The role of women in the management of Pacific Island Inshore Fisheries
Hugh Walton	KP008: Deciding human and financial resources for fisheries management
Shinichiro Kakuma	BP017: Sedentary resource management in Onna village, Okinawa (with Higa, Y).
Colin Reynolds	BP056: Fisheries Resources and sustainability: the need for a holistic approach to management.
Bob Pomeroy	IP001: ICLARM policy brief on fisheries co-management (published by the International Center for Living Aquatic Resources Management, Manila)

2.3.3.2 Summary of presentations and discussion

Hugh Walton's keynote talk was based on his varied experiences as a fisherman, educator, administrator and human resource development adviser, and liberally sprinkled with examples from his travels in the Pacific. One of his basic premises was that finances tend to be fixed from above, and thus pretty much outside the control fisheries departments, but people management is essential if fisheries management institutions and departments are to function effectively and avoid waste.

Information collection is a central need, but the need for information has to be defined. He gave an example of one department which had been running a creel survey for 2 days per week for the last 7 years, which was all well and good except that data entry lagged 2 years behind and the compiled data had never been analysed anyway. Hugh reckoned that there was a lot more potential to involve the user community, and that there should be an onus on commercial fisheries to supply information to fisheries managers. He also threw down a challenge to politicians. Pacific Island governments are very aware of the value of marine resources but it is difficult to find an example where a significant proportion of the overall benefits are ploughed back into maintaining these resources. Should Pacific Island countries with big commercial fisheries continue to subsidise their management? New Zealand for example, levies every fish that is landed. There is too little attention at the political level to management needs, or the relationship

between resource value and the cost of maintenance.

On personnel efficiency—the greatest expenditure in Pacific Island fisheries departments is in the salaries of staff, and whether or not they offer value for money needs to be regularly reviewed. Heads of department often utilise people poorly. Mr Walton gave an example of one anonymous department where he had an appointment with a senior officer at 9am, and sat in the waiting room with 10 other people for the entire morning. During this time he discovered that the other people in the waiting room were actually fisheries staff waiting for their daily assignments. The senior officer didn't arrive that day at all. This obviously is not the case in all departments, but if the people managers are not organised and committed then the department has no chance of functioning properly.

On training, Mr Walton suggested that there was no point in training someone who is not interested in their job. Training does not automatically improve people unless they actually want to be better at their job. If you train an unmotivated person you simply end up with a trained, unmotivated person.

Hugh then ran through the requirements of human resource planning, based on the experience with SPC in helping various Pacific Island fisheries departments. In the conclusion to his talk he posed a pertinent question: “Do biologists make good people managers”? He pointed out that the skills of people management do not equate with the skills of science, yet a lot of Pacific Island fisheries heads were trained as biologists.

Todd Pitlik commented that the Guam fisheries administration has high standards for its personnel. But fisheries officers have to work odd hours and they have to be special kinds of people, needing a lot of initiative. Fisheries management agencies need to be very cohesive.

Louis Aitsi said that in the South Pacific, the pace of development of marine resources is very fast, but the scientific tools for management are very slow. Managers need information quickly and often have to make decisions before scientific information is available. He suggested that there were a lot of training opportunities aimed at scientists and economists, but not enough training for people managers. Hugh Walton responded that SPC was asked in 1991 to assist with senior manager training and ran courses. But it was discovered that most Governments also run courses for senior managers, and the University of the South Pacific has relevant training, but these are not very well used. There was no point in SPC duplicating existing training and it needs internal departmental initiative to link into existing training opportunities.

Robert Jimmy supported Hugh's comments about the need for organisation and commitment by senior managers, but even if the boss is inefficient there should be some initiative at the lower levels to get on with the job. Another problem is that senior administrative staff get most of the training opportunities. Hugh replied that it is difficult for junior staff to show initiative when they are under express orders not to do anything without their senior's approval. On the question of most training opportunities going to senior staff, it just highlighted the need for HRD planning to set training requirements for each type of job.

Bisessar Chakalall admitted that he was a biologist before he became an administrator, and it was true that the tasks required different skills. Suesan Saucerman suggested that a lot of Pacific Island fisheries administrations are relatively new, so the slow progress should not be criticised too much. Mick Bishop said that the Australian Fisheries Management Authority had just gone through an extensive review, and it was found that AFMA staff had much higher levels of job-related stress than most other organisations. Even the police were amazed at the high levels of stress faced by fisheries managers. This causes a high turnover of staff, due to personal and emotional problems within the organisation.

Ray Newnham commented that the Cook Islands solution to a fisheries problem seemed to be to throw people at it. The Ministry of Marine Resources has a huge staff compared to the size of the country, but the department is not very productive. Government departments are often unofficial dole agencies for political reasons. Hugh Walton recalled a department with five sections he reviewed. Four sections were unproductive and the one productive section was so because the section head was well organised and practiced leadership by example. There is a lot of responsibility in the Pacific Islands on leaders, and one good individual can make a big difference.

Sylvester Diake said that financial and human resource management in the Pacific Islands is a problem, because decisions seem to be made by political masters without reference to advice from below. The Fisheries Division can plan its manpower and training requirements but the Public Service Commission often does not accept them.

Being Yeeting pointed out that in Kiribati there is a combination of western and local culture, and this causes problems for resource managers. The training is western, and it is difficult to apply north Atlantic fisheries management ideas back home. Traditional culture is quite strong in the Pacific and it is important for fisheries managers to understand the social background.

Julian Dashwood emphasised that there is a need to involve resource harvesters more in the management process. Logsheets are fine, but in artisanal and subsistence fisheries there is no incentive to provide information and there is no licencing system. He said he would be interested to see what sort of mechanisms other departments had in place for getting feedback from resource harvesters.

Esaroma Ledua said that he didn't entirely agree with Hugh's comment that there was no point in training an unmotivated person. In his experience, training could often lend motivation, through a better understanding of how to carry out the duties. Hugh said that perhaps he had put it a little ambiguously, but the key factor was direction and guidance. If guidance is not provided, then there is no point in training.

Ray Clarke said that the organisation he worked for had 4,500 employees on a US\$250 million per year budget, and had just gone through an HRD planning exercise. The parallels with Hugh's talk were amazing. One point to make is that the HRD process is never-ending, and you need to keep constantly on top of changing circumstances.

Rudolf Hermes presented a paper (BP.23) on the organisation of artisanal fisheries management in Moma in Papua New Guinea. The Government feels that Papua New Guinea fisheries resources are under-utilised and need to be developed to provide extra protein and substitute for imports. The opportunity-driven approach ("the fish are there, let's grab them!") had been tried, and failed. The development project structure that Mr Hermes described was designed to be more active: to increase effort and continuity of fish supply; the infrastructure had to recover costs and the market needed attention, particularly quality awareness and control. The project is integrated, so that when external support finishes, the Division can run it alone. The methods used are relevant to other areas. Institutional strengthening was of paramount importance. Government withdrew from commercial operations and allocated manpower to more appropriate extension work. Rudolf noted that all development efforts based on the need for behavioural changes will inevitably be slow processes. If your only need for money is to pay school fees, there is not much point in going into big business.

Patricia Tuara then presented her paper on the rôle of women in Pacific Islands inshore fisheries management (BP 40), starting off with the comment that perhaps a lot of fisheries management problems are due to the fact that there aren't enough women in management.

She noted that women are the dominant resource users in Pacific Island coastal fisheries. Fisheries management is fundamentally people management, which means that women cannot be underestimated. Women's fisheries are more likely to be sustainable because there is less commercial growth imperative. A lot of information is held by women on the disposition of the fishery resource, but there is not often a good linkage between fisherwomen and fisheries administrations. Women tend to approach women's groups and religious organisations when assistance is needed.

Patricia said that the issue may be seen by some as a popular topic—even a fad by development organisations—but many other people ignore it as “one of those radical women's things”. So there is often lip-service but no action. People often ask why we should separate out women in fisheries development? They are not really wanting to be separate, but women often feel overlooked despite their contribution. It is *inefficient* to think of fishing only in terms of a man in a boat. She said that she would prefer if there was no need for women-in-fisheries projects, but there is a need to recognise that they are a large component of the fishery if management is to work.

Another point that is often raised is that the Pacific Island family unit is strong, and that separating women will somehow damage the family. She thought that assisting women to develop their fishing enterprises actually strengthens the family unit by bringing in income. Increasing the efficiency of women's fishing cuts down the time spent away from home and adds protein to the diet of the family.

In the following discussion, Moses Amos felt that there was not a very good interaction between his Vanuatu Fisheries Department and fisherwomen. They had tried to stimulate dialogue but were not getting much reaction from the women. He pointed out that all fishing and processing training offered by the Department is equally available to all, but the problem was that women have not been historically involved in certain things, and are reluctant to take them up. Moses thought Patricia's report was very interesting, but he felt that she had failed to mention the occasional negative aspect, like the damage that some women do to reefs in shell collection using steel bars and breaking coral. Some chiefs have even had to restrict access by women to reefs. But the rôle of women is important and he agreed that it needs to be brought out.

Nelson Kile mentioned that they had organised three training courses for women in the Solomon Islands, and one in Honiara. One of the most successful groups was from the fishing village in Honiara. It was time that women came out, and he didn't understand the problems that Vanuatu was having when the head of fisheries there was a woman.

Moses Amos replied with the comment that women still feel intimidated in approaching Fisheries despite the fact that the Department is headed by a woman. He said that he was not against women's fisheries development but just felt the need to point out that there were a few negative aspects that should not be brushed aside. On the positive side, Moses, said that it was often a lot easier to talk to fisherwomen, since fishermen seem to have a zero attention span. Sometimes women are nominated as spokesmen by the Chief, and can thus target women with management information for avoiding resource damage.

Patricia Tuara said that the main point was to find ways of strengthening the interaction between fisheries authorities and women, which would also have the effect of mitigating resource problems. She noted that the use of fish poisons and stupeficients was also mainly a women's fishery.

Saimone Tuilaucala endorsed the comments that departments should recognise the rôle of women and felt that Fiji was trying to do its share, including having a separate prize for the “fisherwoman of the year”. But he believed that the village social structure puts women in a different rôle and this has to be taken into account. The Fiji Fisheries Division has run some training programmes for women, with some help from ESCAP and he mentioned that he had worked with women diving for kai (*Batissa violacea*) in

Rewa. These kai fisherwomen were using *bilibili* (bamboo rafts) for diving. It was affecting their health and the Division was able to provide some assistance.

Hugh Walton suggested that one of the biggest problems for women in fisheries was men in fisheries. If you assist women to become more efficient then the men will just sit back and do less.

Paul Lokani mentioned that there was a women's fisheries programme in Papua New Guinea. He also pointed out that the topic of this workshop was inshore fisheries management and it must be recognised that if women are harvesting most of the inshore fisheries resources then they need to be the main target for management. For example, we need to take into account that women are harvesting a great deal of undersized molluscs. We also need to take into account the fact that women can tell us a lot about what is happening to inshore resources.

Bisessar Chakallal said that he had found this opportunity to sit in on a Pacific Islands workshop fascinating, since it provided so many parallels, but also contrasts, to his experience in the Caribbean. In the area of women in fisheries management there were great contrasts, even a complete reverse in roles to the Pacific. In the Caribbean fisheries administrations, women officers form more than 40% of the staff, and greater than 70% in Trinidad. But despite there being a population of 4 million, women are almost non-existent in actual fishing. This is possibly partly because there are no fringing reefs for gleaning, and only two women own boats—one in Tobago and one in Trinidad. In Jamaica there are something like 5 women who take provisions to the keys and return with fish. In the Caribbean women are mainly involved in marketing the catch. This is actively promoted in places since it means that women can control the family income so men do not drink away the catch proceeds. He gave an anecdote about Barbados, where development advice suggested that a deboning machine would greatly improve the efficiency of flying fish marketing. But flying fish deboning is a major income source for many women (it takes around 1 minute to debone each fish, at 5 US cents per fish) and the idea was dropped.

Sione Vailala Matoto stated that Tonga was just beginning to recognise the importance of women, but fully endorsed Patricia Tuara's presentation. He reminded participants that the global women's conference was coming up in Beijing and urged Pacific Island nations to support women in fisheries.

Maureen Mopio congratulated Patricia on her talk. She wanted to see how women could be utilised in the mainstream of fisheries, and would like to see more women around the table next time.

Shinichiro Kakuma then introduced his paper (BP 17), which included aspects of co-management and stock enhancement in Okinawa. He mentioned that he had just been down to the Nouméa fish market and found that many of the species were the same as in Okinawa, which is only a little colder in climate than New Caledonia. He talked about the co-management of artisanal fisheries in Onna, in the middle of Okinawa. These are mostly seaweed aquaculture and shellfish fisheries, and there are three major systems in the village:

1. A cooperative has exclusive rights to collect fish and shellfish, but married women have unrestricted access to these resources.
2. Okinawa prefecture enforces certain regulations, such as a closed season for giant clam between June and August, and a minimum size limit of 8cm for *Tridacna crocea*. However, there is still poaching.
3. There is a self-imposed control system by the community

Nearshore stocks were harvested for many years before Okinawa reverted to Japan in 1974. Giant clam production in 1974 was over 600 tonnes, but by 1992 was only 100 tonnes. The sea-urchin catch of

nearly 2,000 tonnes declined to 300 tonnes, and trochus catches have showed a trend that indicates over-exploitation. Faced with this situation, the Government assisted the cooperative to increase income by managing stocks. Fisheries officers helped the cooperative to develop management plans, but the actual plans were drawn up by the cooperative and fisheries officers provided biological data.

Restrictions were decided by a concensus of fishermen, proposals were discussed by communities and then given back to the fishermen for finalisation. Kakuma then gave an outline of the type of regulations and restrictions that were introduced. He said that the restrictions might appear strict, but they were suggested by the fishermen themselves. It is also necessary to note that seaweed aquaculture is the main money-earner, rather than the coastal fisheries to which these restrictions apply.

The advantages of this sort of scheme are many. Since compliance is good, enforcement costs are low. Management of the fishery does not require a lot of statistics and research, since it depends on direct feedback from the fishing community, and fishermen already have a good knowledge of the status of stocks. Also, the regulations can be quickly changed if necessary. Fishermen have made three revisions since the scheme was started in 1986. Enforcement is done by the fishermen themselves, and violations are viewed seriously by the community.

As a result of these self-imposed restrictions the density of trochus has increased threefold compared to other places. The catch of giant clams has increased (apart from a restriction in 1993 due to the low price). The turban shell regulations did not work, and the strawberry conch regulations did not work but the quota was maintained. The damselfish stock recovered within five years and the harvest has now resumed without restrictions.

Esaroma Ledua asked if the enforcement is carried out by fishermen, were they supported legally? Kakuma replied that there was no legal punishment, but the loss of face within the community suffered by violaters seemed to be sufficient incentive for compliance. Jiro Isa added that one way of enforcing regulations is by the cooperative not accepting products from fishers that are known to have resulted from a contravention of the community management plan.

Anitimoni Peleto emphasised the importance to the Pacific Islands of the Onna co-management experience. He visited Okinawa in 1994 and was impressed by the operation of the community management system, in contrast to the centralised system currently in place in Tonga.

2.3.4 Management Information needs and sources — Feedback to and from fishermen, vessels and the fishing community

Nick Rawlinson was the keynote speaker and moderator for the session, which concentrated on the methods available to fisheries managers for the collection of information from people actively involved in the fishery, and how they can best be used. The editors are indebted to Mr Rawlinson for the trouble he took to compile most of the following account of discussion.

2.3.4.1 Keynote & background papers

Nick Rawlinson	KP013: Feedback from the Fishing Community
Fale Tuilangi	BP022: Community perception of changes in coral reef fisheries in American Samoa, (with Green, A)
Atonio Mulipola	BP057: Catch data and collection from market surveys in Western Samoa, (with Horsman, L and Mulipola, A)
Cathy Hair	BP026: Fisheries data collection in the New Guinea Islands region, PNG

2.3.4.2 *Summary of presentations and discussion*

Nick Rawlinson's keynote talk covered:

- a. the need for data collection
- b. the methods that are available to collect information from the fishing community, including:
 - i. Informal interviews
 - ii. Questionnaires
 - iii. Logbooks
 - iv. Creel surveys
 - v. Other methods, such as fishing competitions and depletion experiments involving local fishers.
- c. the steps that need to be followed to effectively use the methods described above:

i. Define objectives	ii. Assess available resources
iii. Selection of technique	iv. Sample design
v. Training	vi. Inform respondents
vii. Collection of data	viii. Analysis of data & feedback
ix. Validation of data	x. Production of final report
xi. Recommendations to management	

Presentations were grouped into sections based on the methods used to collect data from the fishing community.

Informal Interviews

Fale Tuilangi presented his paper (BP 32) describing how informal interviews were used to assess American Samoan community perception of changes in coral reef fisheries over time. Although a questionnaire form was prepared for the survey, the questions were delivered during conversations with respondents and then transcribed onto the form after the interview had been completed. Writing on the questionnaire form in front of the respondents was considered to be detrimental to the success of the interviews.

The points made included the unanimous perception by respondents on the extremely depleted state of giant clam stocks, and indications that dynamite fishing was being carried out in some of the more remote areas. People did not feel that the annual *palolo* (reproductive propagules of a polychaete worm) rise had suffered though. The American Samoa monitoring programme concentrates on the south side of the island, and there are likely to be more problems on the north side. This monitoring of community perception is a statutory requirement of government, but Fale noted that the results helped to fill in gaps in the hard data.

Being Yeeting described the use of informal interviews with members of the fishing community to obtain information on changes in behaviour and abundance of food fish stocks: information on traditional management practices and local knowledge on marine resources, including spawning seasons and areas,

in Tarawa lagoon, Kiribati. It was emphasised that this approach worked very well for the purpose it was designed, and that it was quick, cheap, and provided useful information for guiding future research. However, Being also stated that the data received was difficult to quantify and verify. The success of the approach depended on identifying the correct fisheries to talk to, and asking questions that would initiate dialogue without any bias.

Questionnaires

The first presentation on the use of questionnaires was also made by Being Yeeting. A socio-economic study of Tarawa lagoon was carried out using questionnaires with tape recorders to verify the responses. The importance of training to ensure all enumerators understood the purpose of the survey and the structure of the questionnaire form was stressed. The survey provided very relevant and valuable information for formulating a management plan and quantifying some social factors. On the downside, the questionnaire survey was strenuous and tedious work for the enumerators, there was a lot of paperwork involved, the recording of information was a long process, and the survey instruments (tape recorders, tapes and batteries) were expensive.

Tony Mulipola then talked about (BP 57) the operation of market surveys in Western Samoa under an FAO project led by Mike King. He said that there is a general feeling that fisheries resources are depleted in the country, and it was necessary to find out if this was in fact the case. Part of the exercise was to assess local fishing activity and fish consumption by families. Questionnaires were designed according to the information that was likely to be available in people's memories, but it was found that they had a problem in remembering what they ate or caught last week, and it was not possible to measure fishing effort. One way around this problem was found with the assistance of the Education Department which set up a final year school project on the subject. This was in the form of a diary, preprinted for one week, where final year students could make daily records of family fishing activity and consumption. This was found to be very successful—the fisheries division was able to sidestep the time-consuming ceremonial introductions that are normally necessary in Pacific Island community surveys; it was reliable (given the help of the teacher in scoring student reliability), and didn't cost a lot. This survey was the source of much of the information that was later published in the Western Samoa coastal inventory and database. A new project is presently under way with AusAID assistance and will include some follow-up on this work.

Kintoba Tearo mentioned that periodic surveys were a feature of the work of the Fisheries Division in Kiribati. This started in 1984 when it was realised that there was not much information available on fishing in the country, and the initial activity was a household interview (with a sampling frequency of 20-100%—the lower figure being for South Tarawa). Kiribati has 33 islands in three groups, and more directed methods like CPUE monitoring were impossible over such a broad area. Kiribati has found the information very useful for management and developments such as the question of where to best site iceplants. This procedure was developed ten years ago by Chris Mees and Being Yeeting, and the survey is carried out regularly (including twice yearly on South Tarawa).

Moses Amos stressed said that questionnaires were a useful way of assessing the social and economic state of community and subsistence fishing, and were straightforward if the questions were standardised. It was important to use female enumerators to approach women and vice-versa, but noted that paper and pen tended to intimidate people, since sitting in front of a person recording answers to some questions which might be personal can be considered to be rude. Veracity was also difficult to judge, and there was a danger of asking leading questions that will give only the answers required. Questionnaires were a way of keeping to the point, but he had also found that they might miss incidental information or news that may be vital. He felt it was important to crosscheck by working alongside fisheries to see, for example, if fishing methods were the same as those reported. Enumerators needed to have some training, and also be

familiar with the local social order. It is a great advantage to have someone on the team to provide personal introductions, and whose local knowledge can be used to confirm the information being received.

Augustin Mobiha wanted to thank the Australian Centre for International Agricultural Research for sponsoring the UVC project involving Papua New Guinea, Fiji and Solomon Islands, which had incorporated a survey of village fishing activity. They had been able to get an idea of the number of fishermen and the catch composition through creel surveys, and this information was used to establish if there were any links between catch per unit effort and counts made by the UVC technique. The questionnaires required the respondents to give details of their most recent and best catches, as well as their most common fishing practises. However, he would have liked to spend more time in the villages to get more complete answers.

Nick Rawlinson said that many people wanted to know if it was possible to reliably assess catch by questionnaire surveys, and he reckoned that it was adequate for species composition, but that it was always difficult to estimate weights of catch from memory, since this unit is not familiar to subsistence fishers. But it may be possible to calibrate against more accessible units and crosscheck. However, logbook surveys are more accurate, and the questionnaire technique generally stops short of estimating the catch volume.

Ian Bertram said that the Cook Islands Ministry of Marine Resources had found it difficult to get commercial outlets to respond with returns on a regular basis. Fishermen think it is a headache to fill the forms in and hotels are worried that the information may get back to the tax department. Questionnaire surveys cost money, and the staff hate doing them.

Saimone Tuilacala said that in Fiji they did not have so much of a problem getting fishermen to talk to them. In fact, when rugby ex-international representative Apisai Sesewa, who works for fisheries, is on the enumeration team, people positively queue up to meet him.

Paul Holthus pointed out that in order to multiply the benefits gained from the effort involved in questionnaire surveys, it was important to ask “where” in addition to “how much” and “when”. Not too many surveys pinned down the exact fishing areas that people used.

Logsheets

In Papua New Guinea, a National and Provincial Fisheries Data Collection Project has been started to focus on inshore fisheries production. Augustin Mobiha described the pilot phase of the project that is being undertaken in the New Guinea Island region. Target areas for data collection are the government fish purchasing centres, retail seafood buyers, sedentary marine resource buyers/exporters, domestic fishing vessels, and markets. Logsheets are distributed to Government fish purchasing centres and cooperative retailers. Detailed consultations with provincial fisheries departments have been undertaken to establish a good rapport and provide an understanding of the aims of the project. This has produced good progress to date.

Rudolf Hermes detailed the advances that have been made to monitor artisanal fisheries in Papua New Guinea under the Moma Coastal Fisheries Development Project. Monitoring and evaluation units have been set up to gather and analyse information in order to make assessments and decisions for the management of the fisheries. Logsheets have been designed to monitor a whole range of areas and a code system has been developed to record information. Codes were considered to be preferable as they are shorter than full names and therefore faster to write. They occupy less storage space when filed and processed and can be analysed by computer more reliably.

Richard Farman described the logsheets that have been used to record catches made by licenced artisanal fishers in New Caledonia. The form has been divided into two parts: one half to record all the catch and effort data and the other half to record economic data for each trip (including fuel and bait used). This economic data is analysed by fisheries officers to prepare economic performance reports for each vessel. These reports are very popular with fishers as they can be used when negotiating with the bank manager. Due to the benefits accruing to them, fishers have participated in the logbook scheme and return catch information even though they are only required to do so on a voluntary basis.

Neil Traynor detailed the logsheet systems that were in place to monitor some of the major fisheries in Queensland. The technology described was advanced but still the key steps involved in data collection were followed. The areas of liaison and validation of data were stressed. It was also stated that the design of the database for recording information should go hand in hand with the design of the logsheets. Fishers had been instructed to record days when no fishing had taken place to limit uncertainty about missing data. One area of vital importance in Queensland was that information supplied by fishers was strictly confidential. Fishers are often concerned that data supplied can be used against them for taxation purposes.

David Ramm explained the importance of collecting data on landings from the Northern Territory using logsheets. This information is important for research and management. It could be used to undertake stock assessments to identify status, maximum sustainable yield and to set management strategies. The data was also essential for monitoring the fisheries in order to evaluate management measures that have been introduced. The importance of feedback of information from the analysis of the data to fishers was stressed as being vital to the success of logsheet recording systems.

Nick Rawlinson drew the attention of the meeting to the work that had been carried out in Fiji to establish the finfish yield from six reef fisheries using catch records from a voluntary logbook system (Jennings & Polunin, 1995).

Creel surveys

Monitoring of fishing activity and catches, or creel surveys, are a routine part of the work for the Fisheries Department in Guam. Todd Pitlik explained the procedures that were in place and the importance of the data. Some of the difficulties encountered were problems with fish identification and intercepting fishers at night.

Mick Bishop of the Australian Fisheries Management Authority described the use of creel surveys as part of the monitoring process of fisheries in the Torres Strait. The methodologies used were developed by CSIRO at Cleveland and participants were encouraged to contact them directly if they required copies of the manuals. Collecting catch data from schoolchildren's projects was also a technique that had been used in the Torres Strait.

General comments

Comments from participants included the importance of ensuring the quality of the data rather than just quantity, confirming the need for the validation process.

The importance of producing a report on any work that is carried out was stressed. The document will be a useful reference for future work even if the expected results were not produced. A comment arising from this was that training would be useful to assist fisheries officers to produce good quality reports.

There was some debate about the use of legislation to enforce operators to supply data. This approach

works in certain situations but depends on government policy. It was felt, especially in terms of small-scale fishers, that a voluntary system with education, liaison, and benefits accruing to participants, would be a better approach for the success of the data collection effort.

There was discussion on the usefulness of catch data collected using questionnaires. This was a method that was being used in some situations, but due to the problems of fishers estimating weight and remembering details of actual fishing trips, there were doubts on how effective this approach would be. It was considered essential that this information be validated.

There were some cases quoted where incorrect data had been collected due to the lack of commitment from fisheries officers. This again emphasised the importance of validation, and the continual feedback that needs to take place between senior officers, their staff, and the fishers themselves. The need for an educational process to inform prospective respondents was also stressed.

The point was made that it was vitally important to monitor subsistence catches as well as commercial to be in a position to offer advice on resources that appear in both sectors. The use of previous reports before undertaking a survey was important, and the use of population census data and existing maps were important available tools that should be incorporated into the design process.

Undertaking a pilot study was recommended to establish that the designed forms were appropriate for the collection of the desired information, as well as ensuring that officers know how to use them.

A comment was made that a lot of surveys concentrated on collecting information from the male population when in many situations women were the most important harvesters of marine resources.

The cost of undertaking a survey was a major consideration for most participants. Cost basically has to be weighed against the importance of the information. If the data was considered a priority for the management process, resources needed to be found to ensure the task was undertaken.

This session included a large number of presentations, and this was an indication of the high interest in this area, and the importance of information to fisheries departments. The talks highlighted the fact that there was a lot of experience within the region of surveys and routine data collection from fishers. Many of these experiences are directly applicable to other countries. Officers intending to carry out such work should therefore read the available literature on previous relevant surveys and, if necessary, seek guidance from those people who have already undertaken this type of work.

The meeting organisers pointed out that the SPC has a Statistics Programme which, although it is separate from the Fisheries Programme and concentrates on general household surveys for producing national accounts, is very training-oriented and would be able to advise with hints and tips on points of survey design and validation methods. Participants might also like to keep an ear to the ground to find out when SPC Statistical Operations and Procedures (SOAP) courses are held in their countries. These are usually hosted by national Statistics Departments, but the SPC Statistician hopes that officers from other departments would be accommodated, if surveys and questionnaire analysis forms part of their job. The meeting organisers also pointed out that the recent report of an ACIAR/ Fiji fisheries subsistence survey (Rawlinson et al, 1994) circulated at the meeting, was a very useful guide to operating such a survey, and included a manual for helping train enumerators.

During the presentations there were examples given of methods that ranged from simple to extremely complex. However, the important steps involved in collecting data from fishers were followed in all cases. There were some shifts in emphasis on each step depending on the particular situation.

Good data collected from fishers is vital to the fisheries manager and as long as the commitment is made to achieve this task and the steps detailed above are followed, effective collection systems can be set up.

2.3.5 Management Tools — Closed seasons

Richard Farman was the keynote speaker and moderator for the session, which was the first of several aimed at drawing the discussion away from the components of management into the consideration of specific management measures, starting with the manipulation of time-related factors.

2.3.5.1 Keynote & background papers

Robert Jimmy	BP039: Traditional trochus management at Siviri Reef, Vanuatu
Richard Farman	KP004: Perodes de fermeture: sont elles bien necessaires? (Closed seasons: are they really needed?)
Chris Evans	BP028 Research and management of the industrial prawn fishery of the GoP, and BP029: Survey of the Distribution and Apparent Abundance of Recruit-Sized Prawns <i>Penaeus merguensis</i> and <i>P. monodon</i> in the Gulf of Papua during the 1995 Closed Season
Paul Lokani	BP005: Fisheries and management of beche-de-mer in Western Province of Papua New Guinea (with Polon P & Lari R)

2.3.5.2 Summary of presentations and discussion

This session was opened with a keynote address by Richard Farman, chief of New Caledonia's Southern Province fisheries service, who reviewed the use of closed seasons as a management tool and cited examples of closed seasons in New Caledonia. Mr Farman explained in detail the rationale behind the closed season for the mud crab (*Scylla serrata*) which was based as much on socio-economic considerations as on biological reasons. Mr Farman noted that this case emphasised that fisheries management was not only concerned with the stock in question but also with interaction and management of the fishing community. Practical fisheries management in the Pacific Islands requires measures that are easy to implement and not costly, and the closed season may have a long life ahead of it, despite its limitations.

Robert Jimmy from the Vanuatu fisheries department described how a village community in Vanuatu imposed a two year closed season on trochus harvesting in their customary reef areas, following consultation with the fisheries department. Mr Jimmy explained how the ban was established using customary taboos with offenders being disciplined by the village chief. Chris Evans of the Papua New Guinea Department of Fisheries & Marine Resources gave two presentations on the Gulf of Papua prawn trawl fishery explaining the results of investigations that led to the establishment of a closed season in the fishery. Dr Evans explained that the areas closed to fishing were immediately adjacent to the principal mangrove nursery areas in the Gulf of Papua and would be timed for the onset of recruitment of the juveniles and allow them time to grow sufficiently before harvest.

Paul Lokani described the beche-de-mer fishery in the Torres Straits which is exploited both by Australian and Papua New Guinea. Over-exploitation of the fishery and declining yields have led to the imposition of a four-month closed season that was later extended to a year following survey results which showed that stocks were still depleted. The initial November-February closed season was based on the fact that bêche-de-mer change their behaviour during the spawning season, coming to coral heads near the surface to release their spawn during the day, and aggregating to a certain extent, and thus become more

vulnerable to fishing. However, in view of the heavily depleted stock one option being considered is to open the season only long enough for a pre-declared total allowable catch to be reached. Mick Bishop pointed out that Thursday Islanders were now fishing for *bêche-de-mer* so poaching from across the border was likely to be less of a problem on the Australian side of the Torres Strait. A TAC was imposed last year but this was never reached, and Thursday Island is now looking at other management measures.

The usefulness of closed seasons was discussed during this session. The main impact of a closed season is to limit fishing effort and sometimes protect stocks when they are spawning or at some stage in their life cycle when they are particularly vulnerable (that is, when catchability increases). Questions posed to the meeting included suitability of closed seasons for different species and the problems of multispecies fisheries catching proscribed species and their doubtful survival if released. Control of closed seasons is easier in commercial fisheries where catches can be monitored relatively easily and proscribed species monitored at the points of sale. Closed seasons are much harder to impose in more diffuse subsistence fisheries. It was noted that closed seasons were not only imposed to limit effort but also for health reasons such as shellfish poisoning when there are phytoplankton blooms.

The use of closed seasons to protect spawning stocks again stimulated discussion on the relationship of recruitment to parental stock size. One line of argument propounded by Professor Claude Chauvet from the French University of the South Pacific in Noumea was that relationship between parental stock size and recruitment was so uncertain as to be of no use for management, and that protected areas and closed seasons should be used not to protect spawning stocks but to protect juveniles recruiting onto the reef out of the abundant plankton. In cases where only one or two adults result from every million eggs spawned it is obviously survival through the recruitment stage that is the critical factor. Greater efforts should be placed on ensuring the greatest survival of eggs and larvae.

Dr Daniel Pauly of ICLARM pointed out, however, that work elsewhere has shown that the stock/recruitment relationship becomes proportional (and parental stock fecundity becomes important) when adult standing stock falls to below 20 % of the unexploited biomass. Cod is just about the most resilient fish in the world, but the stock is now destroyed because it was reduced to less than 5%. Furthermore, from a breeding perspective the large old females in a population (or “big mothers”, as he put it) are the most important component of the parental stock, and closed areas rather than closed seasons are required to protect these. A reduction of 5% (for example) of the time available for fishing does not have the same effect as taking away 5% of the area available for fishing, in terms of total effective fishing effort. It is possible to fish out all of the older fish under the first scenario⁹, but not the second (unless a rotating closed area system is in operation).

Another line of argument presented by Nick Polunin suggested that protection of nursery areas was also relevant in some cases, citing an example from Cyprus where the fishery depended on an influx of juvenile fish each season. The fishery was successfully managed by preventing fishing in these areas during the time when the juveniles were recruiting, whereas a closed season during adult spawning alone had not been effective. Dr Polunin was of the opinion that the supply of eggs is generally not limited until the stock is under great pressure. However, it is extremely difficult to tell when this critical point is reached (and effective action may take too long), and there is something to be said for protecting spawning stocks *per se*. Old fish can disappear very quickly.

Professor Chauvet accepted that old females are more fecund, obviously, but that the relative importance of these old females is difficult to fix. For example, when some fish age, egg quality decreases. For North Atlantic soles, spawning is at the beginning of spring, but the best recruitment is from eggs spawned at the

⁹Editors note: As seems to be indicated during Dave Williams earlier presentation on reef-fish ageing, where surgeonfish over 10 years old (and up to 40) are apparently absent in fished areas, but not uncommon on the unfished part of the Great Barrier Reef.

end of the season. For some many fish, the sex ratio depends on fishing pressure and mortality rates. Some fish, such as groupers, spawn more when they are stressed.

Being Yeeting brought the discussion back on course by talking about the use of closed seasons in Kiribati. Spawning is more or less continuous in the central Pacific and Being pointed out that it is usually more important to know where spawning is taking place than when. However, many fish follow the lunar cycle and there are 3-day closed seasons in Kiribati around the full moon period in areas where bonefish were known to aggregate. Similar customary impositions of closed season elsewhere in the region where reefs were closed to fishing, following random events such as the death of chiefs or other village notables, were discussed, and the recent opening of a 200-day ban in Fiji was mentioned by Nick Rawlinson. Customary practices can also be adopted for specific management objectives such trochus in Vanuatu. Moses Amos pointed out that community-declared closed seasons, using ancient precedent, are important in a country such as Vanuatu where the manpower of the fisheries department is small and enforcement not practicable, but where Section 7 of the Constitution enjoins Fisheries to safeguard resources for the benefit of present and future generations. Vanuatu has found that the community will enforce the closed season themselves if they understand it is for the benefit of their own resources, if think of this as being their capital in the bank, but it has so far only been tried out on trochus.

In industrial fisheries closed seasons may occur for reasons other than the protection of stock but may have a beneficial side-effect. An example was given by Paul Dalzell of the Papua New Guinea pole-and-line tuna fishery, based mainly out of New Ireland, which used to cease operations between December and March due to inclement weather, but which had the effect of reducing fishing effort to zero on the supportive bait fishery at a time when a major recruitment pulse occurred. It also allowed the fishermen to go home to Japan for a holiday and thus had a number of useful effects.

Richard Farman closed the session with the comment that the workshop had not been able to come to any definite conclusions about the use of closed seasons as a management option, and that this probably indicated that further attention needed to be paid to the issue.

2.3.6 Management Tools — Quotas and restricted entry

Mick Bishop of the Australian Fisheries Management Authority was the keynote speaker and moderator for the session, which addressed the limitation of access and catch volume as a management tool.

2.3.6.1 Keynote & background papers

Ian Bertram	BP014: The aquarium fishery in the Cook Islands. Is there a need for management?
Ian Bertram	BP034: Cook Islands trochus fishery management
Ray Clarke	BP015: Current paradigms in trochus management and opportunities to broaden perspectives (with J. Ianelli)
Raymond Newnham	BP013: Cook Islands pearl culture management
David Ramm	BP031: Dynamics of the deepwater snapper <i>Pristipomoides</i> resource and fishery in tropical Australia.
World Bank	BP049: Coastal Fisheries: An authorised extract from “Pacific Island Economies: Building a resilient economic base for the twenty-first century.”
Mick Bishop	KP006: Restricted entry and quotas.
Viki O'Brien	BP050: Introduction of fishing day quotas in the Torres Strait prawn fishery.

2.3.6.2 *Summary of presentations and discussion*

Mr Bishop introduced his keynote talk with Richard Farman's point that when considering the management of a particular fishery, "different courses need different horses". If you want to draw conclusions from someone else's fishery you first of all need to judge how their fishery compares with yours, and then separate out which measures they are using that are effective and which are not working. But each fishery is unique.

(As an aside, he liked Daniel Pauly's concept of adapting "triage" to fisheries, but would subdivide his category of "those most in need" into three further subcategories, in decreasing order of need:

1. Your own blokes;
2. The enemy; and
3. Those of your officers you don't like)

Ray Clarke made a brief exposition of his paper (BP15) on quota management systems in relation to Micronesian trochus fisheries. He pointed out that there is a lot of data on these fisheries in Micronesia and they make a good case-study from a socio-economic perspective since the subregion embraces both ends of the economic spectrum. For example, Guam has ten times the per-capita income of the Federated States of Micronesia

In Japanese mandate times the Micronesian trochus fishery used closed seasons, size limits and moratoria, but total allowable catches are now used as well. Micronesian trochus fisheries do not really have closed seasons but open seasons, since harvesting is only allowed for a short period each year, or several years. There has been a marked decline in the number of days that these fisheries are opened in areas such as Pohnpei, due to increases in fishing efficiency. He drew parallels with the north Pacific halibut fishery which is now open for only two days because of increasing effort, and this has led to a lot of waste. The short open season causes problems in Micronesia as well. In Pohnpei it costs US\$25,000 just to monitor the opening, and there is no way to deal with the resulting trochus meat glut.

Many areas estimate the standing stock biomass by means of transect surveys, but we still face the problem of how to determine what proportion of the spawning stock should make up the TAC. TAC estimation depends very heavily on the accuracy of the abundance survey, but the available data is very constraining. Mr Clarke considered the FFA national fishery resource profiles and the compendium by Wright and Hill (1993)¹⁰ to be very useful sources of information.

The current management methods for trochus in Micronesia focus on biology and tend to ignore social factors. Sanctuaries and artificial augmentation of trochus stocks costs money, seasons alone cannot maintain catches at sustainable levels and moratoria can be regressive, but size limits are a useful passive measure. Ray felt that button factories should be reviewed annually, especially with respect to the level of protection they receive, and that government should stay out of this area as far as possible (except for monitoring). He felt that regional organisations had a rôle to play in disseminating information and gave the SPC Aitutaki trochus fishery case study (Nash et al, 1995)¹¹ as a positive example.

In the resulting discussion, John Munro made the point that quotas don't have much of a place in multispecies fisheries where you don't know what you will pull up at the end of the line. The main point is

¹⁰ Wright, A. and Hill, L. (Eds: 1993) *Nearshore Marine Resources of the South Pacific*. Institute for Pacific Studies, Suva. 710pp.

¹¹ Nash W. , T. J. H. Adams, P. Tuara, D. Munro, M. Amos, J. Leqata, O. Terekia, N. Mataiti, M. Teopa, & J. Whitford. (1995) *The Aitutaki trochus fishery: a case study*. SPC Inshore Fisheries Research Project Technical Document #9. South Pacific Commission, Nouméa. 72pp.

that stock abundances are variable and it is just not possible to estimate quotas accurately enough. Also there is always political pressure to increase them, and if you have just one bad year it is very difficult to back-pedal. The present farce in the north Atlantic is a result of this. It wouldn't happen if effort was restricted from the start. Dr Munro liked the idea of individual transferable effort units, and outlined the concept of transferable artisanal licences that he has suggested in the past¹².

Mick Bishop agreed with the view that the TAC is a great limiting factor, because it is so difficult to accurately estimate. But he warned that ITE's don't always give an indication of the effort that actually occurs. People who sell ITE's have not usually been fishing very hard, whilst people who buy them use them up to the limit. There needs to be a way of accurately monitoring actual effort, like the "black box" that records industrial gillnet shots.

The representative from Tonga asked what chance there would be of introducing ITQ's in that country? Access is unrestricted at present. Mick Bishop suggested that it probably wasn't necessary at this stage, since there are a lot of natural barriers to commercialisation. The characteristic of most Pacific Island traditional cultures is conservatism: it is the people's resource and they want to protect it, and commercial operations are hard to integrate. Examples in the Torres Strait include the *bêche-de-mer* fishery, where tensions are building over hookah diving, but there are also difficult decisions coming up ahead over the purely subsistence fisheries for turtle and dugong, and it is possible that a whole new management infrastructure is needed.

Tim Adams gave one example of successfully introducing a limited entry system into a Pacific Island fin-fishery, but noted that this was only possible because it was a semi-industrial fishery taking a very limited range of species. The Fiji limited entry licencing system for "sashimi" longliners and deepwater snapper fisheries was introduced in 1990 not to restrict catches, but to limit potential fishing effort for social and economic reasons. In 1989 there were something like 450 licence applications pending for a fishery which was estimated, based mainly on infrastructure and marketing limitations, to have room for only 20 vessels, and there was a need to pre-empt a potentially large number of joint-venture bankruptcies. It seems to have led to a stable fishery, which has grown at a rate that has enabled the side-effects to be controlled and the growth in infrastructure to keep pace. This system has been recently reviewed by the SPC Oceanic Fisheries Programme and makes an interesting case-study. Unfortunately there was not time to prepare the story for this meeting.

Mick Bishop emphasised that, in introducing systems of this nature, it is necessary to get in early and not delay too long, otherwise it is very difficult to cut back on overcapitalisation. There is the classic example of the Australian deepwater fishery where the managers had to tell a lot of people that their investment had gone down the drain.

Hugh Walton, head of the Nelson Polytechnic School of Fisheries, but also a former New Zealand fisherman and Fiji longline operator, pointed out that ITQ's put capital value into a commercial fishery, and some fishermen who are in on the ground floor can get rich very quickly. One question is how to cope with non-quota species that are caught, and you need a good quota exchange system for trading these excess catches. A big problem for the fishing boats is the amount of information that needs to be provided to managers. It's very difficult to fill all those forms in! Most industry people support the idea of a transferable quota system, but Mr Walton would not like the task of applying it to a multi-species fishery.

Mick Bishop said that ITQ enforcement is following a paper trail—a bit like a tax bust. ITQ's are a "Rolls-Royce" system of management and difficult to apply to the Pacific or multispecies fisheries in

¹² Munro, J. L. and Smith, I. R. (1984) Management strategies for multi-species complexes in artisanal fisheries. *Proc. Gulf Caribb. Fisheries Institute* **36**, 127-141

general. The problems faced by the multispecies southeastern trawl fishery are a good example.

Ian Bertram presented his paper (BP14) on the evolution of quota management of the trochus fishery at Aitutaki in the Cook Islands. The addition of a short harvest season allows fisheries officers to completely monitor the harvest and remove illegally sized shells back to the reef, as well as monitoring the reserve. A Pacific Island adaptation of the ITQ system was introduced in 1988 whereby every person on the island was given a fraction of the TAC irrespective of their ability to harvest. These could be traded to active fishers and everyone could thus benefit from the shared resource. The main problem is the question of accuracy in the stock assessment and the determination of the allowable proportion of the biomass to allow as the TAC, currently set at a somewhat arbitrary 30% of the number of animals in the size range 80-110mm. This is explained at length in Nash et al (1995).

Kazuo Udagawa asked what the value of a trochus licence was? Ian Bertram replied that a trochus fishing licence cost NZ\$1, to defray the cost of paperwork, but that the trading value of an individual quota depended on the market price that the Island Council reckoned that they would subsequently obtain for the shell. The normal individual quota was in the region of 10kg of shell. Udagawa then asked if there was much negative reaction from the harvesters when the undersized and oversized shells were taken away by the fisheries staff during the harvest? Tim Adams replied that this was not a problem in the Cook Islands, since the community appeared to appreciate the need to conserve a resource that was perceived as belonging to them, but that problems were experienced in diffuse, year-round fisheries like Fiji where shells could only be checked at the point of export and where the exporter had already paid good money for the shells. Augustin Mobiha said that, nonetheless, he had problems explaining to villagers why undersized shells should not be collected in Papua New Guinea and that perhaps SPC could help with the publication of some explanatory leaflets.

Patricia Tuara said that the sociological aspects of the Aitutaki trochus fishery needed emphasising. In 1992 for example, the proceeds of the harvest did not go into individual pockets, but towards a community project, and this led to a marked reduction in effort, as well as a wholesale lack of respect for the reserve area. Ian Bertram suggested that since nobody has ever been prosecuted after being picked up fishing on the reserve, that compliance was being eroded, and that it was a political willpower problem. Moses Amos proposed that the answer is basically education. Fisheries officers often do not provide sufficient information to resource users and owners. Dialogue tends to be more of a monologue, when it is better to mingle with the people and discuss things openly. Moses felt that his western education was a bit of a barrier in dialogue with village people, who might feel that he was talking down to them, but that it was still essential to work from the bottom up.

Mick Bishop reckoned that sitting on the wharf with the the people doing the fishing is hugely beneficial. A discussion with one person can be better than a whole raft of publications.

Julian Dashwood explained that the Aitutaki trochus ITQ system had come about because there was concern amongst the island leaders that only a small percentage of the population was benefitting from the fishery. How could they spread it further? It was relatively easy in Aitutaki because of the small number of people (around 2,700), and households without boats could sell their entitlements to others. The system came about for social rather than resource management reasons. The Ministry of Marine Resources has tried to bring poachers on the reserve to justice in the past. One received a statutory fine, but another went to court, which found that the evidence was inadequate to support the case. Young fisheries officers in the Cook Islands should bear this in mind.

Saimone Tuilaucala stated that many Pacific Islands have gone into the trochus shell button industry, with mixed success, and wanted to know what the future market prospects were given the competition from synthetic buttons? Tim Adams replied that the world market price for shell buttons appeared to be

picking up again after the slump in 1991-4, and that most of the problems faced by shell button manufacturers were not necessarily just from poor prices as from overcapitalisation in the face of an apparent Pacific-wide slump in the abundance of the resource itself. However, trochus harvests appeared to be coincidentally improving and there may possibly have been some long-term climatic cycle effect. Trochus spawn and recruit in very shallow water, and the El Nino Southern Oscillation is known to have an effect on mean low-tide levels. The World Bank is currently sponsoring a study on the world trochus market, carried out by Bob Gillett in Suva, which will hopefully be available by the end of 1995.

Being Yeeting asked if it were possible to apply a quota system to subsistence fisheries, since there was interest in such a system in Kiribati. Ian Bertram said that the quota system worked at Aitutaki because trochus is not a traditional food source (it was introduced to the island in 1957), and a complete ban on fishing outside the harvest system was thus easy to sustain. Mick Bishop gave the example of dugong and turtle, where a quota for subsistence harvesting of individuals of these species has been negotiated between the Great Barrier Reef Marine Park Authority and the community. In the Torres Strait, there is an informal quota in operation of one turtle per wedding, but this is purely a gentleman's agreement.

Ray Newnham of the Cook Islands Ministry of Marine Resources then presented his talk (this unwritten background paper has been paraphrased by the editors from notes taken during the session) on the management of the pearl industry in the Cook Islands.

Setting the background, he said that the first missionaries concentrated the Penrhyn people into villages, where they had formerly been spread out around the atoll, and this broke down the traditional system of area based tenure (with the centre of the lagoon belonging to the Chief). Under the old system, permissions to fish would be requested from the family and could be bartered.

In 1901, New Zealand annexed the Cooks and declared the reef to be Crown Land. In 1902 Island Councils were defined, taking over much of the control of the community from the traditional chiefs in many islands. However the New Zealand claims took some time to filter through to Tongareva and it was not until 1920 that agents broke up the traditional land and sea-tenure patterns here. Wild pearl shell had been harvested for years, with traders maintaining contact, and this appeared to be the main New Zealand interest in claiming the lagoon, but in 1965 the Cook Islanders became self-governing and no longer accepted pots and pans in return for shells.

Pearl culture in the Cook Islands started in the 1970's when Pete Cummings got an exclusive 20-year licence to farm Manihiki. This caused some resentment in the Island Council. Cummings withdrew in 1982, but Government started pearl farming with local partners at Manihiki. By 1987 there were 8 farms with 10,000 shells, and by 1994 this had risen to 150 farms, including Tongareva. The pearl industry is now second only to tourism in terms of foreign exchange earning and was worth \$5 million to farmers in 1994 (and considerably more in retail, jewellery and employment).

The Island Council and Ministry of Marine Resources (MMR) control of the industry has now been augmented by the Cook Islands Pearl Authority. Actual management responsibility rests with the Island Council rather than the government, and the Island Council issues licences under byelaws. The affinity that the local community has for the lagoon is expressed in the management authority that they exert—farmers have a stake in the Council, and Council control means that the Government does not have to get involved in mundane matters like boundary disputes— but it can also hinder central Government in carrying out its policies, such as the current dispute over freedom of access to technicians.

MMR has regulated the industry, has supplied materials to get the industry on its feet, and has actually farmed and marketed its own pearls, but there is a growing awareness that Government should not be actively involved in marketing. Now that suppliers and markets are established, the Pearl Authority is

gradually taking over these aspects. The Pearl Authority arose in 1994 after farmers criticism of MMR in the past for lacking practical and commercial experience, and that the industry needed more private sector input.

With respect to restricted access, no limit is currently set on the number of farms at Manihiki, but only people of local descent actually resident on the island are allowed to farm in the lagoon, with one exception:- a Tahitian Chinese who was brought in to provide a successful commercial example. As a result, the majority of licences are issued to smallholders, and 69% of the farms have less than 3,000 shells each. Penrhyn has gone as far as to restrict the number of shells on each farm to less than 2,000 in a deliberate pre-emptive move to limit development. This is felt to be more beneficial in a social sense, since profits are retained and the pace of change is slowed down. However, there are logistical problems with smallholdings—there is no economy of scale and the farmers need to be grouped together in an organisation. Both the Ministry and the Island Council are reluctant to take the first step in organising this after losing money on similar ventures in the past. The development of a farmers association remains one of the priorities for the future.

Patricia Tuara suggested that this highlighted the problems of the Ministry trying to do too much. She was of the opinion that MMR had spent too much time on pearls compared to other problems. What happened to the management plan that was drawn up in 1992? Ray Newnham replied that the 1992 plan had been dropped and the 1994 plan was being circulated. The delay is since the plan will be hard to implement and is contentious. If the plan is going to work it has to be acceptable to farmers or enforcement is a problem.

Vicky O'Brien of the Australian Fisheries Management Authority gave a talk (this unwritten background paper was based on BP and has been paraphrased by the editors from notes taken during the session) on the management of the Torres Strait prawn fishery.

In 1992 there was the possibility of a “blow out” on effort in the fishery. The ability of AFMA to manage the fishery under was thrown out by the court. Only a few licences were actually active, but the way was clear for inactive licences to come into use with likely resultant overfishing of the stock. But transferable time quotas were introduced and by this means effort was reduced to a third of its previous level.

This fishery is carried out by vessels operating out of Brisbane and Cairns, and takes predominantly tiger and endeavour prawns—approximately 1,500-2,000 tonnes of product per year. Torres Islanders prefer lobster fishing, which has a number of social advantages. The target after the 1985 Papua New Guinea-Australia treaty was to successively reduce the number of licences for the fishery from 1,200 to 500 and finally to 150, and eligibility was based on the history of fishing. But the non-transferability provisions were challenged by some fishermen and then thrown out by the courts. The problem then was how to reduce effort without reducing the number of licences and, in particular, how to treat people fairly.

The first step was to put a cap on effort, but most options after that would introduce inefficiencies. The enforcement costs of ITQ were too high and it would be very difficult to establish a valid quota given the environmental influences on the stock, so the preferred option was the time quota. Days were allocated to boats based on a formula incorporating their history of fishing.

Boats are required to radio in to the Authority when they leave and enter port, and the boat must give a personal identification number (PIN) to verify each call and ensure confidentiality. A system of consecutive PINs is held on the boat and by the authority. This system has managed to reduce effort without any increase in enforcement costs, yet is fair to all.

Chris Evans understood that the objective of this management exercise was to cut effort. How did

existing effort relate to the full potential of the stock? Vicky replied that the stock was fully exploited. The idea was to rely on the more efficient operators to buy out the less efficient.

Moses Amos then gave some thoughts on pre-emptive management intervention in general. Greensnail (*Turbo marmoratus*) was clearly being fished out very rapidly in Vanuatu, but the Fisheries Department could not wait for a stock assessment to rigorously verify this. They decided to enforce a 2.5 tonne TAC despite protests from the factory, but needed time to get the information together. However, greensnail are still around, and the Department is now putting better regulations in place. Mick Bishop suggested that it probably wasn't an election year, but that the point is to bite the bullet and get measures into place in good time. It needs political courage to act before you have sent the scientists in to get support. Mick Bishop wound up the session with the reminder to all fisheries managers that "our real clients are those not born yet".

2.3.7 Management Tools — Protected areas, sanctuaries and reserves

Paul Holthus was the keynote speaker and moderator for the session, which was to discuss the pros and cons of marine protected areas as a fisheries management measure..

2.3.7.1 Keynote & background papers

Nelson Kile	Verbal presentation
Dave McB Williams	BP075: Reserves, resilience and recruitment
Nick Polunin	Verbal presentation
Paul Holthus	KP001: Marine protected areas and inshore fisheries management in the South Pacific (verbal presentation and abstract)

2.3.7.2 Summary of presentations and discussion

Paul Holthus prefaced his keynote talk by asking if this session could be more of a workshop and less of a conference and outlined his plans for splitting the meeting into working groups after several speakers had talked on the subject. Because of the need to fit a lot of activity into this session he promised to keep his comments brief.

Paul started off the session by giving the official IUCN definition of a marine protected area as: "*an area of intertidal or subtidal terrain together with its overlying water, flora, fauna and culture protected by legal or other means to preserve the environment*". He followed this with a list of the known marine protected areas in the region, but noted that not many of these had been set up with fisheries management goals in mind.

Broadly, there were five categories of marine protected area in the Pacific Islands region:

- 👉 tourism and recreational marine protected areas;
- 👉 general marine conservation areas near towns;
- 👉 outlying uninhabited islands;
- 👉 marine protected areas to sustain resources for harvest;
- 👉 fully developed marine sanctuaries, operating under effective management plans.

He mentioned that not a lot was known about the marine protected areas in the region, and there was a particular lack of knowledge about the habitats they covered. He hoped that the workshop participants could add to the available knowledge.

He then introduced Nick Polunin, who talked about marine fisheries reserves in particular. Nick posed himself the question; “what evidence is there that small marine fisheries reserves actually work”? There had been three types of approach to answering this question:-

- ☞ instantaneous comparisons between protected and unprotected areas. There had been approximately 16 studies of this made worldwide, including two in the Pacific, but the evidence provided by such studies could only be circumstantial. A time-series of observations is necessary to properly answer the question;
- ☞ there have only been two time-series studies published (by Alcalá and Russ and by McLanahan and Kaunda-Arara), but the work to be reported later in the session by Wantiez and Kulbicki would add another;
- ☞ theoretical modelling, of which there appear to have been only two studies, by Ed DeMartini in Hawaii and Mann *et al.* (1995).

Tools for assessing the effectiveness of marine fisheries reserves are limited. The tool most often used, Underwater Visual Census (or UVC) has strengths and weaknesses. Unfortunately, it is weak in some of the more important fishery resources, particularly inconspicuous, nocturnal and rare (like “old mother” groupers) species. Also, it is prone to human error, since UVC work is exhausting.

Catch and effort (CPUE) data offer another approach to assessing effectiveness, but the relationship between catchability and actual abundance is problematical, and it is often difficult to correlate CPUE and UVC estimates, as work by Michel Kulbicki (see section 2.3.2.2) and Tony Acosta has demonstrated. The biggest problems often occur in important fishery species like the Emperors, and the evidence for whether or not marine fisheries reserves work is thus limited.

But most of the studies involving a protected site alongside a depleted fishery suggest that even small protected areas are beneficial. Protection leads to a greater biomass and larger average size of fish, and the effects are positive for a lot of species. We still do not know much about the effects of increasing or reducing the size of the closed area, and whether large areas would be better split up into several small areas, or vice-versa.

However, presuming that they are effective, we would expect the following effects from setting up small fisheries protected areas:-

- ☞ increased recruitment, due to a combination of protection of the spawning stock and protection of pre-recruits and recruits themselves (presuming that the nursery habitat is not degraded);
- ☞ effects on growth rate, particularly a likely reduction in individual fish growth rate as stocking density, and thus competition, increases.

Nick also donated some thoughts on the design on marine fisheries reserves. Obviously, areas need to be suitable, both biologically and politically, but it is surprising how often one or the other of these two factors is ignored. An example where both criteria were inadvertently demonstrated was the lay-off in fishing the North Sea during the second world war, where a huge catch was experienced later.

The size of a marine fisheries reserve has to be balanced against the loss of productive fishing grounds but we have little evidence yet to suggest what is most appropriate, particularly for different types of fishery resource. The shape of the reserve must maximise the interception of larvae on currents and the location of the reserve must be within reach of the fishing community. The reserve must also include relevant habitat, to maximise consistent recruitment.

On the question of permanent versus rotating reserves, he pointed out that mobile species need fixed areas.

Really sedentary species need rotating areas otherwise there is no benefit to the fishery. Finally, some background information about the proposed area is needed, since without this it is hard to make a case for the closure of a site. A reserve is easier to comply with if some benefit is clear.

Laurent Wantiez then presented some of the work that had been carried out by ORSTOM in assessing the effectiveness of the marine reserve areas near Nouméa. Three main effects were expected from these reserves:

- 👉 protection of spawning stock and biodiversity;
- 👉 perservation of the age structure of fish populations;
- 👉 conservation of ecosystem characters.

This study had the opportunity to compare fish communities before and after five years of reserve operation, up until the rotating reserve was opened in 1994. Several areas had been established in 1989, including Amedée on the barrier reef, Bailly near the coast, and three reserves inside the lagoon. The 1985-89 UVC dataset compiled by Michel Kulbicki was used to characterise the area prior to reserve declaration, and additional work was carried out at the 1994 reserve rotation using UVC along 50m transects with variable width to calculate fish density and biomass. The observations only included species of commercial value, with the addition of the Chaetodontidae as indicators of reef health.

Species diversity and biomass were found to have increased significantly in the reserve sites compared to the unprotected control sites. The improvement at Amedée on the barrier reef was better than the other sites, and the site nearest shore, Bailly, showed the least improvement. Amedée was presumed to be at an advantage because it had a greater diversity of habitats, less terrestrial influence, and enforcement of the reserve had been better.

In total, there were a greater number of species found in all families after the reserve operation, but there was no increase evident in the average size of fish in the population. There were more big fish, but this was balanced by the occurrence of more small fish. However, the non-reserve control stations also showed an increase in the number of small fish and it is obvious that there was an environmental influence increasing recruitment across the whole area at this time. It was also noted that the habitat had improved since there were less fishermen dropping anchors and causing disturbance, and more spawning stock was evident. A principal components analysis was able to significantly separate the reserve areas before and after protection.

Dave Williams then discussed some work that had been done by his colleague Gary Russ, including work in the Philippines in collaboration with Angel Alcala.

This work, in Sumilon (involving 100 fishers) and Apo (involving 200) in the central Visayas, suggested that reserves can be an effective management tool. but are not a complete panacea for overfishing. There was a lot of information from various closures and openings, particularly for Lutjanids, Carangids and Serranids, based on UVC surveys at permanent transect sites. Non-reserve sites showed a much lower increase in numbers of fish than the reserve sites, in a clear pattern. There was a remarkable linear relationship between the number of years of protection and the numbers of fish, although the biomass did not increase as rapidly as the numbers of fish, after protection.

Dr Williams went on to describe work on the central Great Barrier Reef in Australia, monitoring changes in live coral cover in association with crown of thorns starfish (*Acanthaster planci*) abundance. An *Acanthaster* outbreak in 1982/3 reduced live coral cover to almost zero on several reefs for approximately 7/8 years, but there had been a remarkable recovery since, and reefs were back to normal by 1991. He pointed out that coral reefs are extremely dynamic structures. How did fish respond to this deterioration?

It was expected that the numbers of algal grazers would increase with the increase in algal coverage as corals died, but the parrotfish showed no such increase. However, the numbers of Chaetodontid coral grazers did show a strong correlation.

On some reefs the population crashed and then recovered, but on other reefs the population did not recover from the crash. Recruitment did not occur. Dave then pointed out that, in a natural state, coral reefs are resilient (i.e. not fragile), *but only if there is a source of recruitment*. Reserves, as a source of spawners, should enhance recruitment in down-current areas—a phenomenon often called the “spillover” effect.

There was some evidence of spillover at Apo, but it was not clear and not large. Using theoretical modelling approaches, it is likely that the spillover effect is only significant if there is very severe fishing pressure outside the reserve. Recent investigations of current patterns show that larvae can move 450 kilometres down the Great Barrier Reef in 21 days, so perhaps spillover effects are not local. There are quite a few fish and invertebrates whose larvae spend 21 days or more in the plankton.

Biogeographical analyses suggest that northwest Australian reefs are more like the Philippines reefs than the Great Barrier Reef. Currents move from the Philippines, via Indonesia, to northwest Australia. However, the main current that impacts the Great Barrier Reef comes from the east, and splits at the Great Barrier Reef to move north and south. There is no current linkage with the Philippines or northeast Australia. Some areas are larval “sinks” and some are “sources”. Dr Williams said that areas which are sinks (i.e. areas which are down-current of a source of larvae) can be severely depleted and still recover if the source is good, and in this sense, northwestern Australian reefs are dependent on the health of Indonesian reefs. But if the entire Great Barrier Reef is depleted there is no external source for recruitment.

In summing up, Dr Williams was of the opinion that fish populations *do* recover in reserves, but closures need to be long-term since spawning stock biomass increases more slowly than the increase in fish numbers, and recruitment is erratic. The Philippines experience suggests that even a short term opening of the reserve can negate all of the benefits. Coral reefs appear to be naturally resilient, and can fully recover from a catastrophe in 10-15 years, but they will only recover if there is an external source of replenishment. He felt that the most effective rôle of reserves was thus to provide sources of replenishment for *other* areas. The problem is, we can’t yet easily predict where the sources and sinks are located, and reserves should be placed in sources.

We need to think on a large scale, and regionally, about a network of reserves. One of the most important scientific questions about reefs is this investigation of connectivity—where is recruitment coming from, and where is it going to? Reserves may be our *only* viable option for maintaining spawning stock biomass.

Later in the session John Munro pointed out that the extent of larval transportation, and the spillover effect depended not only on current patterns, but on the biology of the species. Species with short larval lives (such as trochus) were likely to be locally recruiting, whilst those with long larval lives (like lobster) might have a significant part of the stock recruited from a distance. A lot of larvae are likely to be retained locally—otherwise there would be no fish remaining at Easter Island—but many reef species might be straddling stocks to some extent. Dr Munro supported the idea of a initiative to coordinate marine reserves on a more regional basis.

Nelson Kile then presented a report on the setting-up of a marine protected area in the Anarvon area of the Solomon Islands, carried out in collaboration between the local community, the Solomon Islands Fisheries Division, the Nature Conservancy, GBRMPA and ICLARM. This marine protected area was for

the primary purpose of developing a sustainable fishery in an area where several commercially-important invertebrates had been severely depleted.

Nelson first of all revisited the projected benefits of a marine protected area. This should allow spawning stocks to increase in numbers and average size, to encourage a spillover effect into nearby fished areas, but hard evidence for this is still lacking. Fin-fish stocks are still in good shape at Anarvon, but the introduction of surface-supplied underwater breathing apparatus (hookah) has enabled the Gilbertese fishing community to deplete the invertebrates. Anarvon was chosen as a site because it is already fished heavily, it is possible to monitor resource status before the establishment of the reserve, it could be readily compared with nearby similar areas subject to fishing, and because there was good local support.

Both Ysabel and Choiseul island communities claim part of the intervening Anarvon island group, and the Wagina Gilbertese community also uses it as a fishing ground. It took long years of work but the Solomon Islands is now on the point of declaring the area a reserve. The animals studied are bêche-de-mer, trochus, giant clam and pearl oyster, and a fishery has recently started on spiny lobster. The plan is to perform surveys before and after the reserve is declared, and compare these to various control sites over time. This will maximise the chances of detecting differences by analysis of variance with minimal outlay. The study is not designed to look at the possibilities of increased recruitment outside the reserve, but only the effect on organisms within the reserve area. As an example of some of the pre-survey findings, the density of trochus is currently 8 per hectare, greenfish (*Stichopus chloronotus*) 108 per ha, and other bêche-de-mer are found at a density of 9 per ha.

A committee based on the three local communities has been set up to manage the reserve, and the experiment will last for three years in the first instance. The primary aim is socioeconomic benefit and it is hoped that the results will justify the effort put into the project. The Solomon Islands hopes to help other countries by this example, and results will be presented at a future SPC meeting.

Moses Nelson then gave some examples of Vanuatu's experience with marine protected areas. Vanuatu has four marine reserves and many trochus sanctuaries. These did not happen overnight, and it takes a lot of negotiation between resource owners and users and the Fisheries Division to get things moving. There has to be an exchange of information, with resource users contributing their local management traditions and the fisheries division contributing basic biological information. The rôle of each party also has to be clearcut. In Vanuatu, resource owners are encouraged to carry out enforcement and impose penalties and generally oversee the management of the area, whilst the fisheries division carries out periodic stock assessment and monitoring and enforces the size limit regulations.

Moses had noticed that if a trochus sanctuary is small, population density can increase at such a rate that growth is slowed. In other words, if the spillover effect is small, the reserve may become *too* effective.

Noah Idechong then contributed some of Palau's experience with the closure of grouper spawning areas. Palau is most famous for its recreational diving, but this coexists with a big reef fishery. A reserve was set aside in 1956, and then on one grouper spawning aggregation to the north in the 1950's, during April-July of each year. But there had not been any more declared until recently. This recent action was prompted after one year's worth of targeted commercial fishing, in 1986, wiped out the aggregation on the southeast passage. There are other aggregations in the north, but these are not of the species preferred by the fishery, so they were spared.

The Division of Marine Resources started to work more actively with the fishermen and to get regulations in place. This relationship was developed in 1986-90 and regulations were imposed to ban fishing and exporting these fish between April and July each year. Fishermen also closed channels on their own initiative, and enforced this themselves. By 1994 the Marine Protection Act was in place, and in 1995

areas covering two spawning aggregations were set aside. All of this was without the benefit of hard scientific information, but based on local knowledge and the 1986 experience. Chiefs have asked if the southern area can be made a year-round sanctuary, but MRD lacks the manpower to properly enforce it.

Noah has tried to stop violations going to court, since the Chiefs would have a problem making traditional law stand up. But since the legal basis has been set up and fines paid, compliance has been better. Bob Johannes is helping MRD to set up monitoring for a further year, and to figure out what sort of boundaries are needed to properly protect aggregations.

Richard Farman had some comments based on his experience overseeing the marine protected areas system of New Caledonia's South Province. He was worried about the extent of the contribution of reserves to enhancing nearby fisheries. The potential benefit of increased recruitment compared to the definite loss of available fishing grounds was difficult to demonstrate, and it was not clear if reserves had any rôle in fisheries management or were just valuable for protection and conservation within their boundaries.

He pointed out that there was no problem in developing a political will to set up reserves in New Caledonia. It is very fashionable to have reserves, but some think that reserves alone suffice to maintain resources and that they can then do whatever they like in other areas, such as cutting down mangrove forests. Richard said that he would sometimes prefer to abolish all reserves, not because he thought that they did not work, but because they make politicians feel too safe and happy.

He then went on to describe some of the marine protected areas. Reserve Merlet, landward of Ile des Pins, is banned to all entry except for traditional purposes by the people of Goro and Ile des Pins. However, the distinction between commercial and traditional usage is very nice, and it is important to involve traditional chiefs to enforce this distinction. Other reserves are much newer. the Plage de Poé reserve has a narrow reef area attached, and there are several islets around Nouméa.

Other areas, such as Prony Bay, are tourist reserves—diving is allowed, but no harvesting. A “refuge” effect is noticeable here. Not recruitment of juveniles, but an influx of adult fish from surrounding areas, attracted by the feed offered by tourists, and the population of Lethrinids has been noted to build up within two weeks.

Since 1981 some other areas have been declared. The Amedée island reserve has recently been extended to include the barrier reef with the discovery of some important fish nursery grounds, and there are three zones on the barrier reef opposite Nouméa which are reserves in rotation. A review is being carried out to see if this 3 year rotation cycle is meaningful, and some results from this were presented earlier in the session by Laurent Wantiez. After opening the first zone, as much fishing effort was observed in a few weeks as occurs in a whole year in other areas, and this is mainly recreational fishing close to the urban centre so it is very hard to control. Perhaps the effects of the reserve were completely nullified.

An additional activity has been the installation of permanent boat moorings to prevent anchor damage. If you create a reserve it leads to an increase in visitors, and the damage must be limited. Richard concluded with the point that the system of reserves should include all biotopes, otherwise the spawning stock of several important species may be missed. And nursery grounds must also be included in the protection, otherwise there is no point in protecting the spawners.

The final contribution before the meeting broke into discussion groups was from Todd Pitlik. He mentioned that marine preserves in Guam (some permanent, some rotating) were under the control of the military and did not appear to be particularly effective. Public hearings were presently being carried out on marine preserves. The public at first was not enthusiastic—not many wanted them in their back-

yard—but public opinion was definitely improving, to the extent that one area wants to have a permanent preserve, not just a rotating. Todd said that Guam had no information on the relative merits of rotating or permanent preserves, or whether some were sources or sinks, but that they were hoping for beneficial results all the same.

The discussion groups took the form of addressing different aspects of a case study drawn up by Paul Holthus, and stimulated considerable internal discussion about the practical pros and cons of various factors in marine protected area design. Unfortunately, the free discussion format of this part of the workshop, with participants split into several groups, did not lend itself to rapporteurial exactitude, so no report of discussion is available.

2.3.8 Management Tools — Resource ownership (including customary marine tenure and individual transferable quotas)

Bob Kearney was the keynote speaker and moderator for the session, which was intended to give Pacific Island fisheries managers the opportunity to learn from the experiences of Australia and others in applying ITQ as a management tool, since such systems are increasingly being suggested for Pacific Island fisheries by economic planners, and to provide opportunities for discussing any specific aspects of traditional fisheries management that have arisen since the traditional management workshop held at the University of the South Pacific in 1994. It should be noted that there was some overlap in discussion of ITQ systems with session 2.3.6, since the word “quota” appears to have now become virtually synonymous with “individual transferable quota” in Australia and New Zealand.

2.3.8.1 *Keynote & background papers*

Tom Graham	BP035: Managing Palau's aquarium life fishery
Bob Johannes	Verbal presentation
Rick Fletcher	BP043: Use of computer simulation models and quotas to manage the Albany pilchard fishery of Western Australia
Bob Kearney	KP014: Resource ownership: customary marine tenure and individual transferable quotas
Paul Lokani	BP021: Traditional and commercial use of marine resources in the warrior reef (Torres Strait protected zone) Papua New Guinea.

2.3.8.2 *Summary of discussion*

Bob Kearney's keynote talk, based on recent experiences in assessing the feasibility of introducing ITQ systems into certain New South Wales fisheries, and his previous experience in the Pacific Islands region, is included in the appendix in full. He added that sharing resources between the recreational and commercial sectors is difficult and that a recent major investigation had shown that the recreational fishing sector in New South Wales is surprisingly large, exceeding the commercial catch when all species are combined. He was of the opinion that recreational fishing will probably exclude commercial fishing in Australian inshore waters by 30 years from now. Recreational fishermen are not licenced, but probably will be within the next five year.

John Hampton said that the effectiveness of Individual Transferable Quota (ITQ) systems for managing stocks depended very strongly on the accuracy of Total Allowable Catch (TAC) evaluation. ITQ systems were unresponsive to the variability of stock recruitment, and force this variability to be absorbed by the stock rather than by management. He reckoned that the west Australian rock lobster fishery is well-

managed by ITQ, probably because the future catch can be fairly well predicted, but thought that few other ITQ systems were a success. He felt that effort control systems were much more flexible when it came to accommodating variability.

Saimoni Tuilaula felt that it was a bit difficult to apply ITQ systems to multispecies fisheries, especially in the Pacific Islands where stock assessment is not rigorous. Fiji was also worried about the likelihood of such systems evolving into “rich men’s clubs”, with new fishermen, particularly young people, finding it difficult to enter the fishery. He also wanted to know how individual ITQ’s could be fairly allocated to different boats.

Bob Kearney replied that the allocation was usually based on historical fishing rights or catch history, but that even western countries did not have good records on catches. Usually, there is around 5 years warning before an ITQ system is introduced, and people start inflating their catches hugely in order to gain quota. Another way is simply to specify those with a right to be in the fishery. For an exploratory, or new, fishery it is possible to auction these rights to generate revenue up-front. One has to be mindful of cultural needs, but the fact must be faced that *whatever* you do, someone will complain.

Dr Kearney said that ITQ systems definitely do create a “rich man’s club”—fishermen do get richer, and new people cannot enter the system without *buying* in. Normally the selling value of a quota settles at 4 to 6 times the annual landed value of the fish, based on various experiences around the world. ITQ systems have not been in operation for long enough to see if recruitment of new participants is going to be a big problem but, in effect, the ITQ system appears to be creating an hereditary fishing industry, in the same way as the present system of land ownership. ITQ systems create an incentive for economic efficiency, but remove the incentive for technological advancement.

Sylvester Diake said that he was interested in the comparison of different marine resource ownership systems like customary marine tenure (CMT) and ITQ. He said that CMT has the problem of resolving different interests within the system, unless the traditional chief is powerful. He could see the ITQ system working in a broad national fishery like tuna, but not in the customary system.

Bob Kearney saw ITQ systems as being more likely to work in single species fisheries where catches could be monitored easily and where licences were required. Indeed, he was not sure that they would work at all in village-level fisheries, certainly if CMT is already in place. But he saw the threat to CMT as being in external influences, such as the pressure to export, or government pressure to develop resources. If CMT works then don’t change it. Not many modern management systems have been proven to work.

Rick Fletcher then gave a talk on the management of a West Australia pilchard fishery. He said that this was one example where ITQ does work, but that for other fisheries Western Australia had calculated that ITQ would cost significantly more to assess and enforce than limited effort systems.

Western Australia is different from all other continental west coasts in that there is no upwelling of cold nutrient-rich water, but a warm-water current. The pilchard fishery is carried out by purse-seining, and the production goes into anglers bait and feed for lobster and tuna farming. The number of boats in the fishery increased due to dispossessed southern bluefin fishermen moving in, and an unfortunate characteristic of the pilchard stock is that catchability seems to increase as the abundance decreases. External restrictions were thus necessary.

When ITQs were allocated, they were given out in units, rather than tonnes, so they could be altered more easily if necessary, and the initial unit was 10 tonnes, with a minimum of 8 units being allocated to each quota-owner. The initial allocation was not based on catch-history, since those who had caught the most had caused the problem in the first place.

In assessing the TAC, otolith weights are used to determine the age structure of the stock, which has shown that there have been some notable recruitment problems recently. The department can predict the fishery by monitoring the two and three-year old fish, since most of the catch is of the 4 year old age-class. This appears to be pretty accurate, based on the concurrence of model-based predictions with actual catches.

In order to absorb fluctuations in recruitment and reduce the impact on the stock, the quota unit was reduced from 10 tonnes to 7 tonnes recently, resulting in a reduction in the TAC from 5,000 to 3,500 tonnes. They had found that the ITQ system works well in a large-volume, single-species, restricted-gear fishery. Since the number of boats is small it is easy to monitor and police. There has not been much cheating apparent, but the potential is there. One problem is flexibility, since quotas appear to become chiselled in concrete. Also, quotas can become targets instead of limits.

☺Anitimoni Peleto then talked about the existing open-access system in Tonga, and the case that they were trying to make for an increase in community-based management in the country. Tonga has 150 islands, and a population of almost 100,000. The human population is not growing very fast but more people are drifting to urban areas, and there are more people now than in ancient times. Tonga became politically united in the mid-1800's and power was consolidated in the monarchy. A royal proclamation in 1887 claimed an exclusive economic zone for the country — a box-shaped area from 15°-23.5°S and 173°-177°W, and this was reinforced by the Land Act of 1927. However, all of this area was declared to be owned by the king, and under this ownership all Tongans have equal rights of access, with no traditional local controls. ☺Anitimoni said that Ron Crocombe has pointed out that Tonga was the only Pacific Island group never colonised, but was the only Pacific Island country that had formally abolished customary marine tenure. The National Environment Management Strategy states that Tonga never had CMT, but this is not the case.

Tonga is just in the process of setting up new fisheries regulations, with the help of the Forum Fisheries Agency. Amongst other things, these will require a permit for the export of all live fish and place a ban the taking of marine mammals. ☺Anitimoni was of the opinion that Tongatapu fisheries were heavily exploited, and that the Ministry of Fisheries had noticed a decrease in the availability of fish, especially high-value species. Decentralisation of management responsibility is needed for reef fisheries. Tuna fisheries, and reef fisheries near the capital should be managed by Government, but Government management cannot function effectively in all areas. There is mounting local pressure to give differential access to neighbouring villages, although others suggest that this would be unconstitutional.

At the moment, the Privy Council has the powers to declare reserves etc., and these powers can also be used to restrict fishing, so a legal mechanism already exists. Sentiments in the 6th national development plan promote the idea of increased decision-making powers for local communities. ☺Anitimoni reckoned that open access does not foster a long-term relationship with the resource, and hoped that the new way of thinking could be accommodated under existing legislation.

Ray Newnham said that there seemed to be some momentum building up in Tonga towards giving responsibility back to communities in remote areas. Did ☺Anitimoni see problems in going towards that system? Mr Peleto replied that they were fostering community awareness through radio programmes, but that the main point of this effort, at this stage, was to get discussion going. Perhaps a more integrated management authority involving other government groups, not only villages and fisheries, would become possible later.

Bob Johannes' talk about the live reef food-fish export trade, and the problems it is likely to pose to Pacific Island fisheries managers, was fitted into this session since Bob only had a limited time to spend

at the meeting.

Bob said that he and Mike Reipen had just spent 14 weeks figuring out what was going on around southeast Asia in the live grouper trade, and that this should be of some concern to the Pacific in its implications. He said that the Philippines was finished as a source of grouper for this market, that they would be fished out of Indonesia in three years and that the new frontier was now Papua New Guinea. The fishery concentrates on groupers and maori and napoleon wrasses, and *Cheilinus undulatus* can fetch up to \$150 per kg at Chinese New Year in Hong Kong.

The fishery started in Hong Kong and the Philippines in the 1980's and has now spread as far as the Maldives. It is largely uncontrolled, and many operators use squirt bottles to direct cyanide into holes by hookah divers. Sometimes whole drums of cyanide are dumped in the water if the fish can be marketed dead. Live fish are put into a small-boat holding tank and then into floating holding pens before being transferred in a larger vessel (usually around 20 tonnes capacity) to Hong Kong and mainland China. The cyanide damage has not been quantified but 150-400 tonnes of cyanide was used annually in the Philippines. A lot of small fish are killed outright, and many corals. The fishery also has impacts on people, mainly on untrained hookah divers. In villages in the Philippines 5-10% mortality of divers per year has been noted.

Around 40% of the live fish in this trade result from aquaculture, but the demand is huge and increasing all the time, particularly in the special economic zones in mainland China. Groupers cannot be reliably raised from eggs since mortality is huge, so farming relies on gathering groupers from the wild. A lot of scientists don't know where the juveniles are located, but fishermen have been targeting them for years, using artificial reefs and coconut fronds to attract them. There is no source of juvenile groupers around Hong Kong, and they are now starting to disappear further afield. Bob noted that if reef-fish are recruitment-limited then the harvesting of juveniles will have severe impacts.

Efforts to develop this fishery have also been made in the Solomon Islands, Yap, Tuvalu and Kiribati. An operator was kicked out of Palau, but only after wiping out one grouper spawning aggregation. Other places did not authorise the fishery when they realised that the groupers would have to be fed on other reef-fish.

Experience has shown that central government alone has not been able to cope with controlling this fishery, and the only areas where there is partial control are those where CMT or co-management is in place. For example, North Palawan in the Philippines has an impressive campaign. Indonesia does not recognise CMT, but Irian Jayans have been known to chase out fishermen. Further west, the Indonesian government actively discourages customary marine tenure, thus there is no control since the provincial governments collaborate with the Hong Kong businessmen.

Dr Johannes suggested several management measures for limiting the deleterious impacts of this fishery:-

- 👉 require separate licences
- 👉 draw up contracts with the company
- 👉 monitor catches and exports
- 👉 make sure vessels are marked for surveillance
- 👉 put spawning aggregations off-limits
- 👉 ban SCUBA and hookah gear
- 👉 advise villagers on the pros and cons
- 👉 ban the possession of cyanide on boats
- 👉 ban the fishery where control is not possible
- 👉 impose moratoria on depleted areas, as has been done in parts of the Philippines.

He also suggested several avenues for further research and action:-

- 👉 develop aquaculture of maori wrasse and groupers to mitigate demand for wild fish. There may be a market for fertilised eggs (using the type of system that has been developed in Guam from Palauan groupers). These have a high mortality, but groupers do not seem to aggregate for spawning in southeast Asia and thus the Pacific has a competitive advantage. Also, wild eggs are more viable than those from farmed fish;
- 👉 production of a manual on avoiding wastage and losses during holding-tank storage and transit, or even collection. For example, some fishermen release air from the swim-bladder by means of a straw inserted in the arsehole, where a needle in the swim bladder would give a much lower mortality;
- 👉 convene a panel of experts to develop guidelines for ensuring a sustainable off-take. Nobody knows much about grouper biology and some rules of thumb are needed;
- 👉 carry out research on the effects of cyanide. What levels are toxic? There are conflicting results at present;
- 👉 set up a regional register for foreign grouper fishing boats;
- 👉 develop a model contract to guide fisheries departments through new applications by grouper fishing companies. New Ireland has a very good one;
- 👉 lobby governments (especially Indonesia) to support customary marine tenure;

Kimberly Lowe asked why a panel of experts was needed to determine allowable catches for groupers. Was this necessary to assess a quota? Bob Johannes replied that the fishery was actually a very good source of foreign exchange, and a very high unit value usage for limited reef-fish resources, *if* it could be kept sustainable. But we do not know how much is sustainable.

John Munro said he hadn't realised how serious the problem had grown. If turned to a good purpose the fishery could be very valuable in island economies but... (the sentence was left hanging). He said that Caribbean-style fish traps would be the obvious way to catch groupers alive and in good condition. Groupers have fairly uniform growth characteristics as a family and one can set minimum weights or lengths fairly consistently. And since the fish are kept alive, the undersized can be released successfully. Bob Johannes said that unfortunately, traps have a lower catch rate than cyanide, but if cyanide is successfully restricted then traps could be useful. Paul Dalzell said that he traps had worked well in northern Papua New Guinea and that he had developed an intimate relationship with many of them, except for one or two that he would not name in Aitutaki.

Johann Bell pointed out that the onus should really be on the company to *prove* the sustainability of its operation.

Tom Graham then presented his paper about the management of the Palau aquarium fishery. Live tropical marine aquarium fish have been exported from Palau for 5 years or so. MRD does not have exact figures, but around 150,000 fin-fish, invertebrates, pieces of coral and "live rock" were exported last year, with gross receipts in the region of US\$200,000. Concern by different interest groups about possible competition for food fish, damage to reefs and about who was really benefitting led to the imposition of regulations early in 1995.

These included gear restrictions (no poisons, and a limitation on net type) but the main element is a limited entry permit system to put a cap on the number of individual fishermen rather than vessels or companies. There was a problem in choosing those eligible for permits, with various ideas suggested including time of application, lotteries and fishing history, but the department finally decided on a case-by-case review based on a set of criteria to select environmentally "clean" operators.

Tom mentioned that property rights in fisheries can range through degrees of ownership from open access to sole ownership (such as in pond aquaculture). The closer the system is to sole ownership, the closer the fishery should be to achieving sustainability, at least in theory. In the Palau aquarium fish case, permits are not transferable so some security is taken away from the property owner, however, permits can be transferred amongst employees of the same company. Permits are valid for one year only, to enable a finer degree of control.

In Palau, regulations are made by the national government, but the states have strong rights to control fisheries within the 12-mile limit, and there is potential for conflict between management regimes. However, this has not been a problem so far, since permits are only valid if endorsed by the State as well as the national government. National government does not charge a resource rent but levies an administrative charge of US\$100 per year, however State governments are free to do so, or even to ban such fishing entirely within their waters.

The regulations can restrict the taking of certain species and impose quotas, and a couple of resources (giant clam and hard coral) are already “hard-wired” into the prohibitions section. The industry was exporting more coral and live rock last year and that is now banned (except for scientific purposes, specimens originating from aquaculture, or from a permitted dredging site). The department was originally going to ban coral export entirely, but this might have appeared hypocritical when dredging (for roadbuilding and other purposes) was allowed.

Suesan Saucerman asked if there were any favoured fishing grounds. Tom said that they did not have much information on fishing locations, but the total catch came from fairly small areas.

Johann Bell mentioned that soft coral is very much in demand by aquarium suppliers nowadays, and can be cultured by fission. Some research needs to be done on monitoring the survival of colonies which have been divided, since not much is known yet. An export trade is starting up in the Solomons, and Jo advised that if departments are approached for permits then collectors should be asked to demonstrate the sustainability of their proposed operation.

Augustin Mobiha mentioned that the agreement between the provincial government and the company carrying out the live fish exporting trade in Kavieng had now lapsed with only one shipment. They were catching and exporting fish from the North Solomons under an agreement based on the Fisheries Act and the exports also included lobster.

2.3.9 Management tools — Artificial enhancement of stocks and introduced species management

Johann Bell was the keynote speaker and moderator for the session, which explored the use of aquaculture as a management tool for enhancing wild stocks.

2.3.9.1 Keynote & background papers

Gideon Tiroba	BP062 Pearl Oyster and Mother of Pearl in the Solomon Islands
Shigeaki Sone	BP008: Ocean culture of giant clam in Tonga (with Lotoahea, T)
Ken-ichi Kikutani	BP011: The present status of introduced trochus and greensnail in the Tongatapu island group, (with Fa'anunu, U & Manu, N)
Steve Lindsay	BP012: Reef reseeded programs for giant clams: do they work, and do they

	use the limited resources wisely? Using Yap State, FSM as a model.
Jiro Isa	BP016: Rule and regulation in the conservation of the coastal fisheries and re-stocking project in Okinawa, Japan.
Shinichiro Kakuma	BP017: Sedentary resource management in Onna Okinawa, Japan, with Higa, Y
Ray Clarke	BP019: Technological innovations and multidisciplinary approaches for sustainable mariculture development for pacific insular settings
Tadashi Kimura	BP054: Biological Survey and Management of Mullet Resource in Tonga
Johann Bell	KP003: Enhancement of marine fisheries
Lu Eldredge	IP001: Introductions of commercially significant aquatic organisms to the Pacific Islands ¹³
John Humphries	IP002: Disease threats and guidelines for quarantine ¹⁴

2.3.9.2 *Summary of discussion*

This was a popular session, with many speakers, so the time available for discussion was short. Dr Johann Bell of the ICLARM Coastal Aquaculture Centre (CAC) in the Solomon Islands gave the keynote talk, which reviewed the evidence on whether artificial enhancement is a viable option in managing tropical marine fisheries. Much of his address followed from a recent review paper on the subject compiled together with John Munro and Villy Christensen¹⁵, which can be referred to.

Jo commented that hatchery juveniles are often less hardy than wild stock, for example, bream from Japanese hatcheries can adopt unusual behaviour when released, and maricultured queen conch in the Caribbean have thinner shells, but he pointed out that juveniles can be pre-conditioned before release. In choosing species for enhancement, the best results are likely to come from organisms with a high adult value; that can be cheaply produced as juveniles; that have fast growth and good survival, with a low impact on the environment, and which have a restricted habitat so that it is easier to recover releases.

The Pacific Islands have an advantage in that discrete reefs and small islands increase the chances of retaining harvestable stock within the area of release. Long coastlines encourage migration of released stock away from the harvestable area. ICLARM CAC is setting up an enhancement programme in the Solomon Islands, and Hawaii is poised for sea-mullet farming, but a lot of work is needed in other areas before the technique gets off the ground. Jo reckoned it would need about 15 years to realistically assess feasibility in the Pacific. The difficult part is assessing survival of released stock in the wild, and it was possible that the genetic markers now coming into use would be valuable here.

Natural recruitment is variable at the best of times, and there is no point in artificial enhancement if there is a lot of wild spat available. However, recruitment of juveniles varies from year to year, and the carrying capacity of the environment changes as well. For example, in Norway the density of zooplankton in the fiords can vary by a factor of 10 from year to year, which has a big influence on the amount of cod that can grow to adult size.

¹³ Perspectives in aquatic exotic species management in the Pacific Islands: Volume I: *Introductions of commercially significant aquatic organisms to the Pacific Islands*. Inshore Fisheries Research Project Technical Document No 7. South Pacific Commission, Noumea

¹⁴ Perspectives in aquatic exotic species management in the Pacific Islands: Volume II: *Introductions of aquatic animals to the Pacific Islands: Disease threats and guidelines for Quarantine*. Inshore Fisheries Research Project Technical Document No 8. South Pacific Commission, Noumea

¹⁵ Munro, J. L., Bell, J.D. and Christensen, V. (in prep) *Enhancement of Marine Fisheries Resources*. International Center for Living Aquatic Resources Management (ICLARM), Manila

Another factor in natural recruitment is that there are certain places where the majority of spat settle each year. Some of these good recruitment areas are also places where primary productivity is not high, and production could be quickly increased by adding nutrients. Sewage disposal is becoming a problem in Australia, but this could be a useful nutrient supplement in oligotrophic areas. In Japan, artificial enhancement projects have employed artificial habitats to provide juvenile nurseries, and food supplements have been used (such as seaweed for abalone).

Globally, artificial enhancement of natural stocks has been practiced as a technique for more than 30 years and involved more than 90 species. 14 billion shortneck clams are released every year and 3 billion scallops, and there is a fishery in New Zealand involving these scallops, however, the technique is still experimental in most cases. There have still not been many “hard-core” economic analyses, but some data is starting to come in on flounder and bream enhancement in Japan to show that it is economically viable. Another economically successful example is the recreational red drum fishery in Texas, because anglers pay highly for each fish.

Dr Bell stressed that artificial enhancement is not a panacea for mismanagement—that fisheries managers should not relax their use of other available management tools just because a hatchery is set up. It was also clear that, at this stage at least, that hatcheries could not “re-start” fisheries that had been wiped out.

The potential impacts and disadvantages of artificial enhancement as a management tool include:-

- 👉 Genetic impacts, such as inbreeding and inadvertent selection for poor natural survival or growth traits leading to a reduction in fitness;
- 👉 Translocation and introduction of diseases, such as the problems that French Polynesia had with the transfer of diseases between blacklip pearl beds. Monocultures make the spread of disease much easier;
- 👉 Impacts of introductions on other species. This is not easy to demonstrate or measure given the current state of our quantitative knowledge about Pacific Island reef organisms, but the potential is obviously there.

Jo noted finally that artificial enhancement seems to be a more controversial topic than many other fisheries management options, and that the topic often polarises fisheries departments.

Jiro Isa then talked about tropical invertebrate stock enhancement in Okinawa. 400,000 trochus spat and 250,000 giant clam (*Tridacna crocea*) spat had been set out over 6 years in one place. Reseeded areas were set aside as reserves and Isa reckoned that the restocking had been successful, with a high survival, particularly of giant clams. Giant clams reached harvestable size in about 4 years and the survival rate around Onna village was around 50% after this time—an amazingly high figure. However, the restocking was labour intensive, needing cages to protect the small juveniles and experiments with drilling holes in the substrate to shelter juvenile *T. crocea* were being carried out.

It was difficult to judge the success of the trochus reseeded since there were also increases in the stock in areas that had not been reseeded, and there had probably been a good natural recruitment year preceding the reseeded. Fishermen said that giant clam catches had increased, so the project is judged successful in community terms. Perhaps there was no big demonstrable effect of the reseeded biologically, but the reseeded effort was also necessary to convince fishermen to pursue other management methods as well.

Kimberley Lowe asked if the reserve areas were ever rotated? Isa said that rotation was the original plan, but this was never carried out since it was found that fishers preferred to reseed the same area every time.

Esaroma Ledua was interested in the use of drills to provide holes for sheltering *T. crocea* seedlings, and whether or not this would work on other giant clam species, since cages were so labour intensive and expensive. He noted that the Fiji giant clam hatchery at Makogai had experimented with *T. squamosa* but that this species did not seem to like living in holes. Brendan Pasisi asked if any other work had been carried out testing drill-holes for, say, *Tridacna maxima*, since there were significant gains to be made if clams could be put out at a younger stage into the ocean nursery, and would also cut the cost of translocation of ocean-ready clams to countries without hatcheries. Johann Bell said *T. maxima* would probably be amenable to this sort of treatment. But in Niue, with its high-energy reef environment, it might still be wise to put netting over the top.

⊕Ulunga Fa'anunu then presented a paper in collaboration with Tadashi Kimura on mullet culture experiments in Tonga (see BP54). Johann Bell mentioned that Hawaii had had good recoveries of artificially bred mullet from the wild, in the order of 30%, and that the prospects for mullet culture in Tonga looked good provided there was good nursery habitat in the lagoon. Kimberley Lowe added that Hawaii had released 200,000 fry at Hilo, and that the area was unusual in that there was a wedge of cold water sitting in the estuaries to stop the mullet escaping out to sea. Also there was protection from net fishing in the bay. If the seeding had been done in other areas the mullet would be picked up by commercial surround-netting. Released fish are identified by a coded wire implant tag. She mentioned that the reason for the decline in the original mullet population of the area was probably the herbicide used to clear drainage channels. In addition, creel surveys showed that significant numbers of small fish were collected in the nursery habitat for ponds using small mesh nets. The Hawaii mullet restocking programme had significant community impact and Kimberley noted that people seem to be more interested in protection when they know that the state has invested in restocking.

In the following general discussion Bob Johannes asked if there was any point in trying to artificially enhance natural trochus populations when moratoria seem to work so well for trochus. Are there cases where moratoria do not work, and thus mandate re-stocking? Moses Amos replied that the Vanuatu fisheries department has justified trochus re-stocking in public awareness terms. It is a lot easier for a village to agree to a moratorium if re-stocking occurs in parallel. Also, in Okinawa co-management seemed to work much better with Government input. However, he added that it was true that trochus reefs do not get completely fished out, and that moratoria alone (if they can be agreed without the additional persuasion of re-stocking) would probably be sufficient.

John Munro added that trochus is a special case when it comes to comparing comparing moratoria with reseeded because it can become established very quickly. It has a short larval life and is probably not recruitment limited, so if you leave a few it can quickly bounce back.

Sylvester Diake asked about the expenses involved in reseeded—are they justified by the market value of the fishery—and are there any hard figures? How about mullet in Hawaii, for example? Kimberley Lowe said that the cost of releasing mullet fry was about 2¢ each, but added that the reseeded also increased the value of the area for other users and that you got back a lot more than just the cost of producing the fish.

Moses Nelson said that the meeting seemed to be indicating that there was a trend towards success in species introduction and reseeded programmes. He asked if it was too early yet to detect the deleterious effect of introductions, and noted that there had been initiatives through the SPC Regional Technical Meeting on Fisheries a few years ago to look at marine quarantine protocols for the region, and was it time to revisit these?

Johann Bell said that this needed to be looked at. There had been more than 70 successful trochus introductions in the Pacific, but nobody knew about the impacts. He noted that there were numerous

examples of deleterious species introductions in the rest of the world, for example.

Kimberley Lowe mentioned that there had been a problem with introduced snails in Hawaii carrying a parasite that was transmitted to mullet under culture. The mullet were then put into the wild and the disease perhaps spread to the wild population. How sure can we be that this is not happening with trochus? Snails are good hosts for various parasites, including trematodes.

John Munro said that a good rule of thumb when considering species introductions is “don’t do it”! ICLARM does not do it without very good justification. He said that trochus are so easy to spawn, so why not just ship a bag of sterile larvae instead of wormy old shells?

Johann Bell agreed, but noted that we had 70 experiments here in moving trochus around the Pacific Islands, some of more than 60 years duration. If there have been no deleterious impacts noticed then perhaps there is a case for continuing? There do not seem to be the same sort of horror-stories as are told about some terrestrial introductions, and greensnail (*Turbo marmoratus*) introductions for example could have great economic benefit. Was there any information on this from French Polynesia? Steven Yen said that no impact studies had been undertaken on the impact of greensnail introductions into Tahiti or the nearby islands.

Edgar Cocker asked if there were any regional programme looking at sites and suitability for species introductions, and wondered if this should be a recommendation from the meeting? Tim Adams drew the attention of the meeting to two reports which had been circulated during the session, in the SPC Coastal Fisheries Programme series on introduced species management in the Pacific Islands region (Eldredge, 1995; Humphrey, 1995) and said that SPC was seeking funds to commission a third report on assessing and mitigating the impacts of introductions but as yet no donor had been found. He thanked SPREP for sponsoring Lu Eldredge’s catalogue of known introductions, and ACIAR for sponsoring John Humphrey in drawing up guidelines for the quarantine of translocated marine organisms in the Pacific Islands, and noted that these guidelines had been endorsed by the 1994 South Pacific Conference. He additionally noted that although these guidelines had been accepted by Pacific Island nations and territories, that there was a long road ahead, and that Pacific Island nations would require a great deal of assistance in setting up systems of their own, particularly the setting up of effective marine quarantine installations.

2.3.10 Management Tools — Size limits and gear restrictions

Stephen Yen was the keynote speaker and moderator for the session..

2.3.10.1 Keynote & background papers

Augustine Mobiha	BP003: The management of the coastal barramundi fishery in the western province of PNG
Chris Mees	BP007: Optimisation of yield of <i>pristipomoides filamentosus</i> from the Tongan seamount fishery by changing the size at first capture, (with Rossouw J)
Kazuo Udagawa	BP010: Lobster fishery in the Tongatapu Island group, Tonga - its biology and the effect of a new fishery regulation (with Kava V & Fa'anunu U)
Patricia Kailola	BP032: The beche de mer fishery in Tonga, with Petelo, A & Gillett, R
Stephen Yen	KP005: La gestion des ressources cotieres par les limites de taille et la reglementation sur les engins de peche.

2.3.10.2 *Summary of presentations and discussion*

Steven Yen's keynote talk is appended in full at the end of this report. He noted that there was not complete agreement between the regulations of Pacific Island countries and territories on size limits for the same species, and that various different justifications might be used for the imposition of such limits. Although the biology of the organism is often fundamental, particularly the size at first maturity, it was also the case that some organisms have a higher unit value the larger they grow (such as sea-cucumber) and thus a size limit can help to maximise the proceeds from fishing. For trochus, a maximum size limit was often imposed for the opposite reason, since larger shells tend to have a lower value.

In talking about gear restrictions Steven noted that there are three basic categories: prohibitions, design limitations, and conditions of use. Most types of fishing gear are easy to define, but he raised the question of whether or not toxic substances could be classed as fishing gear. Prohibitions are usually used where everyone agrees that the gear will damage the environment and reduce the carrying capacity, such as dynamite, reef-breaking tools, poisons and even electrofishing. Additionally, some gear types are relatively non-selective and becoming controversial, such as driftnetting.

Net mesh size restrictions allow the escape of certain sizes of fish. However, such measures are most efficient in single-species fisheries or in homogeneous areas, and this is not often the case in Pacific Island fisheries. On the conditional use of certain gear, it is generally accepted that the possession of gear does not confer the right to use it, but this is difficult to regulate. It is forbidden to use nets in rivers in French Polynesia, but in the sea it is possible to restrict the way nets are set and to regulate the spacing between nets. Nets can be a hazard to navigation. They need to be marked and should not be set in busy passages.

Steven talked briefly about social reasons for limiting fishing gear and noted that this was not the preserve of biologists. He said that many factors have to be taken into account and that fisheries managers do not have an easy task. In many cases they can't even get scientists to agree amongst themselves.

Kimberley Lowe said that Hawaii is trying to limit the length of nets, which is done by eye at the moment. Was there any way of labelling or marking nets for enforcement? Steven Yen said in French Polynesia nets are only required to be marked by buoys in passages, under the navigation rules. Augustin Mobihia added that he was marking nets to quantify effort in the Papua New Guinea barramundi fishery (although results were not in yet). Nets thus marked can be inspected, and there was the possibility in future of restricting sales of nets in order to reduce effort.

Paul Dalzell mentioned that the maximum length of set for a gillnet in French Polynesia is 24 hours, and that the net cannot be reset for a further 24 hours. How difficult was this to police? Steven Yen replied that it was not actually possible to effectively enforce this at present.

Being Yeeting pointed out that French Polynesia had a multispecies fishery, and wondered if the new mesh size regulations were seen to be effective? Steven Yen said that the results had not really been seen yet, but that there were some single species fisheries, such as atule (*Selar crumenophthalmus*), where the regulations did not apply and where it might be useful to consider them. Smaller and smaller atule were reaching the market and fishermen were turning to other resources as a result, but it was also true that atule stocks go through marked changes in apparent abundance and catchability on a cyclical basis. Being Yeeting said that Kiribati was just formulating regulations, and that lots of fishermen were concerned over the likely influence of mesh restrictions on the multispecies fishery, so the justification for one overall mesh size is difficult. He would like to know what mesh sizes are allowed around the region.

Regis Etaix-Bonnin said that New Caledonia had a global restriction of 45 mm minimum mesh, but that there were exceptions where individuals could be authorised to use smaller mesh for certain single-species fisheries. However, by-catches are difficult to avoid. Steven Yen asked if there was any information on bycatch rates. Regis said that there was no quantitative information, but it was noticeable that a lot of fish being sold at the market were smaller than were likely to be caught by the minimum mesh size.

Paul Dalzell said that there was not enough information available on the selectivity of gillnets in multispecies tropical reef fisheries, and suggested that such experiments would be a useful subject for student projects, since they are not hard to carry out.

Bobby Tan turned the subject to size limits and suggested that since sea-cucumbers change size quite dramatically after capture, that size limits might be a rather inappropriate method of control for these organisms, unless there were some way of also factoring in the width of the animal. He said that Fiji had introduced a 3-inch minimum size limit obviously with good intentions, but that it was causing problems in this multispecies fishery. He had heard rumours that Fiji had now increased this minimum size limit to 5 inches. Saimone Tuilaucala said that Fiji still had a global 3 inches minimum size limit, and that this was usually applied to the dried product.

Tim Adams admitted liability for introducing this regulation to Fiji in the first place, and explained that it was calculated on the published length at sexual maturity of the major species component of the fishery at the time, blackfish (*Actinopyga miliaris*), which was the smallest species being landed in 1988. This was factored to allow for the 50% shrinkage experienced during processing into bêche-de-mer. Dr Adams stressed however, that the size limit was introduced less for biological reasons than for socio-economic reasons. It helped to maximise the value of the fishery (since bêche-de-mer unit value increases with size), it provided an unequivocal legal basis for improving enforcement (since size limit contraventions are a lot easier to prove in the courts than fishing or business licence contraventions), and it sent a strong signal to the industry that the Fiji government was prepared to do something about preventing overharvesting. Whatever its subsequent weaknesses, the size limit succeeded in more than halving exploitation the year following its introduction. In 1988, over 1,000 tonnes of bêche-de-mer had been exported, equivalent to around 10,000 tonnes of fresh sea-cucumber—way over even liberal estimates of sustainable yield.

Augustin Mobiha then presented his paper (BP 3) on the barramundi fishery in Papua New Guinea and the use of gear restrictions and size limits in its management. Barramundi are only found on the southern side of Papua New Guinea, from Indonesia to just east of Port Moresby. There is no management plan for the fishery, but some regulations have been in place since October 1983, and these were in need of review. The catch has been decreasing, with some people reckoning that this was a problem caused by the Ok Tedi mining activity, and others that it was caused by an excessive catch of juveniles in Daru. Freezer boats follow the spawning migration down the Fly River to coastal waters when the water level drops in December-February, and the juveniles migrate up the river in the rainy season in February and March.

Gear restrictions are in place together with a 50cm minimum size limit, but compliance is obviously poor since some 10-50cm individuals have been noticed on sale in Port Moresby. The two commercial boats appear to be compliant, since their licences are at stake, and the problem is in the coastal villages. They have been fishing juveniles since 1989— it is a major source of income with the population increase in Daru, where a lot of people are coming out to the coast from the interior and the Fly River. The fisheries department has an inspection and enforcement branch, but most officers are not trained and funds are limited, so offenders are rarely brought to court.

The idea now is to change the gear restrictions to cover the two peaks in juvenile migration in February-

March and August-September. It is not feasible to ban the fishery entirely, but the peak seasons can be protected, although a two year closure would probably be more beneficial to increase the spawner biomass. Instead of leaving all enforcement to government it might be better to devolve the onus of enforcing the closed season for that particular gear onto local councils.

Steven Yen commented that this provided a good example of management measures having to be taken where commercial fishers were compliant but the artisanal fishery was at fault. He pointed out that size limits were not much use when deployed alone, but had to be augmented by a closed season.

Patricia Kailola noted that barramundi can change sex, and the fishery for juveniles hits them during this sex-change, implying that not many males would be going upstream to become female. The fishery used to take 300 tonnes per year and was now virtually wiped out, with the local catch having to be substituted by imports of barramundi from Australia and hoki from New Zealand. There was an inadequacy of policing, especially of gillnetting.

Moses Amos said that unless you are given the opportunity to experiment there are always problems. One measure for reducing gillnet problems was to restrict the import of nets. Vanuatu had placed an import duty on certain nets in order to reduce effort, and there is also a requirement for a licence to use a net, whether for commercial or subsistence purposes. As well as these government restrictions there were also local measures to enforce closed seasons or to ban netting in certain areas. It doesn't eliminate small fish from being landed, but it reduces the number of people landing them.

Kimberley Lowe commented that biologists can make suggestions but they are not always workable. For example in Hawaii the fishing regulations were made with sympathy for subsistence needs, but there was no knowledge of the size of the subsistence sector. It was later found that this sector had a very substantial impact. She said that enforcement officers were often blamed for inadequacies, but that regulations were often unenforceable. It greatly help enforcement if the possession of undersized fish is illegal. She said that the contravention of some regulations was also difficult to prove in court, and that we really need more practical regulations that would link areas and seasons to the usage of certain types of gear, and do not make exemptions for subsistence if the subsistence sector is large. She pointed out that decisions can be difficult, and compliance is easier if people understand the reasons, and if they are explained by someone they respect.

Esaroma Ledua explained some problems that Fiji was having with nets. Some fishermen comply technically with the mesh size restrictions, but can construct the net in such a way that they still catch small fish, for example by slackening the net to compress the mesh. This makes the enforcement task very difficult. Saimone Tuilaula added that several different regulations apply to nets in Fiji. The hand nets typically used by women can be any mesh size. Cast nets for bait, including the fisheries for sardines and whitebait, have a minimum mesh of 1.25 inches. The minimum mesh size for general gillnets was 2 inches, but the Fisheries Division had been trying to get an increase to 3 inches through (is this through yet? Check) Cabinet for over 10 years. The law banned netting in rivers and estuaries, but enforcement was a problem despite a high number of confiscations of nets and fish. Fiji was trying to educate fishermen about the reasons behind size limits and mesh restrictions and Tui suggested that more educational materials, particularly posters, would be useful.

Patricia Kailola suggested that regulations might need to stipulate the hanging ratio of nets as well as mesh size and length, otherwise it is too easy to turn a gillnet into a tanglenet.

In summing up the session, Steven Yen said that a lot of problems had been raised and discussed, but that there was no time to work out a complete solution. One of the main points to emerge was that size limits are not a complete solution, but need supplementing by other measures.

2.3.11 Management Tools — Trade and Market Intelligence

Fatima Ferdouse was the keynote speaker and moderator for the session. There was no record of discussion during this short session, but Fatima's keynote paper is appended

2.3.11.1 Keynote & background papers

Edgar Cocker	BP052 Market Identification of Pacific Islands Seafood Products
Glenn Sant	BP069 International trade in marine invertebrates from the South Pacific
Fatima Ferdouse	KP011 Asia/pacific seafood market current situation and outlook

2.3.12 Management Policy and Regulation — Mitigating adverse short-term economic effects of management intervention: Improving returns from conventional fisheries products, novel products and new products from under-utilised resources

Steve Roberts was the keynote speaker and moderator for the session. There was no record of discussion during this short session, but Steve's keynote paper is appended

2.3.12.1 Keynote & background papers

Steve Roberts	KP009 Post-harvest Activities and their Relevance to Fisheries Management
Len Rodwell	Verbal presentation

2.3.13 Management Policy and Regulation — Modern quality assurance systems as a factor in post-harvest fisheries and trade

Vance McEachern was the keynote speaker and moderator for the session. There was no record of discussion during this short session, and Vance's keynote paper was published as BP.45 in Volume II of the manuscript proceedings.

2.3.13.1 Keynote & background papers

James Movick	BP068 The implementation of quality control in a Pacific Island fish processing company : the example of Pohnpei Fisheries Corporation
Vance McEachern	BP045 The application of HACCP in a government food inspection program - the Canadian Department of Fisheries and Oceans' experience
Y Pau Woo	BP064 (Abstract: A Regional Approach to Improving Inspection and Quality Control: The ASEAN-Canada Fisheries Post Harvest Technology Project, Phase II)

2.3.14 Management Policy and Regulation — Crisis management and emergency intervention measures: prioritisation of response

Patricia Kailola was the keynote speaker and moderator for the session. There is no record of discussion available for this session, but Patricia's keynote paper is appended to this volume.

2.3.14.1 *Keynote & background papers*

Bob Gillett	IP004 Food security in the Pacific Islands (FAO)
Moses Amos	BP037: Combination of fisheries management regulation, traditionally based management and wild stock enhancement using hatchery reared trochus juveniles as a precautionary management principle for <i>Trochus niloticus</i> resources in Vanuatu
Rick Fletcher	BP042: Investigations into the causes and implications of the wave of pilchard (<i>Sardinops sagax neopichardus</i>) deaths across Western Australia during April to June 1995 (with Jones, B)
Todd Pitlik	Verbal presentation: Decline of fishery stocks on Guam and rise of commercial fishing

2.3.15 **Management Policy and Regulation — Integrating fisheries into coastal zone management**

Andrew Smith was the keynote speaker and moderator for the session. There was no record of discussion for this session, but Andrew Smith's keynote paper is appended.

2.3.15.1 *Keynote & background papers*

Kim Lowe	BP076: The main Hawaiian Islands marine resources investigation (MHI-MRI) integrated watershed and inshore fisheries management to conserve Hawaiian coastal fisheries ecosystems
Being Yeeting	Verbal presentation: Problems of lagoon causeway construction in Kiribati
Paul Lokani	BP004: An oral account of overfishing and habitat destruction at Pororon Island, PNG
Andy Smith	KP12: Integrating Fisheries Management into Coastal Management
Rick Fletcher	BP041: Effective Management of coconut crab resources, is it possible?
Mike King	BP055: Management strategies for inshore fisheries in tropical Pacific Islands (with Fa'asili, U & Ropeti, E)

2.3.16 **Management Policy and Regulation — Pacific Island experiences**

Tim Adams was the moderator for the session, which was intended to share the day-to-day fisheries management problems and longer-term priorities of Pacific Island fisheries administrations. Participants were encouraged to skip the background details of the fishery context of their islands, which were contained in the text of their papers, but to talk particularly about their concerns. This would also be useful for the guidance of future SPC work programmes.

2.3.16.1 *Keynote & background papers*

Thierry Teai	CP01: Exposé national) Polynésie FranHaise
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Esaroma Ledua	CP07: Policies, problems, law and regulations with regards to inshore fisheries resource management in Fiji
Sione Vailala Matoto	CP18: Kingdom of Tonga country report: Status and management of inshore fisheries
Siamupini Iosefa	CP17: Fisheries management policies, laws, regulations, constraints and recommendations in Western Samoa (with E. Ropeti & A. Mulipola)
Paul Lokani	BP006: Illegal fishing for sea-cucumber by PNG artisanal fishermen in the Torres Strait protected zone.
Paul Medley	BP033: Fisheries Management in the Turks and Caicos (with Ninnes C)
Robert Jimmy	BP038: Current management policies and problems of the inshore fisheries resources in Vanuatu
Moses Nelson	Verbal presentation on Federated States of Micronesia fisheries
Kintoba Tearo	CP15: Kiribati country statement
Nena Kilma	Verbal statement from Marshalls Islands
Brendan Pasisi	CP09: Country statement - Niue Island
Louis Aitsi	CP13: Summary of coastal fisheries development and management problems in Papua New Guinea and priorities for action (with L. J. Opnai)
Sylvester Diake	CP10: Country statement - Solomon Islands
Mose Pelasio	CP12: Tokelau country statement
Peter Sharples	Verbal presentation: Pitcairn fisheries
Paul Dalzell	Verbal presentation: Nauru coastal fisheries
Kimberley Lowe	Verbal presentation: Hawaiian coastal fisheries management
Tom Graham	Verbal presentation: Northern Marianas Islands
Daniel Tahimili	CP02: Exposé du représentant du Territoire des Îles Wallis et Futuna
Ian Bertram	CP03: Cook Islands country paper: Inshore Fisheries Management Status
Regis Etaix-Bonnin	CP04: Expose national de la Nouvelle-Caledonie
Karim Beladjali	CP05: Tuvalu country statement
Suesan Saucerman	CP06: Fisheries management and conservation in American Samoa (with A. Kinsolving)
Theo Isamu	CP08: Palau country paper
Tim Adams	BP036: Research on fisheries in the Pacific Islands region (with A. Richards, P. Dalzell & L. Bell)
Paul Dalzell	BP030: Coastal fisheries in the South Pacific (with Adams, T. & Polunin, N.)
Barry D Kares	BP027: A Review on the Research and Fisheries of Barramundi, Reef fish, Dugongs, Turtles and Spanish mackerel in Papua New Guinea side of the Torres Strait

2.3.16.2 *Summary of presentations and discussion*

Tim Adams, as moderator, said that no keynote paper would be presented for this session since the time was limited, but that both BP36 and BP30 were intended to provide a regional overview of fisheries and administrations in the region. He added that Pacific Island fisheries management problems often developed rapidly, and that it was very difficult to put together an up-to-date summary without personally visiting every single SPC member every year. He foresaw that this session would be extremely helpful in

filling these gaps.

Suesan Saucerman talked about fisheries management in **American Samoa**, which is presently working under regulations which were introduced in 1990. She mentioned that these regulations were drawn up on a typical Pacific Island “seat-of-the-pants” basis since information was limited but that the department had been concentrating on collecting basic information, and running public education programmes, for the past four years. They put adverts in the newspaper and targeted the school syllabus, and there were leaflets printed in English and Samoan.

Suesan said that there had previously been big problems assessing the accuracy of information collected by staff, and one of the major issues they were tackling was to get a good handle on the volume of catch from their multi-species, multi-gear fishery. On enforcement, there had been one court case on lobster recently, but it had been settled out of court, and there was a general problem of enforcement officers concentrating on the easiest things first, particularly immigrant fishermen. This made problems such as dynamite fishing difficult to nail. It was mentioned that the regulatory process was cumbersome, with proposals going through a great number of offices and with an additional need for a 45 day public comment period. She felt that this process was good for absolute issues, but did not make for flexible fisheries management and fine-tuning. An annual proclamation process would be better.

The major problem in fisheries was overpopulation and the resultant reef degradation. The department was enumerating habitats and the effects of sedimentation on marine communities.

Ray Newnham in talking about the **Cook Islands** said that an institutional problem in the Cook Islands fisheries administration was that too much of the budget was used on staff, leaving little for operational work. There was still a problem of getting good people into useful positions, since they wanted to further their educations and careers, leading to situations like the one where an officer has been out of the country on further education for 5 out of 7½ years of employment. He mentioned that the Cook Islands had lost three people to regional organisations, and that there was now a big gap at the middle management level. The Ministry of Marine Resources (MMR) was a young department with not much experience, so they are having to train a lot of people to make up.

Geography is a specific problem in the Cook Islands, as in many other countries. The pearl industry is 700 miles away from Rarotonga; ships are rare, freight is expensive, and staff are reluctant to move away from the bright lights.

MMR is trying to develop an awareness of marine management needs. Ray noted that giving authority to local communities also means spending time consulting and talking with them, and passing information to people. He said that it was difficult to implement management plans that could deal with potential future problems, and the Cook Islands has none just yet.

Ian Bertram added some thoughts on specific fisheries in the Cooks, and said that the trochus fishery at Aitutaki seemed to be running fairly well, and that the only problem was poaching in the reserve. He thought that a few prosecutions might be needed, but that education was the best way since their appeared to be a certain amount of scepticism in the community about the results of stock estimates. The aquarium fishery in Rarotonga does not have sustainability problems, but social problems caused by conflict between groups such as dive shops and conservationists.

Ian said that the artisanal and subsistence fishery was difficult to manage. Local people think catches and mean sizes of fish have declined, and blame SCUBA fishing and gillnets, but administrations don't want to place regulations without scientific proof. We need to think of a more socially-based justification for management.

Thierry Teai then talked about experiences in **French Polynesia**. He thanked the SPC for hosting the meeting and said that it was very useful to share experiences in this way. This was his first experience as head of department and he was going home with a lot of information, but he hoped that the contacts could be maintained afterwards. Thierry described the institutions responsible for fisheries management in French Polynesia and described some of the measures in place. He noted that associations had been concerned about resource depletion and that the response had been to establish marine parks managed by the State.

French Polynesia has some wonderful lagoons, but there is big competition for access to these lagoons. He pointed out that the lag before scientific information can be provided to match the needs of management and reserves is a problem. This was a problem common to many countries, but caused particularly worry in French Polynesia.

In the artisanal fishery licences are required more for monitoring than for management, so lagoon fishermen are encouraged to group into associations so they can be reached more effectively. Thierry mentioned the Sigma Poe Rava system to address aquaculture management in the lagoons, but pointed out the problems they were having in deciding rational lagoon use and drawing up a plan for fully integrated lagoon management.

Kimberley Lowe said that **Hawaii** fisheries administrations didn't normally get a chance to talk face to face with other Pacific Island countries since they were normally represented by the federal administration of the USA. However State responsibility goes from shore to three miles for the inhabited islands, so participation in a coastal fisheries meeting like this is very useful. She said that assessment was one of their main problems. The 1940-onwards catch-effort database is only for commercial fishing and has economic analysis in mind, and incomplete assessment means that the department does not have a good basis for making a case to the public and the judiciary for management. She said that they were trying to get an idea of total catch and effort through fieldwork and creel surveys, and a lot of effort was going into this at present. Most of the personnel and funding went into commercial data, to which biologists had little access in the past, and re-prioritising management goals has been difficult since it has meant changing the habits of staff.

Kimberley said that the opportunity to sit in on the meeting had made her realise that, compared to many Pacific islands, Hawaii actually has some fairly good regulations in place. If they can persuade the public to comply with them they would probably be in a fairly good situation. However, she said that enforcement staff have trucks, not boats, and it is hard to enforce everything from the dock. The department was making efforts to collaborate more with other departments. The coastguards are giving a lot of help, and research and enforcement are working together much better now, and designing regulations that are enforceable. She noticed that Thierry Teai had given a multitude of institutional abbreviations in his talk, and noted that Hawaii has a lot as well. She also noted that educational components are built into everything now.

On the management of introductions, she said that the Agriculture Department handles inspections at the airport, but that they are having to look at discharges of ballast water since it seemed to be legally out of the loop. The National Marine Fisheries Service handles most of the pelagic fishery issues.

A major problem is reconciling conflicting use. Tourism, divers and fishermen all have different views of the optimum for habitat and environmental protection. The settlement of water rights conflicts in favour of irrigation can mean that migratory species do not get the necessary cues to enter streams. Erosion, sedimentation, and pollution in bays is another issue.

Dr Lowe suggested that there was still a big need for public fora and education, and that awareness amongst the judiciary was a priority, since they did not tend to take anything seriously that was not an immediate human problem. There was a problem with regulations going into the system and coming out changed from the original concept, and there was a need to have less consultation on certain things. The last problem was that of breaking down the political economic networks. For example, one market controls 80% of the fish, and was not noted for its cooperative attitude.

Brendan Pasisi said that **Niue** was a small island and had no fully commercial fisheries. There is only a small fringing reef and it does not go all the way around the island, so there is no potential for commercialisation and export linkages are poor. Luckily, the small population means that there are few overexploitation problems. Most resources are in good shape, but with the forced contraction of the civil service more people have had to go into fishing to make ends meet.

Niue's main fisheries institutional problem is lack of money and staff. The department relies heavily on aid, and there is not much political support for fisheries. Brendan said that there were only two fisheries staff, and that they would be happy to take some of the excess from the Cook Islands. There is no place to hide on Niue. Duties of the two staff include overseeing the coastal management plan (which extends to the EEZ boundary when Beveridge and Antioch Reefs are included), FAD deployment and supervision, licencing of foreign fishing vessels, extension, dinghy repair, research, surveillance, VHF site maintenance, the environmental impact assessment programme, and the construction and maintenance of tracks. Civil servants thus have to be extremely flexible. Attendance at overseas meetings, such as those necessary for managing the regional tuna fishery, sometimes causes problems and the department had to be closed down twice last year because of staff travel. Much of the fieldwork capability is taken up in policing safety at sea requirements, which does not leave much time for gathering information about fisheries. Most of the accumulated information got washed away when the building was hit by Cyclone Ofa. They do however have transport, in the form of a tractor.

Tokelau entered into the spirit of one-upmanship with Mose Pelasio pointing out that they only had one fisheries staff member to service three islands. Again, funding was a problem, but some of the tuna vessel licence money provided to New Zealand under the US multilateral treaty (which New Zealand devotes to Tokelau) is set aside for fisheries. The SPC/UK Integrated Coastal Fisheries Management Project was going to assist in the formulation of a lagoon fisheries management plan for one of the atolls in 1996, and this would include the setting up of systems for monitoring fisheries since there was no information currently available about the status of stocks.

Mose stressed that there was a definite need to improve the awareness of fishermen. He pointed out that he personally knows every fisherman in Tokelau—all are either friends of relatives—and that it was difficult to exert authority in this situation. However, there was no real problem with enforcement since the population is small, and traditional cultural values still hold sway. But outside influences are becoming stronger, and it might be necessary to re-potentiate traditional management.

Siamupini Iosefa said that village fisheries management in **Western Samoa** was for long mainly the preserve of the chiefs, who could impose those measures they felt necessary on the fishing grounds and resources under their control. With the establishment of the Fisheries Division, this now has overall responsibility. Most of the Division's efforts were concentrated on development at the start rather than management, and various projects were identified to utilise all of the available resources. Around 1988 there began to be worries about overfishing.

Institutional problems were similar to those described by previous speakers, particularly the limited manpower. Only 5 staff have specialised fisheries training, and there is the additional problem of losing staff to regional organisations and neighbouring islands. Western Samoa similarly has to rely a lot upon

aid assistance to fund much fisheries work. There is not much integrateion between departments in their approach to areas of common interest, such as marine reserves. The biggest present problem is that there is no management plan in place, and no regulations specifically directed towards management, particularly limitations on effort or gear, or any system of licencing. Fisheries are effectively open access nowadays, except near villages, and even this control is becoming more ineffective. He said that it had been interesting to hear the ideas expressed at this workshop on limiting effort and catch.

Although there was no representative of **Pitcairn** present (Pitcairn only has 50 or so inhabitants in its 800,000 square kilometre EEZ, and the British administration based in New Zealand does not have any fisheries staff), Peter Sharples had recently visited the territory for an SPC coastal fisheries project monitoring a trial commercial fishery, and offered to describe it.

Peter pointed out that the trial fishing trip out of New Zealand was mainly to scout for lobsters and to look at the possibilities for other fisheries, and was licenced to fish around the three uninhabited islands of Henderson, Ducie and Oeno. It was not a roaring success. Pitcairn had been hoping to identify resources and set up a commercial partnership, but resources were not sufficient for a commercial operation so distant from available markets. However, there is already effectively a commercial fishery on Pitcairn, which trades fish energetically with passing cruise boats and cargo ships. Given radio warning, Pitcairners fish up to the arrival of the vessel using the island longboat and then sell the fish to the vessel standing offshore. Asians vessels seem to prefer small red fish and US vessels prefer big fish, so some selection of the catch is practiced. In addition, some locals occasionally send frozen lobster to New Zealand.

Pitcairn is 2,000 km southeast of Tahiti. There is no air-service and the shipping service is on a 3-4 month rotation. Each home has 3 or 4 freezers, but power is only available for 12 hours per day. Although Pitcairn has a huge EEZ, they are not sure how to profit from it.

The meeting then moved away from Polynesia to consider the north/central Pacific with Moses Nelson on the **Federated States of Micronesia**. Moses said that the basic philosophy of fisheries management in FSM is managing people, and this involves a considerable focus on public awareness and education. The management activity involves all government agencies, and has links with NGO's, womens groups and church organisations. The idea is to start at the grassroots level with the educational system and build the requisite awareness into the school curriculum. He noted that the coastal resource management plans put in place some time ago hadn't really worked out and that there was a need to revive them. Resource assessment, in the sense of assessing the effects of damage to fisheries, were needed.

Todd Pitlik said that a big problem in **Guam** was that there were not many fish. The main concern was to control the spread of development, infrastructure and population growth. There are a lot of hotels in Guam and disregard of the environmental laws was rife, so there was a lot of sedimentation, runoff, sewage and pollution, and that this was probably why there was insufficient recruitment and sustainability in the fisheries. One approach they were trying was to set up marine preserves to segment remaining pristine areas.

Guam is very aware of the multiple users of marine resources, and there is the problem of conflict between sectors. A water-use master plan has just been drawn up, and an example of one of the provisions is to try to zone jet-skiers away from fishermen. There is a big recruitment of juvenile rabbitfish at certain times of year, and a small bag of little fish can be sold for 40-50\$. However, one of the jetski areas is where 50% of the rabbitfish catch is made. Todd concluded by saying that public education and awareness is a major priority for the department at the moment.

In **Kiribati**, Kintoba Tearo said that the 1979 fisheries regulations were still current, but that they were

limited in scope. There was still a major problem in the lack of knowledge about the fisheries themselves. The Fisheries Division had gathered some information over the years, particularly from questionnaire surveys, but there was still a need to put this into an overview, and particularly to have a way of getting up-to-date information. A basis for managing private-sector fisheries was through licencing. There is some question about the reliability of this data, but the licence to operate depends on this.

I-Kiribati are fish-eating people, and the subsistence sector is greater than 75% of the total fishery. It is difficult trying to reconcile the need for better fisheries management with the need for food. In common with many fisheries departments, budget is always a problem in Kiribati. Enforcement of the legislation is by the Fisheries Division in collaboration with Island Councils, and the Councils can always depend on central government for assistance. Closed seasons are implemented on Christmas Island. Geography is a major problem since the islands of Kiribati are very scattered.

The participant from the **Marshall Islands**, Nena Kilma, said that he did not have any information available to provide to the meeting, but that it might be possible to comment at a future meeting.

Theofanes Isamu introduced his description of coastal fisheries management in **Palau** with the comment that a paper had been circulated with details and that his comments would be confined to an overview. The Department of Marine Resources (MRD) was putting together a set of comprehensive national regulations and these would be used as a basis for state government to adapt to their local situations. He pointed out that government enforcement capability was very limited and that Palau looked towards local communities to assist in the task of managing their fisheries. A workshop involving various Palauan agencies was being set up to create awareness of the different responsibilities and to improve cooperation.

Theo said that MRD had been concentrating on public education quite strongly, and that environmental symposia had been held in several of the states, targetting outlying villages with brochures and videos. There was also a standing invitation to tour MRD facilities in Koror and to become aware of the programmes going on, so there would not be so much hesitation in approaching the department in future. In Palau the philosophy was not just for central government to run fisheries, but for communities and state governments to work together.

Karim Beladjali said that **Tuvalu** was not so much small as “geographically challenged”. For a fisheries officer the big problem is transport. Karim mentioned that he had been on the job for over 6 months, but had only been able to visit 4 out of the 9 islands. There were few regulations in place, but there was no real need for much hard-wired legislation since since chiefs tended to enforce management measures on each island. In fact, not many island councils seemed to know much about the written regulations.

He felt that there was no real worry about overfishing on the outer islands, but that there were problems on Funafuti, the capital. The main needs of the outer islands are more in the post-harvest area, with requirements for better salting and preserving of catches to prevent wastage and to avoid health problems. Karim emphasised that Funafuti was different, with concern about overfishing, and friction between the original local inhabitants and communities derived from other islands. There is also some commercial fishing in Funafuti, with the potential for conflict between commercial fishermen and Island Councils. The deep-water snapper exporting fishery would probably need some sort of limited entry licencing system. He was interested in the possibilities of standards such as HACCP for increasing revenue to the country.

There are a couple of operators exporting *bêche-de-mer* from Tuvalu, and there have been two deaths already this year resulting from the untrained use of hookah gear despite there being only two sets of gear in the country. The government is now proposing a ban on the use of dive gear for commercial harvesting of *bêche-de-mer*. In Funafuti a 40 km² marine park is being proposed by the Funafuti Town Council, to

be run by the community, and this will be aimed towards improving the sustainability of harvesting rather than supporting a complete ban on fishing. If it is only going to be open to local people then there is likely to be conflict.

The Tuvalu fisheries administration probably has enough people working for it, but there are few staff with relevant training and the manpower needs to be directed towards a more formal set of goals. As with all Pacific Islands fisheries departments there is a lack of funds for operational work, but there is also a lack of basic information about fisheries (including a lot of missing reports) and, as in any department which derives part of its direction and funding from development projects, a lack of continuity. One year the department might be concentrating on giant clams and the next year, seaweed. Karim noted a high turnover of personnel in fisheries research, and that training was often a path to career advancement in either in administration or in another country.

Wallis and Futuna fisheries department activities were briefly described by Daniel Tahimili, who referred participants to his paper (CP2) for more detail. There was a big problem with manpower, since there were only three staff, one based in Wallis, one in Futuna, with one secretary. The territory has largely a subsistence fishery, regulated by legislation introduced in 1994, and Daniel felt that the priority problem was a lack of knowledge about resources, particularly from the point of view of assessing the prospects of developing more income from the fisheries sector. An agreement has been drawn up with the French Government for a study to run from 1995-2000, including protection of the lagoon, development of deep-slope fisheries and EEZ development. The production of fish was 153 tonnes but there was a marketing problem.

Nauru coastal fisheries, and their management were described by Paul Dalzell since the Nauru participant could not attend the workshop. He pointed out that Nauru was small, but comparatively rich with the income from phosphate mining, and was thus out of the ordinary as a Pacific Island. The fisheries administration is part of the department of aviation, and employs two officers whose main responsibility is EEZ tuna fishery management. Even the coastal fishery is mostly devoted to pelagic fishing, particularly around the mooring buoys for the phosphate cargo ships which also fulfil the function of fish aggregation devices. Much of the artisanal fishing is done by i-Kiribati migrant workers and much of the catch goes to supplying local Chinese restaurants.

SCUBA spearfishing is also carried out in Nauru, and these fishermen have seen a reduction in the size of target species, so have gradually moved into deeper water. The Nauru Government is very aware of the fact that when phosphate stocks run out the island will need to draw an increasing proportion of its food supply from the coastal zone, and that there has been a great loss of traditional knowledge and fishing skill. Milkfish used to be cultivated in the lagoon, but no more. Future fisheries development would require improved access for fishing boats to reach the shore and perhaps more fish aggregation devices. Paul mentioned that Nauru did not seem to have any real management problems in its reef fisheries except perhaps for the SCUBA spearfishing, but this has now scaled down.

Tom Graham gave a brief rundown on **Northern Marianas** reef fisheries, where he used to work, since the Marianas was unable to send a participant to the meeting. He said that the Marianas had a lot in common with Guam, including a much higher ratio of tourism and physical development than the South Pacific Islands. In effect, developments on land were using the reef as a dump, with water quality problems and habitat degradation in general, at least on Saipan. Like Nauru, there is a good proportion of pelagic fishing, and much of the subsistence reef fishing is carried out by migrant workers, in this case from the Philippines. Saipan, like Guam, is an importer of reef fish, mostly from Palau and the Federated States of Micronesia, and it was important to note that events in Palau also had effects in the Marianas group. For example when Palau became more restrictive about exports of fish, Guam had to derive a greater proportion of its supply from Chuuk, which would probably have an effect on reef fisheries there.

Unlike the previous session, which had covered the country status reports from most of Polynesia, this session covering mainly Micronesia found itself with some time to spare for more specific questions, which was the cause of some light-hearted comment about the capacity of Polynesians for talking.

Suesan Saucerman raised the question of the use of underwater breathing apparatus for fishing, noting that American Samoa had not really started to worry about it just yet, but that the reports from other islands had indicated that there might be some cause for management concern. What was happening elsewhere?

Todd Pitlik said that the use of SCUBA gear for spearfishing was legal in Guam, but that people were having to go deeper to get fish nowadays and the old skills in free-diving were declining, so it was being considered a problem. He also noted that the use of “bangsticks” for taking humphead parrotfish was now also a problem. Theo Isamu mentioned that the use of SCUBA and hookah for fishing had been banned in Palau as a result of an investigation that looked at the sustainability of resources in the face of people from other islands introducing these methods to Palau to catch fish for export. He felt that banning SCUBA has the fundamental benefit of making it harder to overfish stocks. Patricia Kailola said that the use of hookah gear was now banned in Tonga for taking some species, but that there were problems in policing the ban. There had also been a lot of fatalities and illnesses in Tonga resulting from the use of this gear, and that to improve policing it might be a good idea to restrictively licence hookah units themselves, and put serial numbers on tanks and hookah gear. There was a need for a Tongan booklet on safe diving practices. Mick Bishop said that hookah diving was a big issue in the Torres Strait, and that it had been banned for trochus fishing, but was still required for pearl diving. Most islanders still used free-diving and most of the hookah operators were commercial, so there was some conflict. A 2-month ban on the use of hookah in November-December had been introduced and there was an agreement not to use it on home island reefs at any time. This would have been mainly on lobster.

Suesan Saucerman then posed the question, “how much is too much”? Although SCUBA fishing catches more fish, surely the fishers cannot stay down too long? Kimberley Lowe said that Hawaii has strict controls on the use of SCUBA, and that it was more efficient and quite significantly increased the total fishing power. She also noted that this really complicates stock assessments using catch per unit effort as a basis, and you inevitably underestimate overfishing unless you take into account that methods tend to become more efficient. However, crossbow fishing is becoming trendy in Hawaii now, and this is actually less efficient than spearing.

Esaroma Ledua noted that Fiji now had a total ban on the use of SCUBA and hookah for fishing, but that there was the possibility of Ministerial exemption for justified cases, which were sometimes given to people collecting funds for a village project. In such cases, the Fisheries Division has to make sure that the divers involved are certified. Noah Idechong noted that Palau has a lot of SCUBA gear and a lot of freedive fishermen, but that it was a lot easier to target spawning aggregations of grouper with SCUBA gear. Sione Matoto mentioned that Tonga had been struggling with the hookah gear issue, and that the high injury and death rate had prompted the rushing through of regulations in September 1994. A radio announcement of the ban on SCUBA and hookah for fishing was made, but it was really hard to enforce. In a meeting with the operators it was found that many had taken out loans to buy this gear and wanted a chance to recoup, so a phase-out period was introduced during which only certified divers can be used, and the gear only used for bêche-de-mer and aquarium fishing.

The following session of country statements covered the west-central Pacific. Mick Bishop spoke for the tropical coastal fisheries of **Australia** and said that although Australia is a big industrialised country, it doesn't have all the answers. Australian fisheries managers were still battling problems even though they had perhaps been at it a little longer than the Pacific Islands. He appreciated the staffing problems faced

by the islands, but commented that Australia would have to have 20,000 fisheries officers to match Niue's staffing levels in proportion to the population.

Mick said that two issues being addressed now in Australia were environment and bycatch. Fisheries management had been focussed on target species and particular gear types, but they were now having to look at much wider issues (with a concomitant increase in duties), such as marine pest introductions in bilgewater. One issue in the Torres Strait is that some people assume that there are no regulations in place, but there are actually too many. There are two administrations and too much paperwork. If you catch mackerel you need a commonwealth licence, but coral trout needs a state licence.

Politics is very big in the Torres Strait, and Murray Island is the home of the Mabo land case. The impacts of this ruling are going right across Australia, and the next big question is going to be Aboriginal rights to the sea. Artisanal fisheries are going to come to the forefront of attention. The question of autonomy, whether independence or a measure of self-government like Norfolk Island, usually gets mixed into fisheries issues when talking with people, and it is always frustrating to be criticised just because you are working for the national government.

Turtles is another topical issue, with a massive cull in Indonesia not so far away. The regulations are good in the Torres Strait where no commercial turtle fishing is allowed, but fishing in other areas is going to affect the local turtle population. One social issue is the loss of traditional skills. Torres islanders are still good seamen and free-divers, but the younger generation is less marine-oriented. Illegal foreign fishing is another problem in the Torres Strait. The problem with Papua New Guinean *bêche-de-mer* fishing has died down, but poaching from Indonesia is still rife and they can escape over the border fairly easily. The annual catch of spanish mackerel (*Scomberomorus commerson*) by the Torres Strait is 90 tonnes, but one Taiwanese gillnetter was caught recently with 80 tonnes aboard.

Esaroma Ledua said that one major problem faced by the **Fiji** fisheries administration in managing fisheries is the overlapping system of ownership in state law and customary law. Previous to the Deed of Cession to Queen Victoria all fishing was governed by customary law. The Fisheries Division also has the problem of overlapping responsibilities with other Government Departments, with whom there is often little contact. For example, mangrove areas are considered to be under the control of Forestry with respect to trees, the Lands Department when it comes to reclamation, and the Fisheries Division with respect to crabs and fish. The Water Board of the Public Works Department and the Marine Department both have a hand in aquaculture. Ledua mentioned that the main deleterious impacts on coastal fisheries come from terrestrial activities, and that fisheries managers had no control over this.

The conflicts between traditional and national law often result in a lack of compliance with regulations. The control of damaging fishing methods such as traditional fish stupeficients, poisons and dynamite, although these methods are currently localised, is a major concern. He said that there was a lack of good information in some areas, particularly about Fiji's coral reef fisheries, and that addressing this lack was going to cost the Division a lot of money, so tended to be de-prioritised in favour of crisis management. Ledua said that culture and tradition have to be taken into account in managing Fiji fisheries. The declaration of a one-year moratorium on all forms of turtle fishing, although generally endorsed, had raised a few eyebrows since turtle play a part in many Fijian ceremonies, and the Minister had had to approve exemptions for the taking of 25 turtles so far (up to June).

One of the Division's main general philosophies is to try and develop offshore fisheries to satisfy increasing needs for income, and to promote conservation of subsistence fisheries nearer shore. He hoped that SPC would be in a position to support this with scientific advice on the assessment of the coral reef fishery, and mentioned that the impact of coral collection was also in need of an up-to-date assessment. He also thanked the SPC Integrated Coastal Fisheries Management Project (ICFMaP) for being able to

assist with the management of the freshwater clam (*Batissa violacea*) fishery in 1996.

The future direction of fisheries management efforts by the Division include the development of co-management, and clarification of the roles of tradition and government, as well as the promotion of increased consultation and awareness. There also needed to be more effort put into marine reserves, which had started with an agreement between the Tui Levuka and the Ministry to set up the northern half of Makogai lagoon as a reserve in 1990. The Fish Aggregation Device programme was a major tool in the strategy to divert commercial effort offshore, and efforts would be made to enhance it, and the Fisheries Division was also putting quite a few resources into the development of aquaculture to supplement the fish supply and to reduce pressure on coral reef fisheries. The Division was presently restructuring its staff to cope.

Regis Etaix-Bonnin then introduced the meeting to the problems of coastal fisheries management in **New Caledonia**, but first described the structure of the fisheries administration. New Caledonia has 4 or 5 public bodies involved in fisheries, from the level of the State, to the Territory, to the Provinces (which are self-governing to a certain extent). The Provincial governments handle economic development, and also manage the marine reserves. The fisheries legislation was controlled by the Territory until December 1994, but is now under the Provinces, with the likelihood that new regulations will be set up, and that differences will emerge from province to province. Regis said that he would be interested to know how other countries have coped with the provincialisation of fisheries management. As in Fiji, the co-existence of western and customary law leads to regular conflict between resource owners and fishermen, and Regis said that it had been useful to hear the experiences of other countries in this area.

Getting information from isolated areas is a problem and it is difficult to manage staff in remote places. Provincial officers were having problems when they were asked to both enforce the laws and to collect information. New Caledonia does not have an overpopulation problem affecting fisheries, but there is pressure on the shoreline from tourism and there is no shoreline development plan yet in place for New Caledonia. Regis was very interested in getting some information about giant clams, especially market studies. One of their aquaculture projects had giant clam farming as a component, and an increasing number of fishermen are now interested in exporting aquarium fish, so an appraisal of the international market for these fish is needed.

In the post-harvest area, quality control for export is a problem. When the European Union and the United States of America set up standards it would be beneficial to have the regional capability to set up criteria and to give a "Pacific label" to our products, and he felt that this was something SPC could help with.

Louis Aitsi then talked about **Papua New Guinea**. The Government hopes that fisheries sector development can compensate for some of the economic problems faced by the copper mining industry, but if this development takes place in the absence of good information then there are likely to be problems. He noted that nobody around the table had actually talked about ways of economically developing reef fisheries, but had concentrated on control aspects, but perhaps Papua New Guinea was in the unusual situation of having large reef areas with comparatively little fishing going on. The Papua New Guinea fisheries department was not structured for development, and the newly-erected National Fishing Authority had been designed to promote this. The Fisheries Act had just been revised to cater for this.

PNG has nineteen provinces, and each has its own development plans and objectives, so the job of national government is difficult. Stock assessment suffers because priorities for research have to be balanced against provincial development priorities. The plan to establish a network of fisheries extension and development stations around the coast had failed because there was not enough understanding of the market and resources, however, the new National Fishing Authority was looking at development-oriented

management, and hoped to get management plans for all commercial activities. There is a major problem with information-sharing, and it is difficult to get the results of research and up-to-date prices down to fishermen.

Louis said that with the new focus on development there was a need to get stock assessment up to date and to work on management plans for overharvested resources. The Papua New Guinea fisheries administration has a big staff compared to some other Pacific Island countries, but it is still not really enough to do the job. There is a good revenue from tuna fishery licence fees, but this all goes into general government revenue and fisheries has to bid for it in competition with other sectors, such as health and education.

The Women in Fisheries Project is now well-known but it is not known what is going to happen to it now the money has run out. There is a lot of pressure to get the project going. Another specialised area is aquaculture in the highlands, but this is still in the research phase and a development aspect is lacking. However, in general, it may be that development is happening too fast for Papua New Guinea to cope.

Continuing the Melanesia round-up, Sylvester Diake said that the **Solomon Islands** held fisheries to be important not only as a source of food, but as foreign revenue. Fisheries, mainly tuna, used to head the list of Solomon Islands exports, but has just been toppled by forestry. The Fisheries Division used to spend most of its time on tuna and baitfish but is now trying to cover inshore resources as well. One problem is the policy change that comes with each change in Government, and the Fisheries Division is now trying to get a long-term policy plan set.

Use of inshore resources is reserved for Solomon Islanders, and foreigners are only allowed to do processing. The Fisheries Act dates from 1972, and is in great need of revision. It was reviewed in 1975 by FAO, but the new draft was not approved after dispute over the question of reef ownership. A new revision has recently been drafted. However, the Minister can still make regulations, and there are likely to be a lot more changes in the 1990's.

Recent issues include turtle, where the Solomon Islands used to be the second biggest exporter of turtle shell after Cuba, and where the regulations have been changed to allow customary use, but not sale or export. 3-4,000 turtles were being taken per year and this was thought to be unsustainable. Also, the main market in Japan started to abide by CITES, and there was less incentive for export. Unfortunately the proposed regulations for the trochus industry were thrown out because it was felt that the government would have a monopoly, and the management of this fishery has reverted to the minimum size limit alone.

Some work has been carried out in the Solomons on pearl shell, but lack of funding and staff expertise has limited these. Most of the research has come from outside, and has found that pearl shells are overexploited, particularly by hookah divers, and there is now a ban on the export of raw *Pinctada* shells (but not including *Pteria penguin*). The new regulations have also banned the export of coconut crab, and introduced a 9cm minimum size limit. Regulations to protect crocodiles were also made after a survey found only a small population, and that near extinction from the export of skins. The idea is that if this resource can be protected then the animals can be farmed using tuna cannery waste as feed.

Coral sand extraction in customary fishing areas is now controlled, and licence fees had been reviewed in view of the depreciation of the Solomon Islands dollar. Enforcement of the fish hygiene regulations had been a problem. The Town Council could not assist so these regulations were not amended, and no regulations have been made concerning bêche-de-mer and greensnail since the Division does not have the information to make meaningful changes.

Sylvester pointed out that the drawing up of these regulations had been a protracted, frustrating business

because there was only one legal expert available for the task.

The participant from **Tonga**, 'Ulunga Fa'anunu, did not want to be repetitious since the SCUBA fishing problem had already been covered, and a paper in an earlier session had described most of the issues in the country. However, he re-iterated that the open access nature of the fishery in Tonga considerably narrowed down the options for management. Scarcity of funding meant no money for extension, so public education was difficult. Many people think that since fish were created by God that they have a God-given right to take them, and that attitude needed some work to alter, particularly in the outer islands. One other issue not covered so far was the need to get better management in place on bêche-de-mer and Tonga was interested in a follow-up survey on the Ha'apai bêche-de-mer surveys of 1984 (JICA) and 1990 (SPC) to get an idea of the effects of recent harvesting.

'Ulunga announced that the Tonga JICA aquaculture project was planning to hold a workshop in November 1995 and that they would be interested in getting full participation from other Pacific Island countries. He also mentioned the need to address the subject of women in fisheries, and asked if SPC could help coordinate this.

Moses Amos pointed out that **Vanuatu's** problems were much the same as other countries, and that most of the details were written down in the Vanuatu country paper. However, particular problems were faced in policing violations of the fisheries regulations, and the high competition between buyers for available stocks of trochus and greensnail. Also, some resources had no assessments on which to base management, such as bêche-de-mer, for which a 35 tonne total allowable export volume was in place although with little scientific justification.

Some training was needed for enforcement officers, who for example occasionally failed to recognise that berried female crustaceans were being included in export shipments. He said that fishing licence holders were not screened for previous violations and that not many commercial operators gave in catch returns. Bêche-de-mer processors were skipping from one area to another, and there wasn't a good knowledge at each site about proper processing methods. He mentioned one recent case where 2.5 tonnes of spoiled bêche-de-mer had to be thrown away. On institutional matters, Moses said that a lot of skilled fisheries staff had been sacked after the recent national strike, and they were having to take on new people, often untrained.

Moses said he was currently working on restructuring the six provincial sets of regulations. These would probably limit the number of licences, proscribe certain types of gear, and perhaps increase import duties. More stock assessment was needed, and village communities needed to be brought even further into the management process.

Discussion

The last part of the session allowed time for free discussion of any points that had arisen during the consideration of problems on a country-by-country basis, chaired by Noah Idechong.

Tom Graham said that one issue that seemed to crop up again and again was the old problem of the lack of complete congruence between state law and customary practice. Some countries wanted to make regulations flexible enough to cope, but were frustrated by the cumbersome legislative process and the ignorance of politicians, whilst others were trying to give authority to the community level and avoid the legislative process entirely. These appear to be two different, incompatible directions, so where should we strike a balance? Tom had no answers, but felt that it was important to acknowledge that Pacific Island fisheries management agencies were being pulled in two different directions. He also felt that building up extension and community outreach programmes could help, since the better grasp you have of public

perception, the better you can decide what will be effective.

Moses Nelson felt that it was difficult for a regional agency meeting of this kind to consider matters of staffing and funding, and to address the purely national issue of institutional management. However, the chairman suggested that it was possible for countries gathered together to discuss shared problems of this nature, and learn from each other's ways of coping with them. He noted that SPC had been asked to assist several countries in human resource development and departmental policy planning and that assistance from regional organisations could be another medium for sharing experiences as well as meetings.

Kimberley Lowe wondered how to decide at which level the fisheries management system should be formalised and suggested that perhaps marine tenure was the key. She pointed out that sometimes the legal issues take over the entire debate, and the actual goal behind the regulations is lost sight of. In Hawaii the state controls waters up to the 3 mile limit and the federal government thereafter. Usually the different levels of government negotiate and decide which one will manage the fishery, but sometimes there is a joint authority so each has some measure of control.

Louis Aitsi said that the 19 provinces of Papua New Guinea had authority out to 3 miles, but the national government was still responsible for research and surveillance in this area whilst the provinces were responsible for development. The new Fisheries Act covers all of this, with the provincial governments able to have their say in national processes. The common forum is the National Fisheries Council. There was a problem with the long chain of command but he felt that the effort was worthwhile.

Moses Nelson said that he sympathised with the problems faced by New Caledonia in maintaining effective fisheries management through the provincialisation process, and that the Federated States of Micronesia had yet to find a happy medium. He said that he didn't have any answers, but made two points:- that the owners of the fishery resource have to be identified before any responsibility for management can be assigned; and that it is important to identify funding responsibility for subsequent management activities.

Sylvester Diake added that the Solomon Islands also had a provincial system where the Province held authority out to three miles, but that national regulations applied across the board. There really needs to be approval from all levels before development can take place, and there are sometimes problems when provinces are given more powers.

Being Yeeting said that Kiribati had conflicts between state law and tradition, and traditional resource custodians often see Government as going over their heads. He suggested that the first priority is to give some power back to local communities.

Ray Newnham illustrated this with an example of a conflict between government and community interests the previous month in the Cook Islands. The Manihiki lagoon is controlled by the Island Council, but of the seabed below high-tide mark is Crown Land, and this is legally under the purview of the Ministry of Marine Resources. A lagoon monitoring programme is being set up by MMR at Manihiki with ADB assistance. The Cook Islands contribution to the construction was to be the land to site the laboratory and some construction materials. When the Island Council gave permission to use the land, the Ministry sold one of its trucks to raise some money for the project and shipped the building materials over to the island over a period of 5 months. However, some people objected to this land being used, and to trees being cut down, and the Island Council found it very hard to make a decision on the matter with an election just coming up. Luckily the issue was resolved recently, and Ray pointed out that there was no simple solution to the Government/customary difference of priorities. Each country has to find its own balance.

Robert Jimmy raised the subject of the aquarium fish trade and the use of cyanide in this fishery that had

been noted in the Philippines. Did anyone have any problems with other fishing methods harmful to the environment?

Saimone Tuilaucala first wanted to take the discussion back to the issue of state versus traditional management of inshore resources. He pointed out that customary marine tenure had worked out very well in some countries, but that it was a very sensitive political issue so he didn't want to dwell on it too long. The discussion might take up a whole week! He felt that the main issue was the need for consultation at all levels, and public education.

On the matter of priorities for action at the regional level, he said that SPC needed to concentrate on resources that were being pressured by the export market, including giant clam, aquarium fish and coral, and that a great deal of information was lacking on some of these fisheries. He said that these were problems common to almost all countries represented around the table and that stock assessments were needed so that fisheries officers could get back to resource owners and advise them. He added that turtle was a particularly worry, and that Fiji had banned commercial exploitation of these reptiles. He urged other countries to do the same if they had not already done so.

He pointed out that there were problems with fishing gear apart from SCUBA and hookah, particularly gillnets, and that women's fisheries should be a high priority. He hoped that SPC could find more funding to visit other parts of the region under this project. He said that inshore fishery enforcement was mainly a national issue, but that FFA was of great assistance in legislative drafting. Post-harvest issues were another area where SPC could assist, since the regional agency capacity for sharing experiences between countries was one of its strengths. He pointed out a specific need for a comparative economic analysis of the various aquaculture projects around the region, since several departments were putting a lot of efforts into this.

On the training of future fisheries managers Tui said that human relations skills were a priority, but also leadership training. The approach should be to train trainers so they could pass on this knowledge to villagers.

Noah Idechong pointed out one of Palau's policies that it might be useful to share with the region. He said that Palau had had a very strong export of reef fish for some time. Tourism was increasing but the population was very dependent on fisheries and had been pushing fish exports heavily to earn money. Noah felt that it was time to cut down on exports and to start thinking about encouraging more tourism to earn money. Palau is considering phasing out exports and reserving fish for local consumption over the next 5-10 years, meanwhile adding value and a "Made in Palau" quality label scheme. The idea would be to maximise the value of fish through the local market instead of in the export market. He added that Palau might otherwise soon have exported all its fish and have to start importing from Yap.

Moses Amos returned to the subject of damaging fishing methods, and suggested that a recommendation should come out of this workshop to ban all use of Hookah and SCUBA gear for fishing. He then talked about institutional issues for a while and said that Vanuatu, unlike many other countries, does not have much of a problem turning around the tuna boat licencing revenue derived from the USA multilateral treaty in the budget, and was able to use this to avoid too heavy a reliance on the capabilities of the regional agencies. However, Vanuatu still had only 4 fisheries research officers for the entire country. Enforcement costs were reduced by bringing CMT into play, and luckily the Vanuatu constitution gave full support to this:- a measure that is not so easy to bring into play in other countries. Provincial governments have their own internal provisions to fund resource management through local licence revenue, and Moses said that the provinces had even agreed to devote \$5,000 per year to resource assessment. This was very helpful. He felt that basic legislation was always necessary, but that the ultimate key was education about resource-users relationship with the environment.

Sione Matoto said that the real problem was the fear of the unknown. This workshop was assisting participants to look at resource management and preventing over-exploitation, but people still needed economic advancement, and there was a big problem in persuading departments to change tack. When there was a fear of the unknown, then research is needed to reduce the unknowns. Coming back to Robert Jimmy's comment about damaging fishing methods, he suggested that the use of cyanide to catch fish should definitely be banned, even pre-emptively, and that a conservative approach adopted. He also suggested that the region needed a study on how to integrate the different levels of management.

Kintoba Tearo said that he didn't want to burden a discussion with a listing of Kiribati problems, which resembled those in many other countries. But one thing he was surprised about was the fact that no-one had raised the issue of ciguatera fish poisoning.

Todd Pitlik said that we know what ciguatera is caused by, and there are a lot of studies going on, but it is still a very delicate issue. Certain areas are more affected than others, and there are a lot of rumours going around. For example some people think that fish going up rivers will cleanse themselves. There is an issue of getting good information out to the public.

Tim Adams said that ciguatera had not come onto the agenda since the agenda had been organised to consider different fisheries management measures rather than specific resources or issues, but that there were opportunities for ciguatera to arise during country papers and discussion. He added that the SPC Inshore Fisheries Research Project had looked at ciguatera in some depth over the period 1989-94, including fieldwork in Pohnpei, the setting up of a special interest group newsletter and the compilation of a ciguatera poisoning case-history database. However, the main feeling to come out of this work was that ciguatera was not a big concern over most of the region perhaps since most of the fish caught are consumed by the family that caught it, and local ciguatoxic areas and seasons and high-risk species are fairly well known. There were definite problems areas, such as Niutao in Tuvalu, and in areas where fish were transported from one part of the country to another and where commercial sale severed the linkage between local knowledge and consumption. Local communities in many countries managed ciguatera problems by closed seasons for certain species in certain areas, but governments sometimes stepped in to place moratoria on known ciguatera "hot-spots" (such as the recent example in Rarotonga), or to restrict the sale of certain species (such as the ban on selling certain fish in Fiji municipal markets). He pointed out that the general lack of response to IFRP requests for ciguatera information from most countries had led SPC to drop this as an active work area, but that maintenance of the database and occasional publication of the newsletter would continue.

Moses Nelson said that there was a need to train middle managers, but that there was little follow-through from the regional level. Too many people were elevated from the technical level to management without training, and most of the training available was technical. Andrew Smith said that training had been discussed in depth during the first week of the workshop, before Moses had been able to arrive, and the discussion had indicated that whilst such training was very desirable, there were a lot of under-used opportunities available at the national level. Andy was of the opinion that the training carried out by regional agencies cannot really help with the longer term issues, and that there needed to be a national commitment, perhaps with bilateral assistance.

Being Yeeting returned to Noah Idechong's explanation of Palau's new move to phase out fish exports, and agreed with the general philosophy of trying to maintain local food supplies but pointed out that there are several non-subsistence fisheries which are purely for export, such as bêche-de-mer and trochus shell, and it should still be possible to generate export income from these. On ciguatera, he understood that there was no practical way of testing for ciguatoxin in fish right now, but felt that James Cook University was promoting the right approach through the workshops run by Ursula Kaly. The recent course in the Cook Islands was mainly to promote public awareness, and the transfer of knowledge to the people in the

vernacular was a good way of dealing with this. There was a reduction in poisoning cases during the workshop.

Richard Farman said that a survey in New Caledonia had showed that 75% of people wanted information about ciguatera, but that only 4% of people did not fish because of ciguatera. A comprehensive revision was now being produced by ORSTOM based on information from an older SPC document (Bagnis, 1973, "Fish poisoning in the South Pacific"). Richard said that it was difficult to decide how precise to be. A lot of fish are only occasionally ciguatotoxic in certain areas at certain times, and the more you write down the more you put people off eating fish, so the brochure was made fairly general, and tried to explode some of the myths. It is probably most effective to put the onus on the fish traders: make them responsible, but help them with all the available information.

Richard then returned to day one of the workshop, when the participants had discussed the reasons for managing (or not managing) fisheries, and to Daniel Pauly's concept of *triage*. He pointed out that the workshop still hadn't identified any stocks that don't need to be managed at all, although the meeting was clearly of the opinion that the need for direct government intervention could be mitigated when community management was taken into account. He pointed out that most Pacific Island government fisheries managers are also tasked with development of fisheries, and that some threatened resources don't just need management but complete protection. He agreed with the participants from Fiji and Tonga that we need better information on stocks which are, in Pauly's terms, the "walking wounded". These also need to be identified for each country. Very many potential management methods had been discussed at this workshop, and each one can help in different cases. He hoped that a guide could be produced to discuss which stocks are best managed by which methods. One matter which would need to be taken further at the regional level was the question of how to manage things which are outside your jurisdiction, like larval sources.

Finally, all these units have to be re-assembled to relate to traditional management, and government has to coordinate this to provide national coherence. Somebody has to make sure that decisions made by one group will not affect another group.

3 Conclusion

3.1 *Final session and recommendations*

Noah Idechong was the moderator for this session, which was to round off the workshop..

Although the workshop was not intended to formally agree any priorities for regional action, a number of miscellaneous points arising during the course of the meeting were endorsed in the final session as follows:

1. A special interest group and newsletter on live fish export fisheries (including both fish for food and organisms for aquaria) will be set up under the SPC Fisheries Information Project. Bob Johannes and SPC will collaborate to edit the first issue.
2. One of the priorities for research in support of the improved management of live serranid export fisheries is a practical estimate of the percentage of the stock that can be sustainably harvested.
3. In view of the likely dependency of recruitment and replenishment of some reefs and reef-fisheries from distant areas, the regional importance of different "sinks" and "sources" of larvae need to be assessed on a national basis.

4. A priority for research is the development of rapid appraisal techniques to assess the potential and status of coastal fisheries stocks in general. The following are major needs:-
 - i. the development of basic estimates of the **area** of fishing grounds (“suitable habitat” or “biotope”) for different species in each Pacific island;
 - ii. the collection of existing and new information on catch rates and yields of different species under different levels of fishing pressure, using different gear, in different areas, to improve indicative baseline information on the way that stocks respond to exploitation;
5. All marine species introductions and transfers to or from Pacific Islands should be based on the guidelines agreed by SPC member countries at the 1994 Regional Technical Meeting on Fisheries and endorsed by the subsequent South Pacific Conference (and available from SPC). In all cases the precautionary principle should be followed in guiding decisions, and in all cases the onus should be on the introducer to meet all the costs incurred by the national Government in making a decision whether or not to allow an introduction.
6. For largely export fisheries, such as trochus and bêche-de-mer, a comprehensive and up-to-date source of intelligence is needed on the status and forecast for their markets, particularly in East and South East Asia. This trade seems to be too small for international agencies to devote much effort to, but is extremely significant to many of the small nations of the Pacific and thus to regional agencies.
7. There is a need for a regional organisation to consider maintaining a register of international entrepreneurs and operators engaged in marine product exporting from the Pacific Islands, to improve the ability of national fisheries managers to appraise the likely compliance of companies engaged in commercial coastal fisheries;
8. The possibility of developing a set of regional seafood quality standards should be investigated, and an appropriate plan of action for introducing modern quality assurance procedures, such as HACCP or QMP, for Pacific Island nation exports should be developed;
9. When addressing the sustainable management and development of coastal fisheries, the broader management aspects need also to be taken into consideration, preferably within the general framework of the Integrated Coastal Management concept.

Some of these broader aspects include, but are not limited to:-

- i. Habitat degradation or destruction
- ii. Coordination and cooperation with other sectors (including Government, the private sector and local communities)
- iii. The major rôle that women play in carrying out coastal fisheries in the Pacific Islands, and thus the need to assess their catches, take into account their impacts, and to harness their knowledge and community decision-making potential;
- iv. The concepts of co-management and governance

10. Pacific Island fisheries managers should always consider the possibility of the **complete ban** in their armoury of management tools, particularly if pre-emptive action can be taken in time to stop people investing in equipment. Candidates might include:-
- i. a ban on the use of any kind of underwater breathing apparatus for certain types of fishing;
 - ii. banning the use of fishing methods that damage or reduce the carrying capacity of the environment;
 - iii. a ban on certain commercial export fisheries, particularly those that take the same species as a local food fishery. Local subsistence nutrition, and the development of foreign exchange earnings through non-extractive uses of resources may be a better national economic option.

The recommendations are reproduced above in their final form, after several drafts and considerable discussion of the concepts and wording during this final session. It was stressed by the meeting that these recommendations were not necessarily for the sole guidance of the South Pacific Commission, but for all national and regional organisations of the Pacific Islands region to follow up or implement, as appropriate.

Moses Nelson asked if the findings of this workshop could also be reported to the SPC Regional Technical Meeting on Fisheries, the Forum Fisheries Committee, and the SPREP governing body meeting, since he felt that all present would like to see the results elevated to a higher level of attention, and the opportunity given to all organisations to incorporate relevant points into their work programmes. Moses also said that it was not often that Pacific Island countries were able to get together to talk about inshore and national fisheries issues, since almost all of the regional fisheries meetings were concentrated on the management of the region's tuna stocks, and that it would be beneficial to hold a regular meeting of this kind, say, every three years.

Finally the representative from Fiji, on behalf of all the participants, thanked the South Pacific Commission for hosting the meeting, and the financial sponsors, and closed the session with a word of prayer. The chairman mentioned that the bar was open.

4 Further action

It cannot be claimed that the workshop was a success in achieving its ultimate goal of completely clarifying the types of management measure that should be applied to different Pacific Island fisheries, but the workshop was certainly a very worthwhile exercise for all concerned, and clearly charts a path ahead.

Far more information was submitted than had originally been imagined possible, and discussion was always vigorous, but it almost requires another workshop to draw firm conclusions from the various topics considered. However, the workshop succeeded in its aim of bringing together the new generation of Pacific Island fisheries managers to learn from each other's experiences and assess the relative strength of the ideas of different experts, and will have a great bearing on the direction of future fisheries management-related research and development in the region. SPC was able to hear the views of its member countries, both individually and regionally, and now has a better idea of where to concentrate its coastal fisheries management advisory efforts.

For the immediate future, the SPC Coastal Fisheries Resource Assessment Section and Post-Harvest Section are working together to implement the UK-funded Integrated Coastal Fisheries Management Project, whose major activity, apart from running this workshop, is to carry out detailed case-studies in the development of coastal fisheries management plans in 6 SPC member countries during the period September 1995 to August 1997. Apart from these pre-programmed sub-projects, which were finalised during the course of the workshop after a round of project submissions earlier in the year, the SPC Coastal Fisheries Programme Resource Assessment Section and Post-Harvest Section retain their facility for responding to all requests from member countries for advice and information about the management of inshore fisheries. In addition, we welcome enquiries from others within and outside the region in our capacity of providing a medium for contact between researchers and Pacific Island fisheries administrations.

Under the SPC Fisheries Information Section, we will continue to publish reports, case studies and special interest group newsletters. The latter include 6-monthly issues on Bêche-de-mer, Trochus and other shells, Pearls and pearl shell, Ciguatera, Traditional fishing methods and management, Fisheries Training, and now Live fish export fisheries, and details can be obtained from the Fisheries Information Adviser, Jean-Paul Gaudechoux, at the SPC address below.

For the less immediate future, it is hoped that funding, time and collaborative opportunities will be available to address some of the other recommendations of the workshop, particularly the production of a "handbook" on Pacific Island coastal fisheries management, and also the development of rapid appraisal techniques to assess the potential and status of coastal fisheries stocks in general. Some issues that SPC might follow up, such as the development of a register of marine product exporters (and perhaps live grouper fishing boats), a service to provide trade information or latest export prices, the development of regional seafood quality standards (with perhaps a South Pacific quality product label) and the feasibility of a regional regime for managing larval sources, will require decision at the SPC's governing body, South Pacific Conference, after discussion at the SPC Regional Technical Meeting on Fisheries. These will also need to be discussed in the context of the work programmes of other regional agencies, particularly the Forum Fisheries Agency (FFA) and the South Pacific Regional Environment Programme (SPREP) to avoid potential overlap, although the extent to which FFA could carry out some of these coastal fisheries trade-related tasks is unclear now that the agency is consolidating its efforts into tuna fisheries management.

The background and country papers tabled at the workshop have already been published with minimal editing, as a limited number of manuscript volumes for the benefit of SPC's list of deposit libraries, and

copies, whilst still available, can be obtained from the Fisheries Resource Adviser, South Pacific Commission, BP D5, 98848 Nouméa Cedex, New Caledonia (Fax +687 26.38.18, email: TimA@spc.org.nc). Those keynote addresses that were presented in writing are appended to this report, whilst the keynote addresses that were presented only in verbal form are paraphrased in the body of the text.

5 Acknowledgements

The main organisers and editors of this report would like to thank all the participants for taking part in the workshop and imparting their views, in addition to thanking the well-oiled administrative machine that takes the burden off the programme officers in organising all large SPC meetings.

Special thanks must go to Jean-Paul Gaudechoux for taking notes; to Maeve Michel, who made light of the task of juggling dozens of itineraries and pre-paid travel orders; to the translators, interpreters and specialist secretarial staff who made it possible to run the proceedings for the benefit of SPC's two main language groups, to the Project Assistants who handled the miscellaneous meeting administrative duties (particularly Marie-Thérèse Bui, who was lumbered with the responsibility of being meeting secretary, and first point of approach for all participant enquiries, as well as all the administrative work during the long run-up to the meeting); to the SPC Publications Section for producing a vast number of copies of nearly 100 papers (some in two languages, and some only submitted at the workshop itself); to the SPC Finance Section for handling the accounts (particularly the gorgeous Nicole Milot for handling the participants' per-diems during breaks in the proceedings).

We would like to thank the SPC Maintenance Section for providing impromptu bar-service during the entertainment functions, including the redoubtable André Blom, who organised tea breaks and stayed late in the evenings to clear up the meeting room; the Procurement Office for organising the victualling; the many Fisheries Programme staff members who gave up their quiet evenings around the log fire to man the SPC bar every night; to Jean-Claude who runs the bus to and from the airport; and last, but not least, Phill Hardstaff for running the PA and translation equipment in the meeting room.

This meeting was run under difficult circumstances, since the SPC secretariat was half-way through moving to the new headquarters across the road, so it is to the credit of all that it was a success.

6 Appendices

6.1 Appendix 1 — Agenda

SPC/FFA Inshore Fisheries Management Workshop			
Day	Time	Topic	Session leader/Keynote
Mon 26 Jun	0830-1000	Registration and opening formalities	Secretariat
	(0900-0920)	Secretary-General's welcome	
	(0920-1945)	Meeting procedures & secretariat messages	
	(0945-1000)	Group photograph	
	1000-1030	Coffee break - 30 mins	
	1030-1200	Introduction - Approval of session leaders, setting of evening sessions, organisational	Secretariat
	1200-1330	Lunch break - 90 mins	
	1330-1500	The foundation:- Why and when is fisheries management intervention	Daniel Pauly
	1500-1530	Coffee break - 30 mins	
		1530-1700	The foundation:- Why and when is fisheries management intervention
	Evening	Free	
Tue 27 Jun	0830-1000	Management Information Needs and Sources:- Stock Assessment (1)	John Munro
	1000-1030	Coffee break - 30 mins	
	1030-1200	Management Information Needs and Sources:- Stock Assessment (2)	John Munro
	1200-1330	Lunch break - 90 mins	
	1330-1500	Management Information Needs and Sources:- Stock Assessment (3)	John Munro
	1500-1530	Coffee break - 30 mins	
	1530-1700	Management Information Needs and Sources:- Stock Assessment (4)	John Munro
	Evening	Secretary-General's Cocktail Party	
Wed 28 Jun	0830-1000	Management Tools:- Closed seasons (1)	Richard Farman
	1000-1030	Coffee break - 30 mins	
	1030-1200	Management Tools:- Closed seasons (2)	Richard Farman
	1200-1330	Lunch break - 90 mins	
	1330-1500	Management Tools:- Quotas and restricted entry (1)	Mick Bishop

	1500-1530	Coffee break - 30 mins	
	1530-1700	Management Tools:- Quotas and restricted entry (2)	Mick Bishop
	Evening	Demonstrations of Computer Programs and databases for fisheries stock	
Thu 29 Jun	0830-1000	Management Information Needs and Sources:- Assessing human and financial needs and allocating responsibilities for	Hugh Walton
	1000-1030	Coffee break - 30 mins	
	1030-1200	Management Information Needs and Sources:- Assessing human and financial needs and allocating responsibilities for	Hugh Walton
	1200-1330	Lunch break - 90 mins	
	1330-1500	Management Tools:- Protected Areas, Sanctuaries and reserves (1)	Paul Holthus
	1500-1530	Coffee break - 30 mins	
	1530-1700	Management Tools:- Protected Areas, Sanctuaries and reserves (2)	Paul Holthus
	Evening		
Fri 30 Jun	0830-1000	Management Tools:- Protected Areas, Sanctuaries and reserves (3)	Paul Holthus
	1000-1030	Coffee break - 30 mins	
	1030-1200	Management Information Needs and Sources:- Feedback to and from fishermen, vessels and the fishing	Nick Rawlinson
	1200-1330	Lunch break - 90 mins	
	1330-1500	Management Information Needs and Sources:- Feedback to and from fishermen, vessels and the fishing	Nick Rawlinson
	1500-1530	Coffee break - 30 mins	
	1530-1700	Management Information Needs and Sources:- Feedback to and from fishermen, vessels and the fishing	Nick Rawlinson
	1530-1700	Special Session:(for relevant SPC member country representatives): - Integrated Coastal Fisheries Management Project - discussion of	Dick Beales
	Evening	Free	
Sat 1 July		Free	
Sun 2 July	1200-1600	Special Session: (for UK project administration only) ICFMaP Year 1	Malcolm MacDonald

Mon July	3	0830-1000	Management Tools:- Ownership (including Marine Tenure and Resource Customary Individual	Bob Kearney
		1000-1030	Coffee break - 30 mins	
		1030-1200	Management Tools:- Ownership (including Marine Tenure and Resource Customary Individual	Bob Kearney
		1200-1330	Lunch break - 90 mins	
		1330-1500	Management Tools:- Enhancement of Stocks and Introduced Artificial	Johann Bell
		1500-1530	Coffee break - 30 mins	
		1530-1700	Management Tools:- Enhancement of Stocks and Introduced Artificial	Johann Bell
		Evening	Free	
Tue 4 July		0830-1000	Management Policy and Regulation:- Mitigating adverse short-term economic effects of management intervention:- Improving returns from conventional fisheries products, novel products and	Steve Roberts
		1000-1030	Coffee break - 30 mins	
		1030-1200	Management Tools:- Collecting trade and market intelligence to establish current and potential trade	Fatima Ferdouse
		1200-1330	Lunch break - 90 mins	
		1330-1500	Management Policy and Regulation:- Modern quality assurance systems as a factor in post-harvest fisheries and trade	Vance McEachern
		1500-1530	Coffee break - 30 mins	
		1530-1700	Management Policy and Regulation:- Modern quality assurance systems as a factor in post-harvest fisheries and trade (2).	Vance McEachern
			Round up discussion session on the role of post-harvest fisheries in Inshore Fisheries	Steve Roberts
		Evening	Barbecue, with SPC staff	
Wed July	5	0830-1000	Management Tools:- Size limits and gear restrictions (1)	Stephen Yen
		1000-1030	Coffee break - 30 mins	
		1030-1200	Management Tools:- Size limits and gear restrictions (2)	Stephen Yen
		1200-1330	Lunch break - 90 mins	
		1330-1500	Management Policy and Regulation:- Pacific Island experiences (1) Polynesia	Tim Adams
		1500-1530	Coffee break - 30 mins	

	1530-1700	Management Policy and Regulation:- Pacific Island experiences (2)	Tim Adams
Thu 6 July	0830-1000	Management Policy and Regulation:- Pacific Island experiences (3) Melanesia	Tim Adams
	1000-1030	Coffee break - 30 mins	
	1030-1200	Management Policy and Regulation:- Pacific Island experiences (4) Discussion	Noah Idechong
	1200-1330	Lunch break - 90 mins	
	1330-1500	Management Policy and Regulation:- Crisis management and emergency intervention measures - prioritisation of	Patricia Kailola
	1500-1530	Coffee break - 30 mins	
	1530-1700	Management Policy and Regulation:- Integrating fisheries into Coastal Zone	Andrew Smith
Fri 7 July	0830-1000	Management Policy and Regulation:- Integrating fisheries into Coastal Zone	Andrew Smith
	1000-1030	Coffee break - 30 mins	
	1030-1200	Conclusion:- Discussion of recommendations	Noah Idechong
	1200-1330	Lunch break - 90 mins	
	1330-1500	Conclusion:- Clearing of recommendations	Noah Idechong
	1500-1530	Coffee break - 30 mins	
	1530-1700	Free	
	Evening	SPC Staff club	Julian Dashwood

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6.3 *Appendix 3 — List of papers*

COUNTRY PAPERS (note - these were published in Volume I)	Paper number
Exposé national) Polynésie française	CP. 1
Exposé du représentant du Territoire des Îles Wallis et Futuna	CP. 2
Cook Island country paper: Inshore fisheries management status	CP. 3
Exposé national de la Nouvelle-Calédonie	CP. 4
Tuvalu - country statement by K. Belhadjali	CP. 5
Fisheries management and conservation in American Samoa by S. Saucerman & A. Kinsolving	CP. 6
Policies, problems, law and regulations with regards to inshore fisheries resource management in Fiji by E. Ledua	CP. 7
Palau country paper by T. Isamu	CP. 8
Country statement - Niue Island	CP. 9
Country statement - Solomon Islands by S. Diake	CP. 10
Country statement - Marshall Islands	CP. 11
Tokelau country statement	CP. 12
Papua New Guinea - Country paper Summary of coastal fisheries development and management problems in Papua New Guinea and priorities for action by L.J. Opnai & L. Aitsi	CP. 13
Vanuatu - Country statement Current management policies and problems of the inshore fisheries resources in Vanuatu by R.A. Jimmy	CP. 14
Kiribati - country statement	CP. 15
Guam country paper	CP. 16
Fisheries management policies, laws, regulations, constraints and recommendations in Western Samoa by A. Mulipola, E. Ropeti & S. Iosefa	CP. 17
Kingdom of Tonga country report Status and management of inshore fisheries	CP. 18

BACKGROUND PAPERS

(note - these were published in Volumes I and II)

Paper number

- Are tropical nearshore fisheries manageable in view of projected population increases?
by P. Craig BP. 1
- Stock assessment and status of the ornate lobster *Panulirus ornatus* in reef areas of
Torres Strait fished by Papua New Guinea divers BP. 2
by C. Evans & P. Polon
- The management of the coastal barramundi fishery in the Western Province of Papua
New Guinea BP. 3
by A. Mobiha
- An oral account of overfishing and habitat destruction at Pororan Island, Papua New
Guinea BP. 4
by P. Lokani
- Fisheries and management of beche-de-mer fisheries in Western Province of Papua New
Guinea BP. 5
by Paul Lokani, Philip Polon and Ray Lari
- Illegal fishing for sea cucumber (bêche-de-mer) by Papua New Guinea artisanal
fishermen in the Torres Strait protected zone BP. 6
by P. Lokani
- Optimisation of yield of *Pristipomoides filamentosus* from the Tongan seamount
fishery by changing size at first capture BP. 7
by C. Mees & J.A. Roussouw
- Ocean culture of giant clam in Tonga BP. 8
by S. Sone & T. Lotoahea
- Biological survey and resource management of mullet in Tonga BP. 9
by T. Kimura & 'U. Fa'anunu
- Lobster fishery in Tongatapu island group, Tonga : management options and their
economic impact to the fishery BP. 10
by K. Udagawa & 'U. Fa'anunu
- The present status of introduced trochus and green snail in the Tongatapu Island group BP. 11
by K. Kikutani, 'U. Fa'anunu & N. Manu
- A reef reseeded program for giant clams: Do they work and do they use the limited
resources wisely? Using Yap State, F.S.M. as a model BP. 12
by S. Lindsay
- Management of the Cook Islands black pearl industry: the structure and some issues BP. 13
by R. Newnham
- The aquarium fishery in the Cook Islands. Is there a need for management? BP. 14
by I. Bertram
- Current paradigms in trochus management and opportunities to broaden perspectives BP. 15
by R. Clarke & J. Ianelli

Fisheries resource management development by stock enhancement in Okinawa by J. Isa	BP. 16
Sedentary resource management in Onna Village, Okinawa by S. Kakuma & Y. Higa	BP. 17
Assessing the management needs of a coral reef fishery in decline by S. Saucerman	BP. 18
Technological innovations and multidisciplinary approaches for sustainable mariculture development for Pacific insular settings by R. Clarke	BP. 19
La protection du milieu marin et la gestion des stocks exploités par C. Chauvet	BP. 20
Traditional and commercial use of the marine resources in the Warrior Reef (Torres Strait Protected Zone) Papua New Guinea by Paul Lokani	BP. 21
Community perception of changes in coral reef fisheries in American Samoa by F. Tuilagi & A. Green	BP. 22
Artisanal fisheries development in Papua New Guinea))a concept for project implementation by P. Jarchau, R. Hermes, R. Nagai & B. Kaupa	BP. 23
Fisheries ecology of the white banana prawn <i>Penaeus merguensis</i> in the Gulf of Papua: estimates of sustainable yields and observations on trends in abundance by C. Evans & L. Opnai	BP. 24
Results of investigations into aspects of the ecology of the mudcrab, <i>Scylla serrata</i> (ForskΔl) in Western Province, Papua New Guinea by R. Lari	BP. 25
Fisheries data collection in the New Guinea Islands Region, P.N.G. by C. Hair	BP. 26
A review on the research and fisheries of barramundi, reef fish, dugongs, turtles and Spanish mackerel in Papua New Guinea side of the Torres Strait by B. Kare	BP. 27
Research and management of the industrial prawn fishery of the Gulf of Papua by C. Evans, L. Opnai & B. Kare	BP. 28
A survey of the distribution and apparent abundance of recruit-sized prawns <i>Penaeus</i> <i>merguensis</i> and <i>P. monodon</i> in the Gulf of Papua, during the 1995 closed season, 1st February to 15 March by C. Evans, L. Komoru, K. Kumilgo, B. Kare, M. Tatamasi & L. Baule	BP. 29
Coastal fisheries in the South Pacific Islands by P. Dalzell, T. Adams & N. Polunin	BP. 30
Dynamics of the deepwater snapper <i>Pristipomoides</i> resource and fishery in tropical Australia	BP. 31

by D. Ramm	
The beche-de-mer fishery in Tonga by P. Kailola, W. Petelo & R. Gillett	BP. 32
Fisheries management in the Turks and Caicos Islands by P. Medley & C. Ninnes	BP. 33
The Aitutaki experience in the development of management strategies for the trochus fishery (Cook Islands) by I. Bertram	BP. 34
Managing Palau's aquarium life fishery by T. Graham	BP. 35
Research on fisheries in the Pacific Islands region by T. Adams, A. Richards, P. Dalzell & L. Bell	BP. 36
Combination of fisheries management regulation, traditionally based management and wild stock enhancement using hatchery reared trochus juveniles as a precautionary management principle for <i>Trochus niloticus</i> resources in Vanuatu by M. Amos	BP. 37
Fisheries management in the Lesser Antilles by B. Chakalall	BP. 38
Case study: the application of traditional management on trochus fishery in Vanuatu by R. Jimmy	BP. 39
The role of women in the management of Pacific Island inshore fisheries by P. Tuara	BP. 40
Effective management of coconut crab resources, is it possible? by W. Fletcher	BP. 41
Investigations into the causes and implications of the wave of pilchard <i>Sardinops sagax neopilchardus</i> deaths across Western Australia during April to June 1995 by R. Fletcher & B. Jones	BP. 42
Use of computer simulation models and quotas to manage the Albany pilchard fishery of Western Australia by W. Fletcher	BP. 43
Estimating the demersal lagoonal fish stock in Ouvea, an atoll of New Caledonia by M. Kulbicki	BP. 44
The application of HACCP in a government food inspection program - the Canadian Department of Fisheries and Oceans' experience by V. McEachern	BP. 45
Federal-state cooperation in managing inshore deepwater bottomfish in Hawaii by K. Simonds	BP. 46
Something old something new: an approach to obtaining fisheries management information from a remote Pacific atoll by P. Dalzell & A. Smith	BP. 47

A potential environmental fisheries production model for banana prawns in Kerema Bay and the Gulf of Papua by C. Evans	BP. 48
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Case study of fishery interaction in a Pacific Island country: Kiribati by J. Hampton, T. Lawson, P. Williams & J. Sibert	BP. 59
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Management strategies for inshore fisheries in tropical Pacific Islands by M. King, U. Fa'asili & E. Ropeti	BP. 65
Coping with the live reef food fish trade in the eastern Pacific Islands by R. Johannes & M. Riepen	BP. 66
Regional approach to improving fish inspection and quality control: the ASEAN) Canada Fisheries Post Harvest Technology Project, Phase II by Y. Pau Woo	BP. 67

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International trade in marine invertebrates from the South Pacific by Glenn Sant	BP. 69
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Customary ownership of sea areas and resources with respect to the management of baitfisheries in Solomon Islands and Fiji by N. Rawlinson	BP. 72
The inshore resources of Western Samoa: coastal inventory and fisheries database by L.P. Zann & A. Mulipola	BP. 73
Recent advances in the ageing of coral reef fishes by D.McB. Williams, S.J. Newman, M. Cappo & P.J. Doherty	BP. 74
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The main Hawaiian Islands marine resources investigation (MHI-MRI) integrated watershed and inshore fisheries management to conserve Hawaiian coastal fisheries ecosystems by M.K. Lowe	BP. 76

KEYNOTE PAPERS

("a" = abstract)

Marine protected areas and inshore fisheries management in the South Pacific region by P. Holthus	KP. 1a
Stock assessment and biological information needs by J. Munro	KP. 2
Enhancement of marine fisheries by J. Bell	KP. 3a
Closed seasons: how necessary? by R. Farman	KP. 4
Inshore fisheries management by means of size limits and fishing gear regulations by Steven Yen	KP. 5
Restricted entry and quotas by M. Bishop	KP. 6a

Value-adding in the seafood industry by C. Davis	KP. 7
Deciding financial and human resources for fisheries management by Hugh Walton	KP. 8
Post harvest activities and their relevance to fisheries management by Steve Roberts	KP. 9
When is fisheries management needed? by D. Pauly	KP. 10
Asia/pacific seafood market current situation and outlook by Fatima Ferdouse	KP. 11a
Integrating fisheries management into coastal management by A. Smith	KP. 12
Feedback from the fishing community by N. Rawlinson	KP. 13
Resource ownership: customary marine tenure and individual transferable quotas by R.E. Kearney	KP. 14
Crisis management and emergency intervention measures - prioritisation of response by P. Kailola	KP. 15

6.4 *Appendix 4 - Text of available keynote Papers*

Information is presented here as available. Not all keynote talks at the workshop were represented by written keynote papers, and the last-minute submission of many papers meant that translation into the second language was not possible during the timeframe of the workshop (mitigated by the fact that there was simultaneous translation of everything said during the workshop itself). Consequently this Appendix consists of a *mélange* of information.

6.4.1 Keynote paper for “Why and when is fisheries management needed” session

When is fisheries management needed?

Keynote Paper 10 by

Daniel Pauly

International Center for Living Aquatic Resources Management and University of British Columbia

ENGLISH ABSTRACT

Following a brief review of the global fisheries crisis, a medical concept - triage - is used to distinguish three types of fisheries, those that are (a) autonomous and healthy, i.e. may not require external management inputs; (b) affected by modern resource decline problems, or resource access conflict, or (c) impacted by resource depletion or socioeconomic ills of a magnitude beyond that which can be addressed by dealing with the resource base, and its direct users. It is suggested that fisheries management (sensu stricto, or extended to include co-management), can best deal with fisheries in (b), but not necessarily with those in (c). A few ideas - some perhaps new, most recycled - are then presented on how new governance arrangements may deal with fisheries in (c), and lead to sustained resource utilization even in areas where there is no official capacity to formulate and/or enforce detailed fisheries legislation.

When is fisheries management needed?

By Daniel Pauly

Introduction

Given the sorry state of the world's fisheries (Garcia and Newton, in press), and their even gloomier prospects if business continues as usual, no one will contest the need to rethjink the way fisheries are managed. There are many calls for this (e.g. Christy 1993, Beddington, 1995). Indeed, we might have to rethink the way we *think* about management including perhaps the way we define it. The literature contains many definitions of fisheries management; in spite of their differences, however, most share enough features to be put into two subsets *viz.*

(i)

6.4.1 Keynote paper for “Stock assessment and biological information needs” session

Stock assessment and biological information needs

Keynote Paper 2 by John L. Munro
ICLARM (International Center for Living Aquatic Resources Management)

ENGLISH ABSTRACT

The need for systematic stock assessment programs of South Pacific marine resources is emphasized and it is pointed out that the increasing demand for seafoods, linked to the growing economic power of China and other part of south-east Asia, will place great demands on stocks of exportable seafoods and at the same time offer economic opportunities.

The range of fish stock assessments which can be undertaken as a prelude to management is reviewed and the data requirements and methods available for data analysis are discussed. Past work in tropical fisheries has resulted in the creation of a good foundation of knowledge about many aspects of the biology of the most important species and well-established methodologies exist for almost all aspects of parameter estimation and are embodied in a number of freely-available computer programs.

Les besoins en matière d'évaluation des stocks et de données biologiques

Document présenté par John L. Munro
ICLARM (Centre international pour la gestion des ressources aquatiques biologiques)

RESUME FRANCAIS

*Ce document souligne la nécessité de mettre en place des programmes systématiques d'évaluation des stocks; l'accroissement de la demande de produits de la mer associé au renforcement de la puissance économique de la Chine et d'autres pays d'Asie du sud-est exercera **B** l'avenir une forte pression sur les stocks de produits exportables et offrira dans le même temps de nouvelles perspectives économiques.*

*Les différentes études d'évaluation des stocks qui peuvent être entreprises en prélude **B** l'adoption de dispositions de gestion sont exposées ainsi que les besoins en matière de données et les méthodes d'analyse. Les travaux réalisés par le passé sur les pêches tropicales permettent de disposer de connaissances solides dans de nombreux domaines de la biologie des espèces ainsi que de méthodes reconnues d'évaluation, méthodes qui se présentent sous forme de programmes informatiques faciles **B** obtenir.*

Stock assessment and biological information needs

by John L. Munro

International Center for Living Aquatic Resources Management

1. INTRODUCTION

Why is there a need for stock assessment? Anyone who is not clear on the answer is advised to read the paper entitled “Stock assessment. Why ?” by the late John Gulland (1983a) who shows most clearly why assessments are most beneficial. However, there are varying levels of stock assessment, requiring progressively more detailed and hence more expensive datasets and the primary question to be answered by any fishery manager relates to the level of exploitation of the fish stocks under his or her control. Are the stocks under- or overexploited. If they are underexploited, how much additional development is permissible, or wise? If they are overexploited, what can be done to rationalize the situation and optimize the harvests? How to you decide what is optimal? How will any resulting benefits be apportioned.

We know that most nearshore fish stocks close to population centers in the South Pacific are already heavily fished and that even areas under customary marine tenure will come under heavy fishing pressure as populations increase within the local communities.

An additional concern is the “China factor”. The entry of China into the free market economies and its great rate of industrialization and concurrent increase in wealth and purchasing power is going to vastly increase the demand for seafoods and other marine products, with significant impacts on the demands for exports and on prices. Similar developments have already taken place in much of south-east Asia. The effects of increased purchasing powers are already visible in the trade for *bêche-de-mer*.

The “China factor” provides both threats and opportunities. Poor management will lead to decreased production affecting both food security and national wealth. Good management will mean that high-valued stocks will be available for export, bringing increased prosperity and food security. However, good management requires accurate stock assessments, based on biological, economic and social data for the whole fishery. This means that data acquisition systems must be in place, on a permanent or near permanent basis. This means spending money and governments need to be shown the value of the fishery to the country, in comparison with agriculture or forestry. Fishery officers must be able to see the value of the data collection systems so that they take the work seriously. Correspondingly, data collection systems must be carefully designed so that they produce all of the required information at minimum cost. They must be cost effective, they must not produce useless information such a catch statistics for part of a fishery, aggregated landings for, say, all groupers but no information about which species of grouper are the most important.

2. STOCK ASSESSMENTS

The range of assessments which can be made of the status of a fishery range from the most elementary evaluations based on limited data sets to enormously complex assessments of the interacting fishing stocks in major ecosystems (Beverton and Holt 1954, Ricker 1958). Reviews of the range of options are given by Gulland (1969), Munro (1980), Caddy and Csirke (1983), Gulland (1983b), Pauly (1984) and Munro and Fakahau (1993).

Table 1 summarizes the possibilities in terms of data needs. The data requirements range from a single year of landing statistics not necessarily sorted by species, for a fishery operating at different levels of intensity within a homogeneous habitat, to detailed monthly catch and age or size frequency statistics for all species in a fishery sorted by gear or mesh size, accompanied by precise estimates of growth, mortality

and selection parameters and a detailed understanding of ecosystem functioning. The usefulness of the end result increases up the scale but there is, for each fishery, a cost-effective mode or point, beyond which further effort is not justified. In terms of the national value of the fishery the first task is to find this optimum point. However, for many small island developing states (SIDS) the starting point is close to zero. There is an urgency to rectify this situation and assess and manage fisheries. Neglect costs money in terms of decreased gross national product and needless expenditures on foreign exchange.

Table 1. Options for stock assessment systems, arranged on a scale of increasing costs of implementation and analysis.

Fishing intensity/total biomass surplus yield curves	Munro & Thompson 1973
Yield per recruit assessments	Beverton and Holt 1957
Conventional surplus yield analyses	Schaefer 1954, Fox 1970
Yield/ mortality surplus yield analyses	Csirke and Caddy 1983
ECOPATH	Christensen & Pauly 1992, 1996
Virtual Population Analysis	Gulland 1965
Cohort analysis	Pope 1972
Length cohort analysis	Jones 1974
Multispecies Virtual Population Analysis	Christensen in prep.

3. DATA ACQUISITION AND MONITORING SYSTEMS

3.1 Ecosystem information

3.1.1 Bathymetry and habitats

The first requirement for stock assessment is not biological; it concerns the physical extent of the fishery grounds, their bathymetry and the relative amounts of different habitats. It is often surprising to find that fishery departments have no detailed information on this topic. Yet the accumulated information on yields of fish and invertebrates per unit area relative to fishing intensity, (fishers/km²) is one of the simplest guides to the harvests which could potentially be taken. The availability of cheap global positioning systems and recording echo sounders make it very easy to update or elaborate existing charts. Furthermore, in addition to direct observations by scuba divers, all depths can be examined by towed or lowered video cameras, free or tethered robot vehicles or by manned submersibles. In short, accurate information is now attainable at relatively low cost.

3.1.2 Catch and community composition

The species of fishes and invertebrates which inhabit the various habitats must be known to a reasonable degree. Certainly, that knowledge must include all of the species which are important to the fishery, but should also include a good understanding of the community as a whole, including unfished or unexploitable groups.

Additionally, it is becoming clear that a knowledge of the composition of the diets of the principal species in the fishery or fisheries is of great importance in understanding the interactions between species and the effects of fishing on the ecosystem.

Routine systems for monitoring oceanographic and meteorological information should also be in place as this can provide the key to the resolution of unusual phenomena such as fish kills, red tides and recruitment failures. Strong winds can be solely responsible for poor landings and consequent price increases, but without records the information can be lost. Electronic systems for routine recording of

meteorological and oceanographic parameters are also readily available at modest cost.

3.2 Catch and effort statistics

The need for catch statistics is widely recognized and the level of sophistication varies according to the plans of their end users. Two common problems with catch statistics is that the catches of different species are often aggregated. This point is of great importance, because it is far better to know details of the catches of, say, the twenty most important species in a particular fishing gear than to have data about catches that have been aggregated at the generic or family level. Aggregation renders the statistics almost useless for stock assessments. Likewise, aggregation of catches caught by different gears will also vastly diminish the utility of the statistics.

Total numbers of fishing gears of different sorts and sizes need to be monitored and any seasonal changes in deployment and use need to be known. Labor utilization by the various fisheries also needs to be known.

The need is therefore to design catch and effort data acquisition systems with clearly defined analytical objectives in mind. If this is not done the result is often a mass of data, gathered at great expense, which cannot be easily used for any management purpose.

3.3. Socio-economic data

There is also a need for monitoring of fish prices, and externalities such as the cost of fishing gears, fuels, import duties, exchange rates and other factors which bear on the cost of fishing. The cost of fish relative to other products is also an important factor.

The social context in which the fishery operates must also be very clearly understood. The ultimate goal of stock assessment is the management of the fishery to optimize benefits to the nation and the fishery community. Management systems manage fishers not fish.

3.4 Biological data collection

A primary decision in biological data acquisition concerns the degree to which commercial, artisanal or subsistence catches will be used to provide data. The degree of difficulty is less when a large commercial fishery is studied as sampling can be arranged to ensure that dockside operations are not unduly delayed or obstructed. Also, large samples are available, sub-samples can be taken for otolith examination and the origins of the catch will be known in detail. In contrast, the small-scale nearshore, multispecies fisheries typical of the South Pacific provide limited catches of each species and sampling operations can easily interfere with the marketing of the catch, the catch can often be from a mixture of fishing gears, and the fishers normally will not permit fish to be mutilated for otolith removal or stomach content analysis. In other cases, fish are gutted at sea and yield no data on foods.

As a result, in studies of small scale fisheries it is often essential to mount routine experimental fishing programs such as that advocated by Munro (1983), Munro & Fakahau (1993) in which various standardized fishing gears are routinely used to sample the stocks, on a year-round basis. This approach has been used in the trawl fisheries of the Gulf of Thailand, yielding the only really good time series of such data for the entire region (Pauly 1979). Ideally, the gears used should include some units which sample stocks at a size before they are normally recruited to the fishery.

If a routine experimental fishing program is to be mounted, further opportunities arise. Davies (1989) and Newman (1990) have shown that excellent rates of return can be obtained by using Antillean fish traps to

capture, tag and release a wide variety of reef fishes. Dart tags are used and, when properly applied, seem to have very good rates of retention. Returns might come from the experimental program or from the fishery. Rawlinson (1989) found that a small lottery based on tag return numbers was sufficient incentive to persuade fishers to turn in tagged fish. Other incentives coupled with the lottery could include the purchase of intact tagged fish at a premium price and active involvement of the fishers in the program by means of newsletters and posters.

Age determination based on collection and examination of otoliths of tropical fish species is now proving fairly rewarding in sub-tropical areas (Ferreira and Russ 1992). However, in the central tropics annual rings are usually not found (Longhurst and Pauly 1987) and recourse must be made to length frequency data or the examination of daily rings (Ralston and Williams 1988).

For biological sampling the minimum requirement is a detailed breakdown of the numbers and total weight, and hence the mean weight, of each species in a catch in a specific gear. Additionally, length-frequency data from all, or a large random sub-sample of the catch is required. If it is feasible, otoliths or scales can be obtained for a subset of the measured fishes and gut contents and gonad stages can be examined, either qualitatively or on a quantitative basis (Munro 1982).

In many fisheries, estimates of population numbers or biomass can only be indirectly derived from stock assessment analyses. The exceptions are where the area fished is known, (for example, the area swept by trawls), where stocks can be surveyed by sonar or where underwater visual censuses (UVCs) can be done by scuba divers. There is a lot of uncertainty attached to such estimates.

In particular, it has recently been found that there is no relationship between UVC data and catch rates in a Fijian coral lagoon handline fishery, casting doubt on the usefulness of such surveys relative to the larger fishable components of such stocks (S. Jennings, in press).

Monitoring of settlement and abundance of pre-recruits is routinely done in some fisheries such as those for the West Australian rock lobster (Phillips et al 1984), and for various Gulf of Mexico penaeid shrimp stocks, principally in order to forewarn the fishing community of the expectations in terms of new recruits. This is particularly important when the bulk of the catch is taken in the year immediately following recruitment. The simple expedient of routinely sampling with a mesh or gear size which will take pre-recruits can give valuable data in all fisheries.

4. BIOLOGICAL DATA ANALYSIS

4.1. Morphometrics

All relevant morphometric relationships must be defined at an early stage, males and females separately, and with the estimates based on the widest possible range of sizes, taken in all months of the year. Depending upon the nature of the fishery the inter-relationships between length, weight, gutted weight, ripe gonad weight, otolith weight etc will be needed. Additionally, relationships between length, girth, maximum body depth and width will be needed in order to understand gear selectivity.

4.2. Selectivity

Length and age frequency data, combined with morphometric data, can provide most of the essential data for determining the selective characteristics of fishing gears. Clearly bell-shaped selection curves generated by gill-nets, hooks and other gears which retain a restricted range of sizes are more difficult to estimate than the open-ended curves generated by trawls, and seines. Traps probably represent an intermediate situation on which there is often, in fact, an upper size limit to what can enter a trap. In practice, in any heavily exploited

fishery, upper limits can be ignored as few fishes survive to reach such a size. As shown in Fig 1, combined probabilities of capture for an assortment of fishing gears will generate a need for correction of length-frequency samples.

4.3. Growth rates

The well known techniques of estimating growth rates from scale or otolith readings (Jearld 1983) or from mark-and-recapture data (Wydowski and Emery 1983) will not be elaborated here. The pitfalls which must be avoided and the need to base estimates on the results of several methodologies are emphasized, because it is clear that stock assessments are very sensitive to such estimates. Data should be examined for evidence of seasonality of growth as this is common, even in the tropics (Fig 2) (Pauly 1984, Pauly et al 1995).

4.4. Mortality rates

As in the case of growth rates, mortality rates can be estimated on the basis of age or length frequencies, or from mark and recapture data. Additionally, given accurate growth and selectivity data the mean weight of individuals in the catch gives an estimate of total mortality (Gulland 1983).

However, separating the mortality rates into its natural (M) and fishing-induced (F) components remains a great challenge, indeed probably one of the weakest points in modern fishing science. The bland assumption that natural mortality (M) is a constant cannot be upheld in the face of accumulating evidence that it is both size-related and related to the relative abundance of predators.

Figure 1. Calculated selection curves for *Hampala macrolepidota* in 2.5 cm (1") to 10 cm (4") mesh gill nets and the summed probability of retention in the combined fleet of nets (from Munro et al 1990)

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Figure 2. Modal progression analysis of length data for a tropical fish species, showing seasonality of growth (from Longhurst and Pauly 1987).

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Length-converted catch curves derived from sampling with small meshed nets or traps and which thus incorporate as catches of prerecruits provide a means of separating M and F (Munro 1984, Moreau 1988), particularly for gears such as fish traps or trawls (Fig 3).

Where unexploited stocks exist, length or age samples will provide invaluable data on natural mortality rates; estimates which will otherwise only be obtained by elaborate indirect methods.

4.5. Stock biomass and numbers

Given accurate catch statistics and biological parameters (K, Loo, M, F) there is little difficulty in back-calculating stock biomass and numbers in retrospect. However, estimating current stocks requires additional information on recruitment and this can only be gained from direct sampling of settlement and/or pre-recruit abundances.

5. DATA ANALYSIS AND STOCK ASSESSMENTS

Having acquired the requisite data the next, or preferably ongoing, task is to analyze the data. Advances

in this area have been remarkable, paralleling the development of calculations and computers. Pauly's "Fish population dynamics in tropical waters: A manual for use with programmable calculators" was published in 1984 (Pauly 1984). Within less than two years it was out of date, in that the routines could all be executed on a microcomputer. That is not to say that the effort was wasted, the text remains one of the most lucid expositions available on stock assessment methodologies.

Many of the fisheries laboratories in developed countries have advanced in-house data analysis systems, but not necessarily widely available, portable or well documented. Packages that are available include FISHPARM (Saila et al 1988), the complete ELEFAN (Gayanilo et al 1989) and, recently, FiSAT, the FAO-ICLARM Stock Assessment Tools, which have resulted from the merging of various FAO and ICLARM packages (Pauly and Garcia 1994; Gayanilo et al 1996).

FiSAT provides routines for fitting growth curves to length frequency data, for analysis of length at age, growth increment data, mortality rates, recruitment patterns, probabilities of capture and virtual population analysis. Additionally, conventional yield/recruit (Fig 4) or biomass/recruit analyses and Thompson & Bell Y-S predictions can be made.

Supplementary programs include simulation of length frequency samples, sample weight estimation, predictions of maximum length from extreme values, estimation of growth performance indices, and a full range of regression analyses including Schaefer and Fox surplus production models. FiSAT operates under DOS. A Windows version will appear in due course.

Sissenwine and Shepherd (1987) developed a system whereby the yield per recruit and surplus yield concepts can be converged, based upon the concept of spawning-biomass-per-recruit (Fig 5).

The trophic flows in an ecosystem (Fig 6) can currently be evaluated using ECOPATH II (Christensen and Pauly 1992), which provides an insight into the trophic relationships and interdependencies in an exploited ecosystem or community. A much more sophisticated Windows version, ECOPATH III has recently come available and can cope with the uncertainty associated with parameter inputs (Christensen & Pauly 1996), while a version which includes simulation modelling (Walters et al., in press) is in preparation).

Bioeconomic models remain few, although the FiSAT system does allow values to be included in the yield analyses. BEAM IV, produced by FAO, is available but reported to be difficult to manage. A multispecies bioeconomic model (GBMS) is under development at ICLARM but has not yet been tested in a variety of situations.

Figure 3. Examples of length-converted catch curves for the estimation of mortality rates from length-frequency data (from Munro 1988).

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Figure 4. Yield isopleth diagram derived from yield per recruit analysis (from Munro and Fakahau 1993)

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Figure 5. The relationship between yield per recruit and surplus production models as developed by Sissenwine and Shepherd (1987). Redrawn from Punt (1993).

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Figure 6. An example of a trophic model of a seagrass bed and reef flat, constructed using the ECOPATH modeling approach and software (from Pauly and Christensen 1994).

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Many of the growth parameters and natural mortality estimates required for these studies may be found in FishBase 96 CD-ROM, the computerized encyclopedia of fishes, along with a vast amount of other information on the fishes of the South Pacific (Froese and Pauly 1996).

Even virtual population analysis (VPA; Gulland 1965; Pope 1972; Jones 1974) may become accessible. The single-species versions (both age- and length-structured) are e.g., available as FiSAT routines, while a simplified, length-structured version of multispecies VPA has recently been developed (Christensen 1996).

6. CONCLUSIONS

The conclusions of this paper are simple. The tools and methodologies exist, are free or very inexpensive and there is a pressing need to implement stock assessment programs in all tropical nearshore fisheries. The failure to do so will be costly in the medium term and disastrous in the longer term.

Finally, the pace of tropical fishery science has been moderate. Despite very limited inputs, progress has been made. There is now a good foundation of knowledge which provides guidance on the validity of estimates of growth and mortality parameters and of expectation in terms of harvests per unit area. The point is now to build on this foundation

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6.4.2 Keynote paper for “Closed Seasons” session

Périodes de fermeture: sont-elles bien nécessaires? (Version Français)

(Original: Français)

par Richard Farman

Service de la Mer, Province Sud, Nouvelle-Calédonie

I. Introduction

Quand un jeune étudiant en halieutique aspirant à devenir celui par qui les stocks seront harmonieusement gérés lit dans son manuel de première année que: "Les pêcheries ont été réglementées pour des raisons politiques, sociales, économiques ou même fantaisistes et parfois pour des raisons biologiques." (Everhart, Eiper et Young, 1975), il a de quoi être quelque peu déconcerté.

Pourtant, quelques années plus tard, quand il accède à la fonction suprême où il peut présider à la destinée des espèces dont la principale qualité est d'avoir une valeur marchande, il est forcé de constater le bien fondé de cette petite phrase.

Comment en effet, dissocier la gestion et donc la réglementation des espèces de leurs pêcheries? Dès lors que le facteur humain intervient, il faut prendre en compte les aspects politiques, sociaux et économiques de l'activité de pêche en respectant autant que faire se peut les contraintes biologiques des espèces ciblées. Quand bien même la Science (avec un grand S) aurait toutes les réponses aux questions du décideur.

C'est donc dans cette optique que je vous propose de passer en revue l'utilisation des périodes de fermeture dans la gestion des pêcheries.

II. Bien fondé de la mesure

La principale raison invoquée pour l'instauration d'une période de fermeture est la protection d'une espèce pendant une partie de son cycle, notamment pendant la saison de frai ou au moment du recrutement: il s'agit de protéger l'espèce pour qu'elle ait le temps de se reproduire ou d'atteindre la taille marchande avant d'être capturée.

En fait, pour bon nombre de poissons très prolifiques, la Science a démontré qu'il n'y avait pas de relation entre le stock parental et l'abondance de la population (jusqu'à un certain seuil de densité) mais que c'était la survie de la progéniture au stade adulte qui importait (Everhart, Eiper et Young, 1975). Les conditions environnementales plutôt que la mortalité par pêche sont donc le facteur déterminant l'abondance d'une population. Le prélèvement d'un individu avant, pendant ou après qu'il se soit reproduit revient donc exactement au même. Empêcher la capture pendant la saison de frai n'a alors d'autre effet que de limiter l'effort de pêche.

De la même manière, si l'espèce modifie son comportement pendant la période de frai et qu'elle devient plus vulnérable à la pêche, la fermeture de la pêcherie peut être décidée pour éviter que des captures trop importantes soient réalisées durant cette période. Cela revient néanmoins au premier cas de figure, à savoir une diminution de l'effort de pêche.

Munro et Fakahau (1986) soulignent à ce propos que les fermetures saisonnières ont le même travers que les quotas en ce sens qu'à moins de connaître l'abondance des nouvelles cohortes, on risque fort avec une fermeture "figée" de surpêcher les mauvaises années et par contre laisser perdre une grande partie du

stock disponible quand le recrutement est particulièrement bon.

Par ailleurs, ces mêmes auteurs remarquent que cette mesure entraîne l'oisiveté des pêcheurs et dans, le cadre de pêcheries plurispécifiques, la sous-utilisation d'espèces associées qui ne nécessitent pas de protection. Les périodes de fermeture peuvent donc avoir des effets néfastes sur l'emploi, l'utilisation des infrastructures B terre ou l'utilisation des bateaux (Munro et Fakahau, 1986).

Dans ces conditions, déclarer une période de fermeture revient B mettre en place une mesure conservatoire en espérant que l'on protège suffisamment un stock pour assurer sa survie mais sans vraiment savoir si cela correspond B l'utilisation optimale¹⁶ de cette ressource. Cela ne ressemble guère, on en conviendra, B de la gestion maîtrisée.

Une première série de questions pourrait donc être posée B ce stade de l'exposé, dirigée principalement vers le monde scientifique:

Q: il y a-t-il vraiment lieu de fermer la pêche pendant les périodes de frai ou toute autre période?

et son corollaire:

Q: il y a-t-il des espèces pour les quelles cela se justifie plus que pour d'autres (ex.: espèces grégaires)?

Compte tenu de remarques précédentes sur les fermetures en période de frai, il semblerait qu'en ce qui concerne la fermeture pendant la période de recrutement, d'autres mesures telles que la protection de nurseries ou des limites de tailles seraient plus efficaces.

Toujours dans les pêcheries pluri-spécifiques, la protection d'une espèce par rapport aux autres n'est effective que si les individus concernés qui sont capturés accessoirement aux espèces autorisées peuvent être relâchés vivants.

Par ailleurs, dans le cadre d'une pêcherie professionnelle, l'application de la mesure de fermeture peut être contrôlée par le biais de la commercialisation mais pour ce qui est des captures des pêches vivrières ou plaisancières, il est beaucoup plus difficile de les appréhender et donc de les contrôler.

Or une mesure n'a de valeur que si elle est appliquée...

D'autre part, cette mesure peut entraîner une modification du comportement de certains pêcheurs qui iront "faire l'ouverture" alors qu'ils ne pêchent pas ou peu le reste de l'année (ex.: pêche récréative). L'effort de pêche peut donc être artificiellement élevé après la période de fermeture, ce qui irait B l'encontre de l'effet escompté.

On peut B ce stade également ouvrir le débat avec les questions suivantes dirigées cette fois-ci B l'ensemble des participants:

Q: est-ce que l'instauration de périodes de fermeture se résume uniquement au contrôle de l'effort de pêche?

et

¹⁶ Par optimale on peut entendre économiquement ou biologiquement ou les deux...

Q: est-ce une mesure envisageable et effective par rapport B d'autres méthodes (facilité de contrôle, compréhension des pêcheurs...)?

Enfin, il faut également noter qu'une fermeture saisonnière peut être déclarée pour des raisons d'hygiène, notamment pour les organismes filtreurs tels que les huTtres qui peuvent devenir toxiques pendant les périodes d'explosions phytoplanktoniques.

Forts de ces réflexions, essayons de passer en revue quelques exemples dans la région et j'invite les participants B apporter leurs propres contributions - ou critiquer la mienne si mes informations sont erronées...

III. Quelques exemples dans le Pacifique

Les périodes de fermeture sont utilisées de manière traditionnelle ou contemporaine dans le Pacifique.

Un des exemples les plus notoires concerne la gestion des stocks de troca et de bêche-de-mer B Ontong Java. La communauté toute entière a décidé d'alterner l'exploitation de ces deux espèces d'une année sur l'autre. Ce concept de fermeture annuelle, si il ne repose pas sur des impératifs biologiques précis et ne constitue pas forcément l'utilisation optimale de ces ressources, illustre parfaitement le concept qui consiste B limiter l'exploitation pour qu'il reste toujours suffisamment d'individus pour pérenniser ces ressources.

Cette mesure paraTt compatible avec le niveau d'exploitation en cours et elle a le mérite d'être d'une grande simplicité, éliminant ainsi le besoin de réglementations et donc de contrôles supplémentaires.

A Touaorou dans la Commune de Yaté en Nouvelle-Calédonie, l'exploitation du troca a été régie traditionnellement de la même manière en y ajoutant toutefois la notion de zone (Homou, comm. pers.). Sans déborder sur le prochain thème il s'agit IB plutôt d'une notion de jachère, mais toujours dans l'esprit de protéger une ressource pendant une période donnée.

Dans le même ordre d'idée et de conception plus récente, l'exploitation ponctuelle de stocks constitués B partir d'introductions (ex.: le troca en Polynésie FranHaise). Après avoir constaté le succès d'une introduction, l'ouverture de la pêcherie est décrétée pour une période donnée. Celle-ci est généralement déterminée en fonction d'un quota autorisé. La période de fermeture est donc variable et devrait en théorie pallier le travers d'une fermeture saisonnière fixe qui ne prendrait pas en considération les variations annuelles du stock. En pratique, si la fermeture n'est pas complètement maTtrisée, on risque d'aboutir B une sur-exploitation (Yen, 1987).

En Nouvelle-Calédonie, la pêche de plusieurs espèces est fermée périodiquement: les huTtres, les crabes de palétuviers, les tortues et la commercialisation des picots (siganidae) pendant la période de frai. La pêche des mullets est, elle, interdite dans les estuaires du 1er avril au 30 juillet. Toutes ces interdictions ont donc pour objectif la protection de l'espèce pendant la période de frai oφ elles sont les plus vulnérables ce qui n'est pas vraiment le cas pour les huTtres de roche, mais la réglementation date de 1893.

Cette dernière constatation permet d'éclairer quelque peu la réglementation néo-calédonienne. En effet, beaucoup des textes en vigueur, même si ils ont pu être modifiés depuis, remontent B des époques plus ou moins reculées oφ, faute de données biologiques, des mesures conservatoires ont été édictées selon les principes d'usage dans la gestion des populations terrestres qui voulaient que l'on protège les animaux

pendant leur période de reproduction.

Ceci étant, l'information biologique n'est pas la seule base de décision pour le législateur et, pour revenir au propos de l'introduction, je citerai maintenant l'exemple de la gestion du crabe de palétuviers (*Scylla serrata*) en Nouvelle-Calédonie pour engager la dernière phase du débat.

IV. Biologie et gestion rationnelle

La pêche du crabe de palétuviers est réglementée en Nouvelle-Calédonie depuis 1963, date à laquelle la taille minimale de première capture fut fixée à 13 cm et la pêche des crabes mous interdite.

Deux ans plus tard une période de fermeture du 1er janvier au 31 mars était instaurée.

Au fil des ans, la réglementation a évolué incluant puis abandonnant la protection des femelles pour finalement aboutir en 1983 à l'interdiction de pêcher, détenir ou commercialiser les crabes des deux sexes inférieurs à 13 cm ainsi que les crabes mous. La période de fermeture elle-même, passa du 1er octobre au 31 mars de chaque année.

Cette réglementation fut établie de manière empirique sans vraiment de fondement biologique autre que des comparaisons avec les pays voisins (Delathière, 1990).

Une première étude sur la biologie de l'espèce fut alors entreprise pour définir plus précisément les facteurs déterminants du cycle de vie de l'animal en Nouvelle-Calédonie. Les premiers résultats portant sur la maturité des femelles conduisirent à porter la taille légale minimum à 15 cm en 1991.

Parallèlement, les commerçants se disaient pénalisés par une période de fermeture aussi longue, notamment au niveau de l'écoulement de leurs stocks. La vente fut donc libéralisée pour autoriser deux mois supplémentaires de commercialisation après la fermeture, sous réserve de déclaration de stock¹⁷ au moment de la fermeture.

Une conséquence de cette augmentation de la taille à la première capture fut une augmentation du commerce de la chair de crabe...

Par ailleurs, les pêcheurs de certaines localités constatèrent que les effectifs de crabes de taille supérieure à 15 cm étaient particulièrement pauvres, les amenant à affirmer que dans leur région, les crabes ne grandissaient pas au-delà de 13 cm...

Les Provinces Nord et Sud ont alors commandité une étude complémentaire à l'IFREMER afin de mieux connaître la dynamique des stocks de crabe de palétuviers et de statuer sur les conditions optimales de leur gestion.

Les premiers résultats ont démontré que le taux moyen d'exploitation sur l'ensemble des principaux sites de production était faible et irrégulier sur les 24 semaines de pêche légale avec des rendements et des fréquences de taille relativement constants au cours de la saison.

Par ailleurs les premières modélisations permettaient de dire qu'avec l'effort de pêche en vigueur, la taille légale minimum était vraisemblablement trop élevée.

¹⁷ Les commerçants devaient déclarer la quantité de crabes qu'ils avaient en stocks à la date de fermeture et ils avaient deux mois pour l'écouler.

Les "décideurs" avaient alors le choix entre ne rien faire jusqu'à la conclusion de l'étude, modifier la taille légale minimum (mais B combien?) et la période de fermeture et modifier l'une ou l'autre de ces mesures pour en mesurer l'impact respectif.

Compte tenu de l'intérêt économique de cette pêcherie pour les populations de l'intérieur mais aussi pour les commerçants du principal centre urbain et marché de Nouvelle-Calédonie, il fut proposé de maintenir la taille légale B 15 cm jusqu'à la fin de l'étude mais de laisser la pêche ouverte toute l'année. Etant donné l'échappatoire que représentait le commerce de la chair de crabe et les conditions d'hygiène dans lesquelles le décorticage était pratiqué, il fut également proposé que la vente de crabe décortiqué soit interdite sauf pour les restaurateurs.

Ces propositions firent l'objet de vifs débats au sein de la commission consultative chargée d'examiner les questions relatives aux ressources marines. Aux considérations purement scientifiques ou économiques était opposé un point de vue beaucoup plus social et pragmatique tel que la nécessité d'une fermeture estivale pour éviter la pêche récréative en période de vacances mais sa réouverture avant la rentrée des classes pour générer une source de revenus supplémentaires.

Après certaines tergiversations et contre-propositions, la taille fut maintenue B 15 cm, la pêche fermée du 1er décembre au 31 janvier et le commerce de chair de crabe interdit.

Décision qui tentait de concilier les différents points de vue sans préjuger les résultats définitifs de l'étude mais qui ne correspondaient pas aux desiderata de tous.

La Province Nord a alors édicté sa propre réglementation passant la taille minimale légale B 14 cm et rallongeant la période de fermeture de deux mois, du 1er octobre au 31 janvier. Le Conseil d'Etat, la plus haute instance juridique nationale a statué sur le bien fondé de cette réglementation particulière car elle concernait la protection d'une certaine espèce dans un but principalement économique.

Aujourd'hui, le rapport final de l'étude (Anon, 1995) est disponible et conclue que:

"en Nouvelle-Calédonie, la restauration d'une taille minimale de capture de Scylla serrata B 13 cm pourrait être envisagée car l'espèce a une croissance rapide, une haute fécondité et se caractérise par un comportement migratoire des femelles gravides..."

..."Périodiquement, les débarquements varient en raison des fluctuations de recrutement liées aux facteurs d'environnement."

...La démarche halieutique consisterait B préconiser une exploitation du crabe B $T_c=13$ cm et ce pendant toute l'année."

Mais, pour des raisons essentiellement liées au contrôle de la pêche plaisancière (amateurs) qui continue B opérer pendant la fermeture et cible les crabes mous souvent sans respecter les terriers, il suggère pourtant également que:

"D'un point de vue écologique, il conviendrait de fermer la pêche durant les mois de novembre B février car ils correspondent B deux phénomènes importants du cycle de l'espèce: croissance (et reproduction) et recrutement. A ce moment de l'année, la fréquentation et la perturbation de l'écosystème "plages B crabes" par les pêcheurs amateurs (destruction des terriers) est très mal contrôlée et gérée."

La Science aurait-elle rejoint le bon sens populaire?

Le dernier épisode de ce feuilleton passionnant n'est pas encore écrit mais il semblerait qu'il faille effectivement concilier la gestion halieutique de l'espèce avec des impératifs beaucoup plus pragmatiques tels que la nécessité de protéger les professionnels des amateurs ou la génération de revenus supplémentaires B une période donnée (ouverture).

En tout état de cause, dans ce cas de figure, la mesure de fermeture ne correspond plus tellement B des raisons biologiques mais qu'importe, la gestion d'une pêcherie n'est-ce pas aussi gérer les pêcheurs?

V. Conclusion

Dans cette présentation, j'ai essayé d'aborder la question des périodes de fermeture sous l'angle de l'administrateur chargé de mettre en place des mesures de protection et, si possible, de gestion des ressources.

Je pense avoir été clair sur le rôle parfois limité que peuvent avoir les biologistes sur la décision qui peut être prise dans un sens ou dans l'autre. J'espère que les débats auront permis de clarifier la notion de période de fermeture, son utilité et la façon de s'en servir.

En dernier lieu, j'aimerais introduire une dernière citation qui pourrait servir d'entrée en matière pour les débats de demain: "Plus le volume des connaissances augmente, plus la surface de contact avec l'inconnu s'agrandit, plus les moyens B mobiliser pour réduire ces nouvelles incertitudes deviennent hors de portée." (di Castri, 1992).

En d'autres termes et pour conclure, combien cela coûtera-t-il d'obtenir l'information nécessaire B la gestion rationnelle d'une ressource par rapport B ce que cette ressource génère comme revenus.

Dans ce contexte est-ce que la bonne vieille période de fermeture n'a-t-elle pas encore de beaux jours devant elle?

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Closed seasons: How useful are they?

English version
(original: French)

by Richard Farman
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I. Introduction

When a young student of marine biology, aspiring to become a well-balanced fisheries manager, reads in his or her first-year college undergraduate course that “fisheries have been regulated for political, social, economic and even whimsical reasons, and sometimes for biological reasons” (Everhart, Eiper and Young, 1975), it is not surprising that he or she should be a little disconcerted.

Several years later, however, having attained the supreme height of presiding over the destiny of a species whose principal characteristic is its commercial value, he or she can only acknowledge how true that statement was.

How indeed can the management, and therefore the regulation, of a particular species be divorced from the fishery itself? Once the human factor becomes involved, political, social, and economic aspects of fishing activity need to be taken into consideration, while having as much regard as possible for the biological constraints affecting the target species, even when Science (with a capital “S”) is in a position to provide all the answers to the manager’s questions.

This, then, is the background against which I propose to review the use of closed seasons in fishery management.

II. Are closed seasons justified?

The main reason used to justify the introduction of seasonal fishery closures is the need to protect a species during part of its life-cycle, especially during spawning or recruitment, the purpose being to protect the species during the period it needs to breed or to reach a commercial size before harvesting.

For many prolific fish species, science has actually shown that there is no relationship between the size of the parent stock and population abundance (above a particular density threshold) but that the important factor is survival of progeny to the adult stage (Everhart, Eiper and Young, 1975). The determining factor in stock recruitment is therefore environmental conditions rather than fishing mortality; and whether a specimen is caught before, during or after breeding is therefore irrelevant. Banning fishing during the spawning season has no other effect than that of restricting fishing effort.

Similarly, if a species changes its behaviour during the breeding season and becomes more vulnerable to capture, a fishery may be closed on the grounds that it is necessary to limit catches during this period. It nevertheless means that we have come back to the first case in point: a reduction in fishing effort.

Munro and Fakahau (1986) stress in this connection that seasonal fishery closures have the same drawbacks as quotas: unless the abundance of new cohorts is known, there is a risk of ending up with an artificial rigid closed season leading to overfishing in bad years and a neglect of the major proportion of available stocks in years when recruitment is particularly high.

The same authors point out that such measures leave fishermen under-employed and, where multi-species fisheries are concerned, cause under-fishing of associated species which do not need protection. Closed seasons therefore can have negative impacts on employment, infrastructure utility and vessel profitability.

Under such circumstances, the introduction of closed seasons amounts to using a conservative measure in the hope that a stock is being adequately protected to ensure its survival, but without really knowing whether this action permits optimum exploitation¹⁸ of the resources. This, it is hard not to agree, does not appear to be an optimum management practice.

A series of preliminary questions could therefore be asked at this stage, principally directed towards the scientific community:

Q: Is it really necessary to prohibit fishing during spawning or at any other time?

And its corollary:

Q Are there any species for which seasonal closures are more justified than for others (e. g. gregarious species)?

In view of the previous comments about fishing bans during the spawning period, it would seem that, rather than banning fishing during the recruitment period, other action such as nursery protection or size limits would be more effective.

With reference to multi-species fisheries, protecting one species and not others can only be effective if the specimens concerned, which are caught as bycatch to the targeted species, can be released alive.

Also, such action can induce a change in fishermen's behaviour and tempt them only to fish when the season opens but not the rest of the year (recreational fishing). Fishing effort can therefore become artificially high after the closed season ends, which would run counter to the desired effect.

At this stage, it is also possible to open another debate by putting the following questions, directed this time to the participants as a whole:

Q: Does the introduction of closed seasons have the sole consequence of controlling fishing effort?

And

Q: Is this a particular measure more worth contemplating than others (is it easier to monitor, or for the fishing community to understand etc.)?

Lastly, it should also be noted that seasonal closures may be required for health reasons, especially for filter feeders such as oysters, which may become toxic during periods of phytoplankton bloom, for example.

With the benefit of this food for thought, let us endeavour to review some examples affecting the region. Here I would ask participants to make their own contributions or to criticise mine if my information is erroneous.

III Some examples from the Pacific

¹⁸ When we use the term "optimum" this can mean ecologically optimum, biologically optimum, or both. Also, in a commercial fishery, the closure can be monitored by observing marketing patterns, but where subsistence or recreational fishing are concerned, it is much harder to determine the quantities concerned and therefore to exercise any control over them. And there is no point in having a regulation unless it can be enforced.

Seasonal fishery closures are used both in traditional and contemporary contexts in the Pacific region.

One of the best-known examples is the trochus and bêche-de-mer stock management on Ontong Java. The whole community decides to alternate exploitation of these two fisheries from year to year. This annual closure concept, although it may not be based on precise biological considerations and does not necessarily represent the best use of these resources, is a perfect illustration of the concept involving the restriction of harvesting for the purpose of guaranteeing that the resource will remain permanently available in adequate quantities.

Such action would appear to be compatible with current exploitation levels and has the merit of being very simple, thus eliminating the need for regulations and therefore enforcement action.

At Touaorou in the Commune of Yaté, New Caledonia, trochus exploitation has always been traditionally managed in the same way with however an additional notion of zoning (Homou, per. Comm.). Without overlapping into the next topic, this seems to be similar to the idea of leaving a zone “fallow”, but is still in the same spirit of protection of a resource for a specified period.

A similar but more recent concept is that of temporary stock harvesting of introduced species (e. g. Trochus in French Polynesia). Once the success of a particular introduction has been demonstrated, the fishery is declared open for a specific timespan. This measure is generally related to a quota. The closed season is therefore variable and should in theory make up for the drawbacks of a fixed seasonal closure which does not take into account annual stock variations. In practice, if the closed season method is not used in full awareness of all the circumstances, the risk is overfishing (Yen, 1987).

In New Caledonia, fishing for certain species is subject to periodic closures: oysters, mud crabs, turtles and rabbitfish, during the spawning season. Mullet fishing is banned in estuaries from 1 April to 30 July. The purpose of these closures is to protect species during the spawning period when they are most vulnerable, which is not really the case for rock oysters, but these regulations were first adopted in 1893!

The last example sheds light on some aspects of the New Caledonia fisheries regulations. Many of the current regulations, even though they may have been since amended, reflect the distant epoch in which they were introduced or, where for lack of biological information, conservation measures were introduced by analogy with terrestrial measures designed to protect animals from hunting during the breeding season.

In this case, biological information is not the only type of information upon which decisions by legislators can be taken and, to come back to my introductory remarks, I would like now to refer to the example of the management of the mud crab (*Scylla serrata*) in New Caledonia, as a starting point for the next phase of our discussion.

IV Biology and rational management

Mud crab harvesting has been regulated in New Caledonia since 1963, in which year the minimum size at first capture was set at 13cm and collection of soft-shelled crabs was banned.

Two years later, a closed season, from 1 January to 31 March, was introduced.

As the years have gone by, the regulations have been modified to include and then abandon the protection of females, culminating in 1983 with a ban on the harvesting, possession or sale of crabs of either sex less than 13cm in size, or any moulting crabs. The closed season was then extended to last from 1 October to 31 March.

These regulations were established empirically without any biological foundation other than comparisons with neighbouring countries (Delathière, 1990).

An initial study on the biology of the species was then undertaken to define more accurately the determining factors in the life cycle of this animal in New Caledonia. The initial results on the maturity of females led to the minimum legal size being increased to 15 cm in 1991.

At the same time, traders said they were being penalised by such long closed seasons particularly with regard to selling crabs in stock. Sales were therefore approved on a more liberal basis by adding two extra months for trading after the beginning of the closure, providing crab quantities in stock were reported at the time of the beginning of the closure¹⁹.

One consequence of this increase in size at first capture was an increase in general shelled crab meat sales.

Also, fishers in certain areas noted that very few crabs over 15cm in size were actually available, which enabled them to assert that, locally, crabs did not grow to a size over 13cm. The Northern and Southern Provinces commissioned IFREMER to carry out a further study in order to gain a better knowledge of mud crab stock dynamics and to come to a firm positions on optimum management arrangements.

The initial results demonstrated that the average size at harvest over all the main breeding sites was low and irregular over the 24 weeks for legal fishing, with yields and size frequencies proving relatively consistent throughout the open season. In addition, the first attempts at modelling showed that, under current fishing effort, the minimum legal size was probably too big.

The decision-makers then had a choice between doing nothing until the study had been completed, or changing the minimum size (but to what?) and the closed-season, and modifying one or the other of these measures to estimate their respective impacts.

In view of the economic benefits accruing from this fishery not only to rural and coastal communities, but also to traders in the main urban centre and market of New Caledonia, it was proposed to keep the minimum legal size at capture at 15cm until the research work was completed, but to do away with the closed season altogether. But, because the sale of shelled crab meat was an easy way around the size limit and because of the hygiene conditions often prevailing when the crab was shelled, it was also proposed that sales of shelled crab meat should not be allowed except in restaurants.

These proposals were the subject of lively discussion within the advisory committee responsible for reviewing matters relating to marine resources. To the purely scientific and economic considerations was added a much more pragmatic and social point of view, stressing the need to close the fishery in the summer to avoid excessive recreational fishing during the holidays, and the need to re-open before children went back to school in order to generate an extra source of income for families.

After a lot of debate and counter-proposals, the size was kept at 15cm, the fishing season was closed from 1 December to 31 January and shelled crab meat sales were banned.

This decision was an attempt to reconcile varying points of view without prejudice to the final results of the study, but it did not meet all concerns satisfactorily.

¹⁹ The traders were supposed to declare the amount of crab they had in stock at the date of closure, which they were given two months to sell.

The Northern Province then introduced its own regulations, changing the minimum size to 14cm and extending the closed season by two months from 1 October to 31 January. The Council of State, the highest national French legal authority, was asked to give an opinion on the legality of this specific regulation, because it related to the protection of a species for a principally economic purpose. The final report from this study (Anon, 1995) is available and concludes that:

“in New Caledonia, the reintroduction of 13cm as the minimum size at capture for Scylla serrata could be contemplated because this is a fast growing species with high fertility characterised by migratory behaviour of berried females...”

“...landings vary periodically depending on recruitment fluctuations associated with environmental factors.”

“...The approach to the fishery would involve recommending that the size limit for crabs be 13cm throughout the year”

However, for reasons basically linked to the monitoring of the recreational fishery, which continues to operate during the closed season targeting soft-shelled crabs, often without any respect for their habitat, the report also suggests that:

“From the ecological point of view, it would be appropriate to ban fishing during the November to February period because this corresponds to two important events in the life-cycle of this species: growth (and reproduction) and recruitment. At this time of year, visits and disruptions to the mud-flat ecosystem by amateur fishers (destruction of burrows) is difficult to control or manage.”

Can this mean that Science and basic common sense are in agreement?

The final episode in this fascinating saga has not yet been written, but it would nevertheless appear that there is a need to reconcile fishery management of a particular species with more pragmatic requirements, such as the need to protect amateur or professional fishers or to generate additional income for a specific period.

Whatever the circumstances, in this particular instance, the closed season option no longer really relates to biological requirements, but is this really relevant? Is the management of a fishery not also the management of fisherfolk?

V. Conclusion

In my paper, I have tried to address the issue of closed seasons from the point of view of an administrator responsible for introducing protective measures and, if possible, resource management.

I think I have made it clear that the part to be played by biologists is sometimes limited, in the decisions which may be taken for or against such closures. I hope that the discussion has made it possible to clarify the concept of the closed season, its merits, and how it can be used.

Lastly, I would like to leave you with a last quotation which could be the starting point for tomorrow's discussion: “the more knowledge we have, the more we realise we don't know and the more impossibly great become the resources needed to reduce this new uncertainty” (di Castri, 1992).

In other words, and in conclusion: what will be the cost of securing the information necessary for rational management of one resource as compared to the income that the same resource can itself generate?

The good old closed season may still have a long life ahead of it yet!

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Restrictions d'accès et quotas

Keynote Paper 6 par Mick Bishop
Torres Straits Fisheries
Australian Fisheries Management Authority

RESUME FRANCAIS

- *Pourquoi prévoir des mesures de restrictions d'accès.*
- *Quand et comment les mettre en place.*
- *Gestion des zones de pêche dont seuls certains secteurs sont soumis **B** des restrictions d'accès.*
- *Avantages des quotas de pêche.*
- *Facteurs de détermination de la gestion d'une ressource donnée par quotas.*
- *Dangers inhérents **B** la gestion par quotas.*
- *Unités individuelles d'effort transférables : une solution de substitution aux systèmes de quotas.*

*La gestion classique des ressources d'intérêt commercial de l'Australie du sud est comparée **B** la gestion assurée conjointement avec la Papouasie-Nouvelle-Guinée dans le détroit de Torres et axée sur la subsistance des populations autochtones.*

Limited entry and quotas

by Mick Bishop
Torres Straits Fisheries
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(The following text is paraphrased by the editors from notes made during the keynote talk)

Introduction

There are two main reasons for imposing a limited entry system: to limit catch, and to limit *potential* fishing effort. Limits can encourage a long term stake in the fishery, and a custodial attitude, especially if that stake can later be sold. It encourages long-term maintenance. Australia generally tries to recover the cost of management out of the commercial operation of the fishery, and if the fisher has exclusive benefits, why should the taxpayer foot the bill? Limited entry can thus allow for defraying the cost of management.

The time to create a restricted entry system is usually when there is full potential for exploitation, and to prevent new players coming in. It is a bit harder to do this through other methods such as gear restriction. One way to decide who is allowed to enter the system is the current unit holding, where an existing fisher holds one small part of an area or can demonstrate active ownership of a certain amount of essential gear. Another criterion is catch history, to demonstrate an active commitment to the fishery. These criteria are

given a wide variety of weightings in different Australian fisheries.

You can manage a fishery if only some sections are restricted, but it is better if the unrestricted component is small, such as a recreational fishery where one of the commercial target species is a minor bycatch. You still need to estimate the level of catch in that unrestricted portion, but this can be allowed for when planning the total allowable catch. Alternatively you can manage the fishery on the basis of period stock assessments and adjust the TAC from year to year, or even simply consider the small unrestricted component of the fishery as part of natural mortality.

Torres Strait fisheries

The Torres Strait is unusual in Australia because it is mostly unrestricted access. Most of the people are on Thursday Island (about 3,500) and there are another 2,500 people on other islands. This is small even by Pacific Island standards. The area is governed by the Torres Strait Treaty on both sides of the border, of which the most important aspect is to maintain the traditional livelihood of coastal inhabitants, although protection of the environment is given almost equal weight. For locals, entry is unrestricted, and Thursday Islanders are involved in everything except the prawn fishery.

These fisheries include tropical rock lobsters and pearl shell. This was the world's biggest producer of pearl shell before the war, but only supplies small amount of live shell to farms now. There is very little line fishing except for mackerel. The bêche-de-mer and trochus fisheries are exclusive to Torres Islanders, and the typical islander concentrates effort on lobster, bêche-de-mer or trochus depending on the current price. There have been recent moves from island leaders and fishermen to give unrestricted rights to non-islanders born in the Straits, or those who are married to islanders and this could be a loophole, but the move is coming from the islanders themselves.

Individual Transferrable Quotas

Many Australian fisheries managers feel that ITQ's are the best way to manage only if conditions are right. Some economists think they are the solution to every problem, but despite that they still have some useful advantages.

ITQ's control the actual catch, and impose minimal overheads on industry. As long as you monitor the catch then you don't need to control gear. They are also flexible with respect to market forces and quotas can be traded in a way that is fair to everyone. Be aware of some dangers though:-

1. The range of jurisdiction is limited. When introduced on orange roughy, for example, the fishing grounds covered both state and commonwealth waters where state jurisdiction did not apply. Fishermen could claim that their catch was all made in Commonwealth waters.
2. Total allowable catches are difficult to determine. If there is good biomass data then TAC prediction is possible, but fisheries like prawn are extremely difficult due to all the environmental variables that influence the stock.
3. Single species fisheries are much easier to regulate by quota than multispecies fisheries. What happens to the fisherman who uses up all of his quota for one species, but has remaining capacity in his other quotas that it is not economic to fish?
3. Quotas encourage "high-grading" where less valuable fish are thrown away, since only a fixed total amount can be landed.

The most important need for any quota system is to be able to monitor catches. If you can't keep fishermen honest, then quotas are a bad option, and if you want to use quotas to *reduce* the total catch then there is a big risk of promoting liars. But if quotas are introduced to alleviate gear restrictions or other overheads, and boats do not suffer a reduction in catch then compliance is much better. The hidden danger is in managers themselves. If a quota is introduced to reduce the total catch, and you find that the logbooks add up to the new reduced catch, there is a strong incentive to look no further and claim that your management is a success. Of course, if the data is based on catch figures that are untrue then that false data gets fed back to the biologists and stock assessment experts, and the resulting quota becomes meaningless.

Individual Transferable Effort

Another idea for restricting entry is the ITE (Individual Transferable Effort) unit. For example, in the eastern shark fishery, fishermen are allowed 100 gillnet-months (e.g. 20 nets used for 5 months, or 10 nets for 10 months) and can sell these units to each other. ITE's offer only indirect control of catch, but they can allow the fishery to be restructured fairly. There is less inefficiency than conventional gear restrictions and they are a lot easier to monitor than quotas.

6.4.4 Keynote paper abstract for session on protected areas, sanctuaries and reserves

Marine protected areas and inshore fisheries management in the South Pacific

by Paul Holthus, Nature Conservancy, Hawaii

ENGLISH ABSTRACT

Marine Protected Areas (MPAs) provide a tool to conserve and manage inshore fisheries by protecting the habitats and ecological processes which support living marine resources, as well as the resources themselves. MPAs refer to a specific geographic area of ocean waters and underlying substrate which are designated to be managed for one or several purposes, including fisheries management. The level of potential MPA management related to fisheries ranges from strict reserves to single species sanctuaries to multiple use areas, and may include a variation in management over time (e.g. seasonal closures).

In much of the South Pacific region various types of what are now called MPAs have been successfully developed in the past as a part of traditional management methods. In the past few decades MPAs have been repeatedly proposed as an important tool for contemporary fisheries management. However, only recently has much modern scientific information on the value of MPAs to maintaining and allowing sustainable inshore fisheries, and the process by which this occurs, been assembled. Unfortunately, there still is only limited scientific data from the South Pacific region on this although there is a growing body of information on the value of MPAs for sustaining fish and invertebrate harvesting in the region based on experience.

In spite of the cultural, subsistence and commercial importance of inshore fisheries to the region and the growing realization of the usefulness of MPAs in maintaining inshore fisheries, the numbers of designated and effectively managed MPAs in the South Pacific has remained relatively low. Identifying, establishing and managing MPAs most involve ecological and fisheries science as much as possible. However, the level of scientific information will almost be always less than desired and fisheries management, including MPA development, will have to proceed on limited data. Most importantly for the success fisheries management involving MPAs is that MPA development and implementation must be conducted in partnership with local communities, making full use of local knowledge and traditional management practices wherever possible.

The impacts of fishing activities in the South Pacific on the habitat and ecosystem processes which support them varies greatly within and among the islands of the region. The impacts of fishing activities, and other direct impacts on habitat and resources, can often be controlled and ameliorated to a great extent within MPAs. Unfortunately, coastal and upland development activities, particularly those which involve direct habitat loss or land based pollution, usually result in important impacts to the habitat and ecosystem processes which support inshore fisheries in the region. Addressing the effects of these development activities on inshore fisheries resources, habitats and ecological processes - both inside and outside MPAs - require that MPA development be undertaken in the broader context of Integrated Coastal Zone Management.

Reserves marines et gestion des ressources cotieres dans le pacifique sud

Document présenté par Paul Holthus, Nature Conservancy, Hawaii.

RESUME FRANCAIS

*Les réserves marines permettent de préserver et de gérer les ressources côtières en protégeant le milieu et les mécanismes écologiques sur lesquels reposent la survie des ressources marines. Les réserves comprennent les eaux océaniques de surface et les fonds sous-marins d'une zone qui a été délimitée afin de répondre **B** un ou plusieurs objectifs, en particulier la gestion des ressources marines. La protection assurée peut concerner la totalité ou une partie seulement des espèces, prévoir des usages multiples de la zone, ou varier selon les périodes de l'année (interdiction saisonnière de la pêche par exemple).*

La mise en place de réserves, sous différentes formes, a souvent été utilisée avec succès par le passé dans le Pacifique Sud comme méthode traditionnelle de gestion des ressources. Ces dernières décennies, elle a été souvent préconisée dans le cadre d'une gestion moderne des ressources. Pourtant, ce n'est que récemment qu'ont été rassemblées des données scientifiques sur l'intérêt des réserves comme moyen de protéger et de gérer de manière équilibrée les ressources côtières. Malheureusement, les données issues de travaux scientifiques sont encore rares dans le Pacifique Sud; en revanche, l'expérience a permis d'enrichir les informations dont on dispose sur la protection des stocks de poissons et d'invertébrés exploités dans la région.

Bien que les ressources côtières revêtent une grande importance sur le plan culturel, alimentaire et commercial, et que l'utilité des réserves comme instrument de protection de ces ressources soit désormais reconnue, le nombre des réserves effectivement établies et exploitées dans le Pacifique Sud est relativement bas. La création et la gestion d'une réserve exige en effet une connaissance scientifique du milieu et des ressources marines. Or les connaissances disponibles sont presque toujours insuffisantes et la gestion des ressources, en particulier par la création de réserves, doit s'effectuer sur la base d'informations limitées. Il est particulièrement important pour le succès de telles opérations que les réserves soient mises en place et gérées en concertation avec les collectivités locales et en s'efforçant d'utiliser pleinement les connaissances et les méthodes traditionnelles de gestion.

*Les répercussions des activités de pêche sur le milieu marin varient fortement d'une **Te B** l'autre. Souvent, elles peuvent être contrôlées et considérablement atténuées par la création de réserves. Les activités de mise en valeur des zones côtières et intérieures, surtout celles qui entraînent une dégradation de l'habitat naturel et une pollution des terres, ont en général des effets nuisibles sur l'écosystème dont dépendent les ressources côtières de la région. Pour y remédier, il faut que la mise en place de réserves s'effectue dans le cadre plus large de la gestion intégrée des zones côtières.*

6.4.5 Keynote paper for the session on resource ownership; customary marine tenure and individual transferable quotas

Resource ownership; customary marine tenure and individual transferable quotas

by Robert E. Kearney
New South Wales Department of Agriculture and Fisheries

"Fishery resources are unusual in the fact of their common-property nature, but they are not unique"
Scott Gordon (1954).

All natural resources were once common property. Humans haven't always had houses or even permanent shelters. Individually owned farms are a relatively recent development. But fisheries resources have continued to be regarded as common property. Why? In 1633 Hugo Grotius answered the question thus "For everyone admits that if a great many persons hunt on land or fish in a river, the forest is easily exhausted of wild animals and the river of fish, but such a contingency is impossible in the case of the sea" (from Keen 1983). More recently Scott Gordon (1954) observed "unlike fishes, the biotic potential of land animals is low enough for the species to be destroyed". Unfortunately the misconception that the ocean's resources are limitless has prevailed in some areas even to the present day.

In Grotius' time humans did not have the same abilities to overexploit the oceans as we do today. But even then some of the more fragile inshore resources were known to be vulnerable to overexploitation. Management systems were in place in numerous parts of the world, notably Oceania, to conserve and ration resources essential to local communities. In the Pacific these developed to become what is known as Customary Marine Tenure (CMT).

As the world industrialised, common property resources, both terrestrial and aquatic, became progressively overexploited in what has been described as "the tragedy of the commons" (Hardin 1968). Hardin's thesis was based on the inevitability of shared cattle grazing land being over-grazed. It is well reviewed by Berkes (1985) who highlights Stillman's (1975) conclusion that it is based on three assumptions:

1. users of resources can pursue private gain even against the best interests of the community,
2. the environment must be limited and it must be possible for the rate of exploitation to exceed the rate of replenishment of the resource,
3. the resource must be open to any user, and if these three assumptions are fulfilled (as they are for many fisheries) then tragedy becomes inevitable. It is significant that at least one (the first) and often two (the third) of these assumptions did not apply in many of the fisheries of the Pacific islands managed under CMT.

There are other characteristics of CMT which contributed to success. Customary tenure offered structured management in the interests of sustainability of resources and efficiency of use. Leaders of the communities, or clans, were custodians on behalf of the community. As Hviding (1991) points out "fishing grounds contained within Pacific island CMT systems are generally communally-held property, inherited as ancestral title through generations and cannot simply be sold or otherwise transferred to

outsiders". The example of Marovo Lagoon, Western Solomon Islands, given by Hviding where "a number of clans control resource use within defined areas of land and sea" is an excellent case of property rights allocation leading to effective management. In most CMT systems the property right is vested in a community and not with individuals.

Much of the success of fisheries management by CMT can be attributed to the fact that clan elders exerted control over all users of the resource. All users shared a common interest in sustainability of resources and clan elders were recognised as rightful managers and enforcers. There were no direct human influences on resource levels external to the clan members and no external markets to encourage harvesting beyond the needs of the local community. The village or clan unit was truly the master of the destiny of the resources it used. Pressure to exploit the resource before somebody else did (Kesteven 1987) was controlled.

Strangely the medieval European village grazing commons which Hardin used as the basis of his "tragedy" also thrived for many years before they reverted to common property. "As a matter of historical fact, village commons existed without an accompanying 'tragedy' for many generations - until the manorial system lost its effectiveness and the community-based self-regulation of the commons broke down" (Berkes 1985).

Declines in effectiveness of CMT systems in Pacific Islands as reported, for example, by Johannes et. al (1991), appear to be attributable to a breakdown in community ownership of management similar to that which occurred with Hardin's commons. National requirements for food or exportable produce led to the over-riding of local yield targets for many species. External influences, such as fishing pressure from technologically advanced vessels from distant lands, and export markets for selected local products drastically altered the balances between productivity, local requirements, total demand and levels of exploitation. In many cases the clan structure was weakened for reasons not related to fisheries and the management lost its authority. Local communities were no longer masters of the destiny of the resources they exploited and in many cases were forced to exploit even fragile stocks before somebody else did. Where local community control of the exploitable resource has been superseded the "commons" have suffered the same "tragedy".

Throughout the world community based units of management have ceased to be effective when the community of people exploiting the common resource has become too broad for social conscience to control exploitation. With expanded influence on resource exploitation the management process becomes too complex, the need for knowledge of the resource base exceeds what is available and enforcement costs quickly escalate. Hardin (1994) used the examples of Hutterite communities in the United States to argue that social conscience can only be expected to be an adequate management tool for communities of 150 people or less. While there are Pacific Island examples of effective management by somewhat larger groups, when the number rises the effectiveness of community conscience diminishes.

The world has struggled to find solutions to its fisheries management problems. The seemingly inevitable declines in the productivity of exploited fish populations and their failure to produce maximum yields is testimony to our inability to manage complex ecological and sociological systems. As the management unit becomes larger the incentive to be truly conservative in the community's interest diminishes. Pressure to exploit before somebody else does causes regrettable actions from even community-conscious individuals.

No common solution to the world's fisheries management problems has been found. Indeed it is most unlikely there will every be a panacea. It is accepted that as technology improves and competition for resources increases, catches must be constrained to conserve resources. It is also obvious that effort must be curtailed to protect economies. Most acknowledge that some form of control is essential, but whether

the desirable objective should be catch (output) control or effort (input) control is hotly debated. It is generally accepted that limited entry of some form is necessary for most commercial fisheries but it is also accepted that limited entry on its own is seldom adequate; the benefits from an individual's efforts to conserve the resource are still shared by others in the fishery, thereby diminishing incentive.

Fisheries managers have struggled to develop systems which reward fishers for actions which improve total resource productivity at the expense of short term gains by individuals. Increased ownership of, and therefore responsibility for, the resource is argued to be the logical way of promoting long term resource sustainability and optimum yields as the primary goals. Agriculture management went this way in Europe centuries ago. As Keen (1983) points out land tenure has given the land owner (grower) control over agricultural processes; the harvester is often a hired hand who has no say in production levels or the destiny of the produce. Fishers are harvesters, not growers. Theory suggests that following the agriculture model in which rights are devolved upon the grower and not the harvester will remove the incentives under which a common property resource is overexploited. Sole ownership could allow the rewards for investments in productivity to be returned directly to the investor (the owner of the resource). The theory is excellent. But the progressive degradation of farm lands in Australia provides a sombre warning on the weakness of the conservation imperative in individual property rights.

In fisheries management many forms of property rights have been considered. Common examples include: the right to use certain types of gear, the right to fish in restricted areas, and the right to sell fish. However most discussions of increased use of property rights quickly converge on the rights to take specified quantities of fish for sale, i.e. quotas. Having reached this point consideration of individual transferable quotas (ITQs) is inevitable.

THE PROS AND CONS OF ITQS

The literature on the advantages and disadvantages by ITQs is growing at a rate that probably outstrips that on any other form of fisheries management. From this mass of documentation I have selected a relatively recent overview (Sutinen et al 1992) as a basis for provoking discussion.

In the abovementioned review the pros and cons of ITQs are listed as follows: (The comments are taken largely from Sutinen et al., however comments which question the interpretations of advantages and disadvantages are largely my own.)

Benefits and Advantages of ITQs

Increased profits

Assured of a given quantity of fish each individual can minimise catch costs and plan marketing to maximise returns. Assuming that the sum of the ITQs approximates the sustainable catch that can be taken with the same accuracy as other strategies, long-term profits should exceed those for most other management systems.

Greater economic stability

Being able to forecast individual catch levels and to plan the timing of landings should lead to greater stability.

Improved product quality

With a known quantity to be landed and time to plan processing and marketing, product quality should increase. The incentive is strong for individuals to maximise their return from their predetermined allocation.

Safety

The incentives to fish during dangerous weather or with faulty equipment should be significantly reduced. The ability to plan fishing trips more thoroughly should also improve safety.

Reduced gear conflicts

In overcapitalised fisheries the fleet size should shrink under ITQ management and effort should become more uniformly spread over the time the resource is available. The number of gear types should also reduce as fishers move towards gear which maximises returns on allocation and away from gear which maximises the speed of catch.

Elimination of the race-to-fish

Reduction in the race-to-fish should definitely occur. Benefits accrue under the other advantages listed, for example, increased safety, reduced gear conflict, mitigation of gluts, and greater economic stability and profits.

By-catch reduction

If the number of vessels is reduced and the total effective effort declines, then it can be argued that by-catch can be reduced. However this reduction could be attributed to any mechanism which reduces effort. Furthermore the increase in high grading which occurs with ITQs could well result in increased by-catch for ITQ systems.

Reduced gear losses

This could be expected to occur if total effort is reduced, and/or if the gear which produces fish with the highest unit price is less likely to be lost than that which takes biggest catches.

Improved investment climate

Greater economic stability, the use of shares in the fishery as collateral for loans, and the fact that quota prices reflect the real value of participation in the fishery, should all improve investment.

Market gluts are mitigated

An obvious benefit from predetermination of individual catches.

Waste reduction

Producers will have more time to process landings, but if by-catch through high-grading is increased then waste may also increase.

Wealth

An ITQ is an asset (for the individuals who hold quota).

Compensation

Fishers leaving the industry or reducing their participation may be compensated by selling or leasing their quota (Note the industry and not Government, pays).

Many of the advantages mentioned above could also occur with any management process which reduces total fishing effort and competition between participants. Comparison with other management strategies should be done on a case by case basis.

Problems and disadvantages of ITQs

High grading

There is clear incentive under ITQs to discard less valuable individuals of any species under quota.

Under reporting

ITQs provide clear incentive for under reporting and misreporting of catches.

Enforcement costs and problems

It is generally held that monitoring and enforcement costs are increased under ITQ programmes but there are exceptions.

Class divisions

ITQs can definitely increase the wealth of individuals who qualify for quota, therefore they do tend to create "a rich man's club" (Anderson, 1992).

Elimination of small scale fishermen

This can occur but the degree to which it is a disadvantage needs to be considered on a fishery by fishery basis.

Reduced employment and crew costs

If total effort is reduced then the total number of crew could be expected to decline. However if profitability goes up the income accrued by individual members may increase.

Industry resistance

There is normally an initial resistance to management in any form. Fishers who are to be included in the quota system generally become supportive when they realise the value of a property right. Those who are excluded may never drop their opposition.

Inequities

Many argue it is not fair to allocate what has been a common property resource to a few individuals. There are always some who believe they have been disadvantaged no matter how the allocation is carried out.

As for the advantages of ITQs the disadvantages must be considered on a fishery by fishery basis, however most of the disadvantages listed above can be more closely ascribed to the ITQ process than to other management measures.

There are advantages and disadvantages of ITQs which have not been covered in Sutinen et al's overview. Some of these relevant to today's discussions include the following:

Advantages**Changed culture of fishers**

There is little doubt that operating in an ITQ system forces individuals to become more business oriented. Many people originally entered fishing industries because of the lifestyle embodied in hunting and gathering. The competitive nature of many fisheries also carried appeal for some. Conversion to a business culture facilitates the maximising of economic efficiency and planning of marketing strategies.

Increased industry involvement in the management process

Introduction of ITQ systems more directly ties individuals' incomes to the management process. Industry interest in this process increases and problems with the fishery are more quickly identified.

Improved industry commitment to resource conservation

The creation of the property right and its allocation to individuals endows those individuals with a saleable commodity which can be regarded as a superannuation benefit. The value of the right is linked to the sustainability of the resource and mitigates against excessive short-term gains which damage the resource's future. Unfortunately factors such as the need to maintain cash flow often counteract commitment to long-term resource sustainability.

Improved resource assessments

As the value of ITQs is directly linked to the size of the TAC, industry pressure normally results in improved resource assessments. As ITQs tend to increase economic efficiency money available from within the industry to support science can be expected to increase.

Facilitation of resource rents

The free trading of quota leads to accurate valuation of shares in the resource and facilitates assessment of a realistic rent. Licensing procedures necessary for implementation of ITQ systems can normally accommodate additional charges and levies with minimal administrative cost .

Creation of a mechanism for anglers to displace commercial fishers

Provided the holding of quota is not restricted to those actively involved in commercial fishing, angling groups or individuals may buy out commercial operators.

Disadvantages

Changed culture of fishers

As mentioned above, ITQs change the culture of those in the industry. This could well be highly undesirable in many situations, for example isolated Pacific Island communities.

Diminished value of catch and effort data bases

The introduction of most new management systems leads to alterations in data requirements. This usually detracts from the comparative value of before and after data as indices of the status of the resource. The incentive to cheat on catch declarations inherent in ITQ management causes additional problems, particularly if catch data are used in the allocation process.

Decreased ability to accommodate seasonal fluctuations in abundance

Abnormally good or bad year classes of fish will be under or overexploited (respectively). The quota setting mechanism even if based on resource assessment and not historical catches, will seldom allow precision in predicting harvest for abnormally good or bad years. Fisheries managed by effort controls will see catches more closely reflect good or bad year classes of fish.

Creation of part-time fishers

The advantages of ITQs, such as economic efficiency, removal of the race to fish, and increased business skills in the fishing community, lead to many operators working less than a full year. Increased monetary benefits also facilitate the diversification of fishers into other

industries, often outside the fishing sector. The positive aspects of this have already been considered. The negative aspect is that those who invest in other industries normally use the high cash flow and reliability of income from a quota managed fishery for day to day servicing of their total investment package. When a resource is in decline and total catches should be reduced, individuals may oppose such cuts to avoid embarrassment in their alternative interests. This often leads to serious opposition to reductions in quota necessary for conservation of the resource.

The need for precision in sharing resources

Allocation of ITQ's gives substance to the determination of a total catch by commercial harvesters (TACC). It forces the issue of the reliability of the TAC and what share is allocated to recreational users. It focuses attention on the problems of allocation between groups, and in particular how to accommodate growing angler pressure on resources.

One of the biggest problem of ITQ systems is that many perceive them as a panacea. They are certainly not that and they seldom obviate the need for all other fisheries management measures. The gap between theory and practice has been found to be great.

When considering "are we better off with ITQs than with conventional management systems" (Sutinen et al 1992) cited the management of the Australian southern bluefin tuna fishery by ITQs as the first example of success. This concerns me. While many people, including managers of the day, deserve considerable credit for their forward-thinking and even bravery for developing new systems and implementing them, I have grave reservations about the inference that the ITQ management process for southern bluefin tuna is a shining example. The ITQ system was introduced in 1984 at which time the Australian southern bluefin catch was 13411 tonnes per annum out of a global total of 36827 tonnes per annum. In 1995 the Australian quota is 5265 tonnes out of a global quota of 11750 tonnes, less than one third of 1984 levels, and opinion is still completely divided on whether or not the resource is still declining.

It must be acknowledged that there were several factors beyond the control of Australian managers which influenced the decline of the southern bluefin resource. However it can be argued that the implementation of the ITQ system was a most important factor in allowing the industry to move progressively westwards and exploit smaller and smaller fish and in masking complaints about the magnitude of the decline in the resource at that time.

There is little doubt that those fishers still operating in the southern bluefin tuna industry in 1995 are more efficient as a result of ITQs and that resource rents being generated are relatively high for a resource in a perilous state. But with the resource at much lower levels now than it was then and in the absence of any confidence about its future, it is extremely difficult to regard the outcome of management since 1984 as a success.

CONCLUSIONS

True common property would only exist if there were no controls on who exploited the resource. Conservation of the resource under such systems would only occur if total competition for the resource and resulting harvest did not exceed the resource's ability to sustain itself.

Customary marine tenure systems involve community control and have great merit provided external influences do not dominate. Most CMT systems that worked appear to have been based on a property right vested in respected local authorities, not in individuals.

The conservation mechanisms of CMT systems were often imprecise but they were in many cases effective. It is doubtful if this effectiveness can be maintained under growing external influences. The merits of reinstating the CMT systems which have collapsed would appear to need consideration on a case by case basis. Reinforcing the CMT process would also appear to need learned, local sociological input much more than the advice of an expatriate fisheries scientist.

Are ITQ systems applicable to Pacific Island fisheries? Again there appears no alternative to a case by case consideration. Once the objectives of management have been clearly defined, the pros and cons of an ITQ system can be evaluated. I am a supporter for ITQ systems in the Australian situation for single species, relatively simple fisheries. Not for multispecies complex ones. While I acknowledge they have several shortcomings my major concern is that their implementers get carried away by the pursuit of economic efficiency and devolving government responsibility and lose sight of the primary objective of fisheries management, which should be the conservation and sustainable use of the resource. Two of the world's most quoted examples of successful ITQ management schemes, the Australian southern bluefin tuna fishery and the New Zealand orange roughy fishery, are testimony to the need for much more concern over the resource base than is inherent in current ITQ practices.

When invited to give this talk I was asked to contemplate the relevance of ITQ systems to Pacific Islands. Accordingly I considered some likely candidates for ITQ management in this region, for example trochus, beche de mer, green snails and pearl oyster fisheries. I could not find one that I would recommend for ITQ management at the present time. I hasten to add that I would probably have a similar problem trying to identify a fishery ideally suited to any other prescribed form of fisheries management.

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Enhancement of marine fisheries

by Johann Bell,
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ENGLISH ABSTRACT

It is now recognised that most populations of marine species are limited by the supply of juveniles, and that many fisheries species no longer have levels of recruitment typical of a virgin stock. These findings have prompted fisheries scientists and managers to develop ways of enhancing recruitment. The broad objectives of these stock enhancement programs are to improve harvests by increasing recruitment to the carrying capacity of the habitat, or to rebuild depleted or threatened stocks. The main methods for stock enhancement involve release of juveniles reared in hatcheries, transplantation of wild "spat", making improvements to the quality and quantity of nursery habitats, creating harvest refugia to reduce growth and recruitment overfishing, and the manipulation of predators and competitors. Release of cultured juveniles is the primary method, but refinements are needed to optimise release strategies and to increase the fitness of individuals for live in the wild. Much emphasis is being placed on the need to measure the effects of stock enhancement. In particular, released juveniles need to be marked to distinguish them from wild stock as adults, or there needs to be large-scale sampling of the target population, and unenhanced (control) populations, on several occasions before and after enhancement. High value, sedentary species that are confined to circumscribed habitats, and for which mass rearing is routine, are likely to make the best candidates for enhancement. Industrial and experimental programs for stock enhancement of marine species are now in progress. Many of these programs have documented encouraging rates of survival of released juveniles, and evidence is mounting that stock enhancement can be cost-effective. In other cases, the high cost of producing juveniles, or low rates of survival, indicate that stock enhancement is not an option for management. On the negative side, careless application of enhancement could jeopardise the diversity of a species' genepool, introduce diseases, and alter the structure of communities through increased levels of competition and predation. Decisions to use stock enhancement should be based on thorough pilot studies to provide stakeholders with information to evaluate the advantages and disadvantages of this management tool. Such pilot studies are likely to take many years as they should include: i) extensive field experiments to optimise survival and growth of released juveniles, ii) responsible efforts to negate the risks of affecting the genepool of the target species and the risk of introducing diseases, iii) assessments of the impacts of releases on other species, and iv) analysis of the range of projected economic and social benefits.

6.4.7 Keynote paper for session on assessing human and financial needs and allocating responsibilities for management

Deciding Financial And Human Resources For Fisheries Management

by Hugh Walton
Head, New Zealand School of Fisheries

English version
(Original: English)

Introduction

Developing and maintaining appropriate strategies for sustainable management of coastal fisheries in the region is a complex task offering a myriad of options for consideration.

Whatever strategies adopted, there is an inevitable cost element and a need to put in place appropriately skilled people (be they formally or informally involved in the management process). This paper examines first the constraints on financial support to management and reviews a range of options for direct funding or cost cutting. Consideration is then given to human resource needs for various management strategies and emphasis placed on the importance of the planning process in developing and maintaining appropriate skill levels for people involved in the management programme or practice.

Returns from Resources

The South Pacific Commission (Adams and Dalzell, 1994) has made a brave attempt to place a financial value on the annual production and value of coastal resources. It is notable that whilst the projected figure of 243 million is a considerable sum of money, almost 80% of this sum is hypothetical, being produced and consumed in the subsistence or informal sector without financial transaction. That which is sold is often also traded informally, outside of direct taxation or revenue generation systems. Although it could be argued that the practice of taking marine resources produces government revenue through indirect taxation such as duty or VAT systems, in all probability the sum of money flowing to government hands from coastal resource use is a very small proportion of SPC's projected resource annual value.

Although we profess to place great importance on sustainability in resource management, the reality is that formal fisheries infrastructure is more often than not under-funded.

Whatever strategies adopted to manage and sustain resources, be they formal or community based, there will be costs incurred and a need to generate revenue in support of those costs.

Given that it is possibly difficult to directly associate expenditure on marine resource management with returns from management practices, it is not difficult to see why under-funding occurs within formal management organisations.

Financial resources - the reality

Whatever marine resource management needs and practices identified, there is a common need to access financial resources to implement programmes and operate management systems. Ideally, the budgetary governmental budgetary process would be one in which management planning included implementation costing and subsequent provision of adequate budget. Unfortunately, this ideal rarely exists.

In essence, resource managers do not generally get the opportunity to decide what financial resources are required to support a particular management programme or strategy. They may get to design and cost a programme but the decision on whether the programme will be financially resourced will be made at senior government level. Financial support for fisheries administrations has to line up alongside all manner of social service and developmental needs and it is unlikely that optimal funding will be on hand.

The reality is that financial resources are decided for managers and that the task of managers is the most efficient and effective utilisation of constantly limited financial resources to effect sustainable management practices.

In the absence of committed financial resources from central governments, many fisheries departments have relied heavily on external aid projects to support fisheries research and management initiatives. The resultant project oriented approach to research and management has the potential to adversely effect management initiatives through a lack of continuity and external funding dependency.

Financial Resources - Options for Fisheries Management

It is widely acknowledged that the management of marine resources and in particular, nearshore and coastal resources, is imperative to sustainable development for both the formal and informal economies of Pacific islands. It is also notable that policy formation and development regarding this sentiment and subsequent implementation of supportive practices has not necessarily followed a logical order.

Given that it is unlikely that resource managers will have access to adequate financial resources, the focus must be on efficient utilisation of all available resources, both physical and human.

Three possible directions for effecting management cost efficiencies are considered. The first, in greater sharing of information gathering cost responsibilities, the second, in the introduction of less costly management practices, and the third, common to all potential management practices, in ensuring efficient and effective people are in place within the management system.

Most countries and territories operate a centralised model for fisheries and marine resource administration and management. As a result, the task of accumulating scientifically useful resource management related information and implementing management practices has primarily been assigned to governmental based organisations or administrations.

The past five years have seen significant advances in the evolution and re-establishment of decentralised fisheries and marine resource management practices in the Pacific region with increasing attention to community based management and co-management practices.

The present workshop gives considerable attention to defining information needs for fisheries management. Whilst it is not the intention herein to discuss these needs in detail, it can be generally stated that most information collection systems operate from the top down with responsibility for information gathering and policy implementation assigned to the fisheries administration without significant involvement of formal or informal user community.

The classic model of fisheries administration and management employs both researchers and data-collectors who are tasked with the collection of various types of information relevant to fisheries management. For catch volume and species information this invariably involves active survey of landing points and markets and adsorbs significant human and material resources.

Acknowledgement of alternative practices for information gathering and for management in general has

been widely debated in national and regional fora. There is most certainly no standard equation which can be applied to a national situation to define optimum management strategies and practices but it is significant that greater use of community based and traditional systems in some countries has broadened the options scope for managers in terms of responsibility divestment.

Under the predominant model, the onus for the collection of resource related information is often placed on the fisheries administration. Catch effort and species surveys are undertaken by fisheries staff at markets and landing places ad nauseam and subsequently collated and analyzed. Interestingly, our Pacific model of this type of information collection has not followed the trend to place an increasing onus on fishers themselves to provide catch effort and species information as a matter of course. Fishers are obliged by regulation to submit regular detailed reports on fishing practices through the completion of data sheets and logbooks.

Although this practice might appear impractical for subsistence fishers, a simple logbook provided to small commercial operators (and appropriate extension support to assist with data entry) could save fisheries managers considerable time and effort. This practice has been adopted with some success in several Pacific small scale commercial fisheries and has also been promoted by the South Pacific Commission through the distribution of simple log books which record both information for fisheries managers and information for fishers about operational costs and profitability.

Logbooks are by no means the only option for including fishers in the network of information gathering. The concept of divesting responsibility for aspects of this task to resource users is certainly worthy of further consideration, not only as a cost efficiency mechanism, but also as a means on ensuring fisher participation in the management process.

The considerable interest in promoting alternative management systems such as co-management, community management or customary management is primarily a focus on introducing a management system that will work. However, the inclusion of fishers and resource users in the management process does imply significant cost efficiencies, particularly in the area of enforcement. If fishers are perceived as owning a particular management control (ie; if they participated in the formulation process and were satisfied with the outcome of the process), they will be prepared to participate in the monitoring and control process, thus eliminating the need for centralised enforcement systems.

Although the short term costs of ensuring community participation in the management process may prove to be considerable, it may be that once such a system is established, the cost of management can be significantly reduced.

The predominant mechanisms for direct funding of fisheries research and management are an annual allocation from government bulk funding and ad hoc funding from aid sources. It is perhaps appropriate to ask how many countries see a significant proportion of economic benefits from economic zone access and treaty agreements channelled back into the development and management of marine resources? How many countries could state with confidence that the levels of financial support to fisheries resource management equates with the importance of fisheries in the national economy and social system? Is it appropriate for countries with an industrial or significant commercial fishery to consider direct subsidy of fisheries management requirements from the commercial operations?

A possible list of potential direct funding mechanisms for fisheries management could include fuel or fishing gear sales tax, percentage levies on fisheries and marine products export and percentage allocation of access fees. The applicability of such funding will vary according to national circumstance and be subject to the specifics of national politics. It can only be concluded that the overall importance of sustainability in Pacific Island fisheries and marine resources requires politicians and administrators to aspire to more comprehensive financial support to resource management.

The `Human' Element

In 1991 the South Pacific Commission published a report on Human Resource Planning in the fisheries sectors of Pacific Island Countries. The findings of this report have been widely discussed in regional fora and have strongly influenced the work programme of the Commissions Fisheries Training Section. At the risk of repetition, the findings of this report are once again summarised herein as they collectively present the third area in which the costs of management might be reduced. The report noted:

- * the lack of effective regional coordination in education and training;
- * the absence of long term human resource development plans
- * the project oriented approach to fisheries in the absence of overall policy;
- * the lack of personnel information for the use of regional donor and educational institutions;
- * the lack of public awareness about fisheries resources, careers, and the principles of sustainable development;
- * the failure of Government systems to keep up with the pace of development;
- * the lack of effort in resource assessment
- * the reluctance by donor agencies to support in-country/and or regional educational institutions;
- * the immediate need for management training for senior fisheries personnel;
- * the need to provide development opportunities to support privatisation;

In short, the conclusion is that many fisheries administrations are inefficient and perform poorly and it follows that improvements in performance and efficiency are a key elements in the cost equation of fisheries management.

Recurrent themes such as the overall management skills of personnel trained as biologists or economists performing as staff and organisational managers, the deployment of staff in work areas in which they have little background, a lack of strategic planning or performance appraisal combine to promote a poor image for fisheries administrations.

It is apparent that, whatever marine resource management system is practised, perhaps the greatest financial efficiencies are to be gained through improved performance in administration and organisation. The question then, is how such efficiencies can be achieved?

The Structure and Organisation of Management

The overall responsibility for marine resource management in most countries and territories of the Pacific region is vested in one or more government or semi government organisations. Often charged with a multiplicity of tasks, these agencies must develop and put in place strategies that will ensure both the long term sustainability of marine resources and the maximum enjoyment of resource exploitation.

These organisations are thus required to put in place systems and personnel in support of a range of policies and practices and to ensure the ongoing efficiency of services and activities. In terms of personnel, the organisation must undertake both deployment of appropriately skilled staff and agents, and assure that such persons perform the tasks assigned to them.

In short, the process can be summarised as follows:

1. Define organisational function and objectives

2. Define appropriate organisational structure to carry out assigned function
3. Define personnel needs, functions and skill levels
4. Undertake training to equate personnel to appropriate skill levels
5. Plan work programmes
6. Monitor and evaluate performance

If we accept that most fisheries organisations are adequately developed in terms of overall function and (perhaps to a lesser extent) structure, the focus is then accorded to personnel, skill levels and performance. The process whereby organisations undertake to ensure adequate skill levels and personnel performance through defining the training and educational requirements for persons to operate successfully in their working situation and to put in place mechanisms to monitor performance and function and promote career development or job satisfaction.

This process, termed Human Resource Planning or Succession Planning, is increasingly being viewed as fundamental to ensuring efficient organisational performance. Whilst primarily a planning tool for the organisation, a well developed HR plan will also be of considerable use to educational planners, training providers and individual personnel.

For a fisheries organisation charged with responsibility for sustainable management of fisheries resources, the required skill base is potentially enormous. In order to undertake useful HR planning, it is first necessary to define the organisational objectives and priorities and the human and physical resources available. Fisheries administrations in the Pacific region are generally well armed with policy and objective statements and most have well developed work programmes clearly aligned to overall objectives.

In such instances, the practical HRD perspectives are relatively simplistic and can be summarised by matching suggested skill levels for a particular position with the actual skills of the individual in that position, and if there is an imbalance between the two, to plan and implement appropriate skill development for the individual. The cumulation of this information within an organisation and this skill based approach to organisational development can do much to improve organisational efficiency.

However, the effectiveness of HR planning is inevitably tempered by the extent to which overall organisational efficiency is promoted. A well trained and appropriately skilled person will only perform well if their work programme is well defined and their performance regularly reviewed. In short, if you take a unmotivated and ill directed person and train them, you get a trained unmotivated and ill directed person.

Management Tools for Human Resource and Strategic Planning

The effective implementation of HR planning requires a range of background information. Fundamental requirements include the provision of job or function descriptions for each position within an organisation (or within a management process) and the assurance that each individual is aware of the expectations of his or her position. Job descriptions should incorporate indicative skill or qualification levels and these in turn must be equated to known training or educational opportunities. Individual staff require clearly defined work programmes and understanding of what is expected of them and what resources are available to them.

The monitoring of performance relative to the work programme must be developed and managed and individuals must be given regular opportunity to report on and review aspects of their work programme with senior officers. Senior officers must be encouraged to acknowledge and reward positive staff performance but the same time be prepared to admonish poor performance.

Incorporation of these simple steps into both formal and informal aspects of fisheries management would do much to enhance both individual and organisational efficiency.

Management of organisations and people is a much studied science but it is not a formal part of the training of biologists or researchers. Short courses, certificates, diplomas and degrees in management have proliferated in recent years and are now generally accessible to those motivated to undertake them. Having senior officers upgrade specific management skills and practices could certainly produce greater efficiencies within fisheries administrations.

Opportunity in Fisheries Education and Training

The definition of skill level requirements and opportunities for personnel to access appropriate education or training is fundamental to the HR process. Given the demographic diversity and physical size of the region and the small population base, it is pleasing to note that the well developed extension services of both the University of the South Pacific and those of Guam and Hawaii have opened educational opportunities to many isolated areas. National institutions, more aligned to technical training are well established in capital centres, and although often constrained by limited budget offer a wide range of training opportunity.

For very small countries and territories, the provision of advanced technical training often requires overseas study. Similarly, for larger countries, when local opportunity is not available, advanced education is obtained overseas. The comparative economics of overseas training verses developing a national capacity to train or educate in a given area will always vary according to situation and circumstance. The key is in the strategic and sustainable nature of the training. How many people need to be trained in a particular subject area over a particular period of time? What are the options for training delivery and what would be most cost effective? This is the substance of educational planning for the regions fisheries sector and it is based on the premise that the information on numbers and skill requirements will be on hand.

The need for coordination in fisheries education and training in the region noted in the 1991 SPC report has significantly influenced the work programmes of the Forum Secretariat, the Forum Fisheries Agency and the South Pacific Commission. A Training Opportunities Database published by the Commission as a Directory on a bi-annual basis offers a comprehensive summary of courses and programmes on offer in Pacific rim countries and institutions. The Training and Education Special Interest Group Bulletin also circulated by the Commission provides an additional means of information exchange between training providers and users.

It is apparent that there is no shortage of educational or training opportunity for fisheries management skill enhancement. Perhaps the key point is to ensure that the right people get the right training.

Conclusion: The Challenge for Fisheries Managers

The Pacific region faces a major challenge in the sustainable management of fisheries and marine resources. With increasing urban growth and unemployment governments are looking to improved returns to the national economy through enhanced employment opportunities in the seafood sector as a mechanism to improve our regions rate of sustainable return from resources. Can the formal sector

provide opportunities to assist in the employment of urban youth? What is required to ensure that resources exploited by the informal sector are sustained to meet the needs of growing populations? These questions are answered by different countries in different ways but responses are linked by the common need for effective management of marine resources.

Whatever management process is in place, strategic planning, particularly human resource planning is fundamental to effective delivery as is the adequate allocation of financial resources.

Fisheries managers must therefore also excel as people managers and financial managers in addition to their roles as biologists, economists and social scientists.

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L'affectation de Ressources Financières et Humaines à la Gestion des Pêches

Version Française
(Original: Anglais)

Keynote Paper 8: Document présenté par
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INTRODUCTION

L'élaboration et la mise en oeuvre de stratégies adaptées de gestion durable de la pêche côtière dans la région sont des tâches complexes qui obligent les décideurs à opérer un choix parmi une multitude de possibilités.

Quelles que soient les stratégies adoptées, elles s'accompagnent inévitablement de dépenses et exigent l'affectation de personnes possédant les compétences voulues (qu'elles participent au processus de gestion à titre officiel ou officieux). Dans ce document, nous étudierons en premier lieu les contraintes qui se limitent à l'aide financière qui peut être accordée aux activités de gestion et diverses solutions possibles pour le financement direct ou la réduction des coûts. Nous examinerons ensuite les besoins en ressources humaines qu'impliquent diverses stratégies de gestion et nous insisterons sur l'importance qui est accordée au processus de planification dans le cadre de la formation qui est donnée aux personnes impliquées dans la gestion ou l'exécution de programmes pour les amener au niveau de compétence voulu et pour les y maintenir.

LES REVENUS TIRES DES RESSOURCES

La Commission du Pacifique Sud (Adams et Dalzell, 1994) a fait de louables efforts pour attribuer une valeur financière à la production annuelle et à la valeur globale des ressources côtières. Le montant de 243 millions qu'elle a avancé est certes considérable, mais il faut noter que 80 pour cent de cette somme ne sont en fait que des extrapolations, fondées sur la production et la consommation dans le secteur vivrier ou informel qui ne donnent lieu à aucune transaction financière. Quant aux transactions monétaires, elles se font souvent de façon informelle et échappent à la fiscalité directe ou aux autres producteurs de recettes. On pourrait certes faire valoir que l'activité de pêche produit des recettes pour le gouvernement, par le biais d'impôts indirects tels que les droits de douane ou la taxe sur la valeur ajoutée (TVA), mais il est plus que vraisemblable que les recettes que le gouvernement réalise sur l'exploitation des ressources côtières ne représente qu'une infime partie de la valeur annuelle de la ressource, extrapolée par la CPS.

Nous prétendons que l'exploitation durable est le principal objectif de la gestion des ressources, mais le fait est que l'infrastructure officielle dans le secteur des pêches est plus souvent qu'à son tour insuffisamment financée.

Quelles que soient les stratégies, officielles ou communautaires, adoptées pour gérer les ressources et en assurer l'exploitation durable, il faudra nécessairement engager des dépenses, et réaliser des recettes pour absorber ces coûts.

Comme il peut être difficile de montrer qu'il existe un rapport direct entre les dépenses engagées pour la gestion des ressources marines et les recettes réalisées sur celles-ci grâce aux méthodes de gestion, on comprend aisément pourquoi les organismes de gestion officiels manquent de fonds.

QU'EN EST-IL VRAIMENT DES RESSOURCES FINANCIÈRES ?

Globalement, on s'accorde à dire que la gestion des ressources marines, et plus particulièrement celle des ressources littorales et côtières, est essentielle au développement durable des économies structurées et informelles des Îles du Pacifique, mais il est tout aussi évident que l'élaboration et la mise en œuvre de politiques ne suivent pas nécessairement un ordre logique, et qu'il y a souvent une différence marquée entre ce que préconise la politique et ce qui se passe en réalité.

Il est généralement admis, à l'heure actuelle, que les modèles modérés de production maximale soutenue et les exigences administratives centralisées qui les accompagnent peuvent trouver une application restreinte dans un milieu tropical caractérisé par la multitude des espèces; en fait, au cours des cinq dernières années, on a constaté que des progrès notables ont été réalisés dans les domaines de la gestion concertée et de la gestion communautaire. Il reste cependant que la majorité des Îles du Pacifique ont hérité de modèles centralisés pour l'administration de la pêche et des ressources marines, et que la collecte d'informations sur la gestion et la mise en œuvre de méthodes de gestion demeure à la charge de ces organismes.

Dans le cadre de ce séminaire, nous nous efforcerons de cerner les besoins d'information dans le domaine de la gestion des pêches. Nous n'avons pas l'intention d'examiner ces besoins en détail, mais nous pouvons avancer, de façon générale, que la majorité des systèmes de collecte d'information sont structurés selon une hiérarchie verticale dans laquelle la responsabilité de la collecte de données et de la mise en œuvre de politiques échoit à l'organisme chargé de l'administration des pêches, sans que les utilisateurs des secteurs structuré ou informel y participent de façon significative.

Dans une structure classique, l'organisme chargé de l'administration et de la gestion des pêches fait appel à des chercheurs et à des spécialistes de la saisie de données qui sont chargés de recueillir divers types d'informations ayant trait à la gestion des pêches. Dans le cas de données sur le volume des prises et la composition par espèces, cette étude implique obligatoirement une intervention directe au point de débarquement et sur les marchés et met en œuvre d'importantes ressources humaines et matérielles.

L'utilité de méthodes différentes pour la collecte de données et la gestion en général a été abondamment débattue dans des tribunes nationales et régionales. Il est évident qu'il n'existe pas d'équation-type que l'on puisse appliquer à une situation nationale pour arriver à des stratégies et à des méthodes de gestion optimales; il vaut cependant la peine de relever qu'une utilisation accrue de systèmes communautaires et traditionnels dans certains pays a multiplié les possibilités pour les gestionnaires de déléguer leurs responsabilités.

Indépendamment des besoins qui ont été cernés et des méthodes qui ont été élaborées dans le domaine de la gestion, il existe un besoin, commun à toutes les méthodes; il s'agit de l'accès à des ressources financières pour mettre en œuvre les programmes et exploiter les systèmes. Le processus budgétaire idéal consisterait à ce que lors de l'établissement du plan de gestion, on établisse le coût de la mise en œuvre et élabore un budget qui y correspond. Malheureusement, cette situation idéale se présente rarement.

Dans les faits, les gestionnaires n'ont généralement pas la possibilité de décider de quelles ressources financières ils ont besoin à l'appui d'un programme ou d'une stratégie de gestion particuliers. Ils peuvent tout au plus élaborer un programme et en établir le coût, mais la décision de le financer est prise dans les hautes sphères du gouvernement. L'aide financière qui doit être accordée au service des pêches est examinée en même temps que toutes sortes d'autres besoins en matière de services sociaux et de développement, et il est peu vraisemblable que le gouvernement dispose des fonds nécessaires pour tout financer de façon optimale.

En réalité, le montant des financements est imposé aux gestionnaires, dont la tâche consiste à tirer le meilleur parti de ressources financières qui sont constamment inférieures à leurs besoins, pour mettre en œuvre des méthodes de gestion durable.

Faute d'engagements financiers fermes des gouvernements centraux, de nombreux services des pêches comptent fortement sur des projets d'aide extérieure pour financer les activités de recherche et de gestion halieutiques. Il en résulte que l'approche qui a été adoptée le plus souvent pour les activités de recherche et de gestion est axée sur les projets; elle manque cependant souvent de continuité, car des membres essentiels du personnel ou des fonds budgétaires sont retirés sans qu'il soit tenu compte des besoins cycliques.

RESSOURCES FINANCIÈRES - OPTIONS POUR LA GESTION DES PÊCHES

Comme il est peu probable que les gestionnaires auront accès à des ressources financières suffisantes, ils pourront essayer de réaliser des économies sur les frais de gestion en intervenant dans trois secteurs interdépendants. Une première solution consiste à partager davantage les coûts afférents à la collecte d'information, la seconde à mettre en œuvre des méthodes de gestion moins coûteuses et la troisième, qui peut s'appliquer à toutes les méthodes de gestion pouvant éventuellement être adoptées, consiste à placer des personnes efficaces dans le système de gestion.

Dans le modèle hiérarchique vertical, qui est le plus commun, la responsabilité pour la collecte d'information sur la ressource incombe souvent au service des pêches. Des études sur l'effort de pêche et la composition par espèces sont effectuées par le personnel du service des pêches, sur les marchés et aux lieux de débarquement, puis regroupés et analysés. Il est intéressant de constater que le modèle adopté dans le Pacifique pour ce genre de collecte d'information ne suit pas la tendance qui consiste à confier davantage aux pêcheurs la responsabilité de fournir des données sur l'effort de pêche et la composition par espèces dans le cadre de leur travail courant. Les pêcheurs sont tenus par les règlements à présenter régulièrement des rapports circonstanciés sur les méthodes de pêche en remplissant des feuilles de contrôle et des cahiers de pêche. Cette méthode peut sembler irréalisable dans le cas des pêcheurs de subsistance, mais il suffirait de remettre un cahier de pêche simple aux petits exploitants commerciaux (et les aider à saisir les données grâce à des activités de vulgarisation adaptée) pour économiser beaucoup de temps et de travail aux responsables de la gestion des pêches. Cette méthode a été adoptée avec un certain succès dans plusieurs petites entreprises de pêche commerciale du Pacifique, et elle est également préconisée par la Commission du Pacifique Sud, qui distribue des cahiers de pêche simples, dans lesquels sont consignés les renseignements à l'intention des responsables de la gestion des pêches et des pêcheurs sur les frais d'exploitation et la rentabilité.

Les cahiers de pêche sont loin d'être la seule méthode permettant d'impliquer les pêcheurs dans les réseaux de collecte d'information. L'idée de confier la responsabilité pour certains aspects de cette tâche aux utilisateurs de la ressource est certainement digne d'être envisagée, non seulement comme mécanisme de rentabilisation, mais également comme un moyen de garantir la participation des pêcheurs au processus de gestion.

L'intérêt marqué que d'aucuns portent à la promotion de systèmes de gestion différents, telles que la gestion concertée, la gestion communautaire et la gestion traditionnelle, participe principalement des efforts entrepris pour mettre en œuvre un système de gestion qui produira des résultats. Cependant, la participation des pêcheurs et des utilisateurs de la ressource au processus de gestion n'entraîne pas d'importantes économies, particulièrement dans le secteur de la mise en œuvre. Si les pêcheurs ont le sentiment d'exercer un certain contrôle (c'est-à-dire s'ils ont participé au processus d'élaboration et s'ils

sont satisfaits du résultat de celui-ci), ils seront disposés à participer au processus de suivi et de contrôle, ce qui éliminera le besoin de systèmes centralisés de mise en œuvre.

Les efforts déployés pour garantir la participation de la collectivité au processus de gestion risquent d'être coûteux à court terme, mais il semble évident que lorsqu'un tel système est bien rodé, les frais de gestion sont sensiblement réduits.

Les principaux mécanismes mis en œuvre pour le financement direct de la recherche et de la gestion halieutiques sont l'affectation annuelle de fonds sur les financements d'ensemble accordés par le gouvernement et des financements ponctuels par des bailleurs d'aide. Il convient peut-être de se demander comment de nombreux pays envisagent de réinjecter une part importante des bénéfices économiques réalisés sur les traités de pêche dans leur zone économique dans la mise en valeur et la gestion des ressources marines. Combien de pays pourraient affirmer avec certitude qu'il y a adéquation entre l'aide financière consentie à la gestion des ressources halieutiques et l'importance que revêt la pêche pour l'économie et les systèmes sociaux nationaux ? Convient-il que les pays qui ont une pêche industrielle ou une importante pêche commerciale envisagent de subventionner directement la gestion des pêches à partir des opérations commerciales ?

On peut envisager différentes sources de financement direct pour la gestion des ressources halieutiques : taxe sur la vente de carburants ou d'engins de pêche, prélèvement d'un pourcentage sur les exportations de produits de la mer ou sur les droits d'accès aux zones de pêche par exemple. L'utilisation de tels financements variera en fonction de la situation du pays et des particularités de la politique nationale. En conclusion, il faut que les dirigeants politiques et les administrateurs, compte tenu de l'importance d'une exploitation durable des zones de pêche des pays insulaires, cherchent à mobiliser davantage de fonds en faveur de la gestion des ressources.

L'ÉLÉMENT HUMAIN

En 1991, la Commission du Pacifique Sud a publié un rapport sur la planification des ressources humaines dans le secteur de la pêche dans les pays insulaires du Pacifique. Les résultats de ce rapport ont fait l'objet de nombreux débats dans les assemblées régionales et ont beaucoup influencé le programme de travail de la section formation du département des pêches de la Commission. Comme s'il s'agit du troisième secteur dans lequel il serait possible de réduire les coûts de gestion, ces résultats sont repris brièvement ci-après :

- ☞ manque de véritable coordination régionale dans le domaine de l'éducation et de la formation;
- ☞ absence de programmes de mise en valeur de ressources humaines à long terme;
- ☞ absence de politique générale du secteur de la pêche, dont les activités se déroulent plutôt sous forme de projets;
- ☞ manque d'information du personnel en ce qui concerne le recours aux bailleurs de fonds et aux établissements de formation de la région;
- ☞ manque de sensibilisation de l'opinion publique à la protection des ressources halieutiques, aux possibilités de carrière et aux principes du développement durable;
- ☞ insuffisance des efforts d'évaluation des ressources;

- ☞ réticence des bailleurs de fonds B soutenir des établissements de formation locaux ou régionaux;
- ☞ besoin urgent de former les cadres des services des pêches B la gestion;
- ☞ nécessité de prévoir des possibilités de développement pour soutenir la privatisation.

En conclusion, de nombreux services des pêches sont inefficaces et leurs résultats peu satisfaisants; une amélioration est nécessaire dans ce domaine pour réduire les coûts de la gestion des ressources.

Les médiocres aptitudes B la gestion des biologistes ou économistes chargés d'encadrer le personnel ou d'administrer un service, l'utilisation d'agents dans des domaines qu'ils connaissent mal, le manque de planification stratégique et d'évaluation des résultats se combinent pour donner une image peu brillante des services des pêches.

Quel que soit le système de gestion adopté, c'est sans doute l'amélioration des structures administratives de l'organisation qui permettra au mieux d'obtenir les meilleurs résultats sur le plan financier. Il reste B déterminer comment procéder.

STRUCTURE ET ORGANISATION DE LA GESTION

En général, la responsabilité de la gestion des ressources marines est confiée dans le Pacifique B un ou plusieurs services publics ou semi-publics; souvent chargés de t>ches multiples, ils doivent concevoir et appliquer les stratégies qui permettront une exploitation B la fois durable et optimale des ressources marines.

Il leur faut donc prévoir des dispositions et du personnel pour mettre en œuvre différentes politiques et dispenser avec efficacité les services habituels. En ce qui concerne le personnel, ces services doivent faire en sorte de disposer d'agents suffisamment qualifiés et de veiller B ce qu'ils accomplissent bien les t>ches qui leur sont confiées.

Il s'agit en résumé de procéder comme suit :

1. définir les fonctions du service
2. définir les structures qui conviennent le mieux B l'accomplissement des fonctions prévues
3. définir les besoins en personnel, ses fonctions et ses compétences
4. prévoir les formations nécessaires pour donner au personnel le niveau de compétence requis
5. préparer le programme de travail
6. suivre et évaluer les résultats

Nous pouvons considérer que la plupart des services des pêches ont déjà défini de façon satisfaisante leurs fonctions générales et (dans une moindre mesure peut-être) leurs structures; il convient donc de mettre l'accent sur le personnel, les compétences et les résultats. Il s'agit pour ces services de donner au personnel les compétences requises en définissant les formations dont il a besoin pour mener son travail B bien, et d'atteindre des résultats satisfaisants en prévoyant des mécanismes de suivi ainsi que des évolutions de carrière ou des mesures incitatives.

De plus en plus, ce processus nommé planification des ressources humaines ou planification des recrutements, est considéré comme fondamental pour le bon fonctionnement des organisations. Bien qu'il s'agisse avant tout d'un outil de planification, un programme de mise en valeur des ressources humaines

bien conHu peut être aussi très utile B ceux qui se chargent de prévoir et de fournir des cours de formation ainsi qu'au personnel.

Les services des pêches, dans la mesure où ils sont responsables de la gestion durable des ressources halieutiques doivent disposer de compétences d'une grande variété. Pour que la planification des ressources humaines soit utile, il faut d'abord définir les objectifs et les priorités du service et déterminer quelles sont les ressources humaines et matérielles disponibles. En général, les services des pêches du Pacifique définissent avec précision leur politique et leurs objectifs et se dotent pour la plupart de programmes de travail bien conHus et correspondant aux objectifs généraux.

Le travail de mise en valeur des ressources humaines est relativement simplifié dans de tels cas puisqu'il s'agit de comparer les compétences théoriquement requises pour un poste avec les compétences réelles de la personne qui l'occupe et, si elles ne correspondent pas, de prévoir un programme de formation pour la personne en question. Les informations ainsi rassemblées et la démarche qui consiste B mettre l'accent sur les compétences peuvent beaucoup contribuer B l'amélioration de l'efficacité du service. Toutefois, les résultats de la planification des ressources humaines dépendent bien évidemment de la manière dont l'efficacité est encouragée dans le service. Un agent doté de la formation et des aptitudes adéquates ne travaillera correctement que si son programme est bien défini et que ses résultats font l'objet d'un suivi régulier. En bref, en formant une personne peu motivée et mal dirigée, vous n'obtiendrez qu'une personne compétente peu motivée et mal dirigée.

INSTRUMENTS SIMPLES DE PLANIFICATION STRATÉGIQUE ET DE MISE EN VALEUR DES RESSOURCES HUMAINES

La planification des ressources humaines nécessite un certain nombre d'informations de base. Il convient avant tout de disposer de descriptions de poste ou de fonctions pour chaque emploi existant au sein d'un service (ou prévu dans le cadre d'un processus de gestion) et d'être sûr que chaque personne est informée de ses attributions. Les descriptions de poste doivent indiquer le niveau de qualification requis qui doit B son tour être comparé aux possibilités de formation ou d'éducation existantes.

Il faut aussi que les agents aient des programmes de travail précis et comprennent ce qu'on attend d'eux et de quelles ressources ils peuvent disposer. Il convient de prévoir et de gérer le suivi de leurs activités en le comparant au programme de travail et de leur donner périodiquement l'occasion de faire le bilan de ce travail avec les chefs de service.

Ces mesures simples, intégrées de manière formelle et informelle B la gestion des ressources, peuvent améliorer considérablement l'efficacité des individus et du service en général.

COORDINATION DE LA FORMATION DANS LE DOMAINE HALIEUTIQUE

Il est fondamental dans le cadre de la mise en valeur des ressources humaines, de définir les besoins en compétence et les possibilités de formation qui s'offrent au personnel. Compte tenu de la diversité démographique, de l'immensité de la région et de sa faible population, il est agréable de constater que les services de vulgarisation de l'Université du Pacifique Sud ainsi que de Guam et de Hawaii offrent des possibilités de formation B beaucoup d'Iles isolées. Les établissements nationaux, plus orientés vers la formation technique, sont nombreux dans les capitales et offrent aussi des possibilités de formation variées en dépit de leurs ressources financières souvent limitées.

Les habitants des Etats et territoires les plus petits doivent souvent se rendre B l'étranger pour bénéficier

de formations techniques de niveau avancé. C'est ce qui se produit aussi dans les grands pays lorsque les formations recherchées ne se trouvent pas sur place. L'intérêt économique d'une formation B l'étranger par rapport B la mise B disposition de moyens nationaux pour organiser cette formation sur place varie en fonction des circonstances. Le caractère stratégique et durable de la formation est l'élément-clé. Combien faut-il former de personnes dans un domaine donné et pour une période donnée ? Parmi les différentes possibilités d'organisation de la formation en question, quelle serait la moins coûteuse ? Ces questions doivent former la base de la planification en matière de formation dans le secteur halieutique; il faut en conséquence que les informations requises soient disponibles.

Le rapport établi par la CPS en 1991, en mettant l'accent sur la nécessité d'une coordination de la formation halieutique dans la région, a fortement influencé le programmes de travail du Secrétariat général du Forum, de l'Agence des pêches du Forum et de la Commission du Pacifique Sud. A partir de la base de données qu'elle a constitué sur les possibilités de formation, la Commission publie deux fois par an un répertoire qui résume de manière exhaustive les cours et programmes offerts dans les pays en bordure du Pacifique. Le bulletin "Ressources marines et formation", également diffusé par la Commission, constitue une autre source d'information pour les pourvoyeurs et les demandeurs d'information.

Il semble que les possibilités de formation dans le domaine de la gestion des ressources ne manquent pas, mais il faut avant tout faire en sorte que les bonnes formations soient dispensées aux personnes qui conviennent.

CONCLUSION : LE DÉFI QUE DOIVENT RELEVER LES CHEFS DES SERVICES DES PÊCHES

La gestion durable des ressources marines constitue pour la région du Pacifique un enjeu considérable. Compte tenu de l'urbanisation et du chômage croissants, les pouvoirs publics s'efforcent d'accroître les revenus des pays en améliorant les possibilités d'emploi dans le secteur halieutique, dans le but d'augmenter de manière durable la productivité des ressources. Le secteur structuré pourra-t-il favoriser l'emploi des jeunes des agglomérations urbaines ? Comment faire en sorte que les ressources exploitées par le secteur non structuré restent suffisamment équilibrées pour répondre aux besoins d'une population croissante ? Les réponses apportées B ces questions par les différents pays sont différentes mais elles ont toutes en commun la nécessité d'une gestion efficace des ressources marines.

Quel que soit le système de gestion en place, la planification stratégique, et en particulier la mise en valeur des ressources humaines, de même qu'une répartition avisée des ressources financières, sont nécessaires au bon fonctionnement des services des pêches.

Il faut par conséquent que les chefs des services des pêches, outre leur fonction de biologistes, d'économistes et de spécialistes des sciences sociales, assurent également une excellente gestion des ressources humaines et financières.

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Post-harvest Activities and their Relevance to Fisheries Management with Regard to Conventional Fisheries Products

By Steve Roberts, Post-harvest Fisheries Adviser
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ENGLISH ABSTRACT

Pacific Island nations consider their inshore fisheries resources to be a valuable asset that must be utilised for their own benefit. Effective management of these resources so that they can be exploited in a responsible, sustainable way is the desired objective. Factors such as high population growths, maintaining food security for local inhabitants, creation of employment, increasing demand for seafood products from overseas, development of a tourist industry, Governments' growing needs for foreign currency, etc., will make the task of establishing effective resource management plans a challenging one.

The paper examines the contribution post-harvest fisheries technology can make to the resource management process, to help maintain or possibly increase the value and returns from inshore resources, if they can continue to be commercially exploited. Key post-harvest fishery activities such as value-added processing of conventional seafood products; identifying alternate/new resources that can be exploited; developing novel product formats; ensuring the full consideration has been given to utilising by-products and processing waste; establishing product standards; introducing modern quality assurance procedures such as HACCP, QMP, etc.; and, improving trade information to help plan production and export marketing strategies, are discussed. Conventionally traded products from the Pacific such as fin fish, shellfish, beche-de-mer, etc., are used as examples.

Les activités de valorisation des produits de la pêche et leur intérêt pour la gestion des ressources halieutiques traditionnelles

Document présenté par Steve Roberts, conseiller pour la valorisation des produits de la pêche
Programme pêche côtière, Commission du Pacifique Sud

RESUME FRANCAIS

*Les pays insulaires du Pacifique considèrent leurs ressources côtières comme un atout précieux et entendent les utiliser **B** leur propre profit. L'objectif recherché est une gestion rationnelle qui permette d'exploiter ces ressources de manière responsable et durable. Cependant, la croissance démographique, la nécessité d'assurer la sécurité alimentaire des populations locales et de créer des emplois, la demande croissante de produits de la mer **B** l'étranger, le développement du tourisme et les besoins grandissants de l'Etat, de disposer de recettes en devises, sont autant de facteurs qui*

font de la mise en place de programmes de gestion des ressources une tâche difficile.

*L'auteur étudie de quelle manière les techniques de valorisation des produits de la pêche s'inscrivent dans le processus de gestion des ressources, en contribuant **B** maintenir ou **B** accroître la valeur des ressources côtières et les revenus qui en sont tirés et **B** déterminer si leur exploitation commerciale peut se poursuivre. Il évoque les principales activités de valorisation, comme la transformation, créatrice de valeur ajoutée, des produits traditionnels de la pêche, la recherche de nouvelles ressources susceptibles d'être exploitées, la mise au point de nouvelles présentations des produits, la nécessité de bien utiliser les produits dérivés et de transformer les résidus, l'élaboration de normes de qualité des produits, la mise en place de procédures de contrôle de la qualité (analyse des risques aux points critiques, suivi de la qualité, etc.) et l'amélioration des informations sur la commercialisation, afin de faciliter l'élaboration des programmes de production et des stratégies d'exportation. Les exemples utilisés portent sur les produits de la mer habituellement commercialisés, tels que poissons, coquillages ou holothuries.*

6.4.9 Keynote paper for session on crisis management and emergency intervention measures

Crisis management and emergency intervention measures - prioritisation of response

by Patricia Kailola

Introduction

The definition of 'crisis' in the Oxford dictionary is one which we can all warm to - or at least acknowledge. It is:

"crisis, n. - turning-point, esp. of disease; time of danger or suspense in politics, commerce, etc."

⊕Emergency intervention' is response to crisis - i.e. if it's a crisis then it must be emergency intervention, and not simply intervention - shouldn't it?

In the field of fisheries management, what is a crisis? Paul Dalzell (SPC, Noumea) offered the definition that it is "anything where a fishery is threatened by a rapid series of events"; but as this address unfolds it will be seen that crises are rarely rapid. Perhaps it is our realisation that is rapid... Yet it is an empty action, as by then the fishery itself may be a long way past the original threat...

The state of crisis appears to be the cloak of fisheries managers. Alistair McIlgorm (Australian Maritime College, Tasmania) remarked that managers are always in crisis yet they mask their situation by a veneer of calm and control; and Tony Lewis (SPC, Noumea) commented that fisheries managers "only work when there is a crisis - and they're always working". Do you recognise yourself here? Fisheries managers are always fighting bushfires, and there is a range of small to large fires lined up to be fought.

The point of this address is to

- a) analyse crisis management and then
- b) investigate whether fisheries managers can apply a formula to responding to crises.

Analysis

What do we respond to in a crisis? To whom are we responsible? For what are we responsible? Who will 'do the right thing' by whom in a crisis?

It is important to acknowledge that one series of events may be a crisis for one manager but may not be for another; and what is a crisis in one country may not be in another.

At this point it is appropriate to examine two sections of information which may seem to be diversions but which are important to an analysis of crisis management. The sections describe the types of fisheries crises and the sources of fisheries crises.

Types of fisheries management crises

(Examples are given only. The list is in no way exhaustive)

- ☞ Stock collapse with or without management (gemfish and southern bluefin tuna in temperate Australia; beche-de-mer in many tropical Indo-Pacific countries; shark fisheries in temperate Australia; ornate rock lobster in PNG through trawling; coconut crabs; turtles; barramundi in southern PNG)
- ☞ Environmental issues affecting fisheries (blooms of toxic blue-green algae in river systems resulting from poor agricultural land use; cold water from the lower water column of reservoirs released downstream and impacting on fish populations; sedimentation of reefs; agricultural chemical run-off and sewage outlets into the sea; sediment run-off from deforestation; introduction of organisms via ships' ballast water; destruction of fish nursery areas from the clearing of mangrove habitats and shore developments)
- ☞ Disease outbreaks with or without apparent cause (red tide/paralytic shellfish poisoning; effluent toxins from beche-de-mer processing; mass mortality of diseased fish; unpredictable incidence of ciguatera fish in marketed fish)
- ☞ Explosive population growth of aquatic organisms (crown-of-thorns starfish; tilapia in northern PNG rivers; carp in Australia; Salvinia in the Sepik River)
- ☞ Super-abundance of fish leading to massive price drops at markets (trochus relying on current fashions, but what if they change?; Japan being the major market for sashimi tuna, but what if it stops importing?; with several nations developing the one export fishery, a drop in returns could result from a satisfied market)
- ☞ New fishery management vs industry (orange roughy in temperate Australia), traditional fishing (turtles, dugong), anglers (license fees)
- ☞ 'Green movement' inspired opposition to fishing methods (turtle/trash exclusion devices (TEDs); drifting gillnets; dolphins in purse seines; trawling in coastal harbours/bays; tuna longlining and albatross captures)
- ☞ User group conflicts (customary marine tenure (CMT) - the younger generation's priorities and money needs vs custom; CMT vs national fisheries management; CMT vs fishery development - e.g. of nearshore pelagics; coastal fisheries - shore developments, multiple water use; trawl bycatch; multigear fishing on one stock; tuna baitfishing in PNG resulting in payment of royalties; social and habitat effects of the live fish trade; recreational billfish fishing vs commercial longlining for tuna in north-eastern Australia; mariculture vs habitat retention and access)
- ☞ Introductions of alien species (trout and other species in PNG; tilapia in some western Pacific nations; Nile perch in Australia, Lake Victoria; release, establishment and impossible eradication of carp in Australia and of freshwater aquarium fish in several nations; sedentary marine resources beyond their natural distributions)

Other examples of crises are included in the body of this address and were identified in country papers and by individuals participants at the workshop, and were given in the two papers in this session. These papers were "Effective management of coconut crab resources: is it possible?" by Rick Fletcher; and "Investigations into the causes and implications of the wave of pilchard (*Sardinops sagax neopilchardus*) deaths across Western Australia during April to June 1995" by Rick Fletcher and Brian Jones.

Sources of fisheries management crises

Is there a difference in managing the crisis if it is generated from a different source? The answer is “Yes”. (And there is certainly a difference in managing in different countries, depending on the resources available to manage).

What are the sources of a crisis? It appears to me that there are five sources of crisis: politics; the resource; economics; environment; society. Crises also arise from combinations or interactions of any of these.

1. Politics.

Politics affects national, regional and provincial fisheries matters. Political issues are never far from fisheries and they are a source of crisis when they require that fisheries managers takes a direction contrary to sound (logical) fisheries management. Moreover, fisheries crises emanating from politics often have a deeper basis in social issues (e.g. increasing human populations). These situations lead to a pressure 'from above' to act - and also pressure not to act (such as in Polynesia). Implementation of customary marine tenure itself is political; and when is this implementation more appropriate than controls emanating from the 'west'? Implementation of fisheries regulations the 'Pacific Way' is often bound into politics from the very top and certainly through community relationships.

It is questionable whether a politician's first priority can be the best interest of the fisheries resources and the environment. It has to concentrate first on votes (i.e. his acceptance by the community) as failure in that context removes the power to act. In other words, if he is not there as a politician, he cannot play any role in fisheries. Although political actions in fisheries may run counter to the knowledge and experience of fisheries managers, if the actions are either popular with or ignored by the people, is that because awareness programs pertaining to careful harvesting and resource sustainability have not been effective? Does the source of the crisis actually lie with the fisheries department?

Many poorly conceived fisheries in the western Pacific are the result of political motivations and, in turn, these frequently incur economic and environmental crises. Examples are the introduction of trout and carp in the Highlands of PNG (non-endemic species introduced to provide fish protein: few trout populations have established and required farming is uneconomic; carp have spread into lowland river systems), pearl oyster introductions to unsuitable areas or economic climates, the setting of unsustainably high harvest quotas for trochus for the same reason, tilapia introductions to inappropriate aquatic systems or regions where their taste is not preferred, and seaweed farming to unsuitable physical environments.

Political crises in fisheries are more likely in countries where politicians have a fast turn-around (e.g. in Australia, PNG, Solomon Islands) than in countries where the political system is conservative or very stable (e.g. Tonga) or where customary marine tenure is effective (e.g. Western Samoa, Tokelau, Cook Islands, Tuvalu). This is because the politicians do not remain long enough to bear the results of their actions. In addition, where fish consumption is very important in the community (e.g. in many Micronesian and Polynesian nations) there are less likely to be hasty decisions affecting the availability of fish to domestic consumers, with most attention being paid to export fisheries.

An interesting crisis being experienced in Vanuatu (this workshop) has a political foundation. The Department of Fisheries in Vanuatu lost experienced staff following the 1993 national public servants' strike, and the loss of experience has impacted negatively on the department's management efforts.

2. The resource.

Resource crises are often perceived first by biologists and fishers. The crises come in two forms. The first is when the resource itself behaves differently to its 'usual' behaviour. For example, the non-appearance of jack mackerel off the Tasmanian coast in several successive years in the early 1990s caused a crisis to local commercial fishers and dependent industries. Another, closer to 'home', is when populations of the crown-of-thorns starfish increase very rapidly and impact heavily on coral reef systems. The unexplained death of thousands of fish is the subject of one presentation in this session.

The second resource crisis is when fished stocks decrease (rapidly) and different levels of resource users are affected. Guam, Palau and the Maldives all reported at the workshop on a particularly sorry resource crisis - where the alliance of improved fishing gear and fish targeting practices has impacted on the reproductive capacity of some fish populations or caused their local extinction (e.g. of large terminal phase parrotfish and wrasse - *Bolbometopon muricatum*; *Cheilinus undulatus*). Examples of resource crises including economic and social bases are where deepwater snapper stocks are being negatively impacted by fishing pressure in some western Pacific nations, leading to loss of export income and displacement of fishers and vessels, and where the export of reef fishes to other western Pacific nations (e.g. to Nauru; to Saipan in the Marianas) has the potential to seriously affect stocks and consumers in the originating countries.

3. Economics.

This source of crisis is manifest in export fisheries yet it impacts domestic fisheries. Examples include the high market prices of locally caught fish, the regularity of inter-island transport and the availability of ice or post-harvest skills. Domestic market 'gluts' are another common example. Export fisheries can be affected by trade balances, price checks, and changes in exchange rates, transport services and changes in market preferences (e.g. for different species of beche-de-mer). A potential crisis in fisheries exports from western Pacific nations is the possible U.S.A. requirement that the products must meet HACCP standards before they can be imported to that country.

4. Environment.

Fish kills are sudden events often caused by the release of toxic effluent into the sea or rivers. Reclamation of sea frontage and salt marshes and clearing of mangrove areas for building construction and marinas, destruction of seagrass beds, coral reefs and other nearshore habitats from terrestrial events such as deforestation, general siltation and the use of agricultural chemicals are all sources of environmental crises. Developers work faster than they can be monitored by an environmental agency (Guam experience).

Offshore, 'La Nina' / 'El Nino' switches have major impacts on equatorial Pacific tuna distributions and catchability patterns.

5. Society.

Socially linked crises have already been noted. My reason for having society stand alone as a crisis source is because I believe that some crises may stem from attitude and understanding. That is, whose system are we following? How can palangis - who have caused the extinction of many fauna and flora - set a principle for non-palangis to follow, and say it is correct? It may well be. However, is there agreement from everyone that the principles are correct?

Even so, managers frequently are faced with a crisis in deciding whether to implement resource principles 'against' commonly held beliefs and needs. For example, why should the harvest of coconut crabs be prevented when there is immediate monetary need from its sale? Why should people stop consuming giant

clam when their society always has? Across all societies is the consideration of going without today so that a resource will exist tomorrow... but does that matter?

These five sources of crisis are present in the problems, difficulties and constraints encountered in fisheries resource management in the western Pacific broadly common to each nation represented at the workshop. These difficulties and constraints include:

- 👉 increasing human population;
- 👉 traditional ownership of fishing grounds and resources;
- 👉 heavy dependence on marine resources for food and money;
- 👉 severe shortages of funds for fisheries management;
- 👉 lack of an integrated approach to management (i.e. overlapping of responsibilities);
- 👉 lack of cooperation between resource owners and users;
- 👉 lack of information (biological, statistical) on the resources;
- 👉 lack of (hands-on) experienced and/or skilled fisheries staff;
- 👉 lack of understanding and awareness of fisheries management policies and legislation;
- 👉 increasing availability of more effective fishing gear;
- 👉 lack of an effective and wide-reaching fisheries extension and advisory service;
- 👉 lack of effective management enforcement;
- 👉 effects of tourism-related or recreational fishing activities / water use;
- 👉 lack of specific management measures for particular inshore and offshore resources;
- 👉 habitat destruction from land effluent (industrialisation, 'development' and forestry practices) and certain fishing practices; and
- 👉 nonexistent or inefficient marketing and distribution channels.

In reality, the day-to-day dealing with these problems is what keeps fisheries managers on their toes, as these issues are pervasive and omnipresent, and their solutions appear more distant as the issues are compounded with time.

Recognition

Firstly, you've got to recognise that you have a crisis. Is it a crisis but not recognised? Or, how long is it 'a crisis about to happen'? - i.e. although it is known about a decision is made about when to act on it. As managers, we've often known of a crisis about to happen but day-to-day issues take it off our minds or we actively put it aside. For example, the live fish trade (Bob Johannes' paper: this workshop) is moving eastwards, but when will fisheries managers respond?

Rarely is a resource crisis immediate. Fisheries resource crises are frequently insidious - they creep up on you. The phenomenon is like urban in-fill: only periodic snap-shots make one aware of it as over a continuum you don't realise that it's happening. Because short term changes are much more noticeable (e.g. after rapid habitat change; upon sea cucumber stocks after development of lucrative export markets for beche-de-mer) we tend not to notice the long term trends. Populations of long-lived, slow growing species (such as giant clam) may take a couple of human generations to reduce and, after management is effected, face long, slow rebuilding. Similarly, habitat reduction in nursery areas may take time to become reflected in catch changes. (An interesting contrast is the rapidity with which fish stocks build up in tropical areas set aside as marine parks or reserves.)

Secondly, the crisis has to be perceived. Again, this is not simple as it has three aspects, viz: perceiving that the crisis has happened, perceiving that it is going to happen, and - simply - perceiving. These three levels surely are interwoven with our knowledge (understanding) of the subject fishery. There are examples where progress in research has revealed past crises (e.g. environmental events detected in ice

core samples, astronomical events detected by satellites and improved telescopes) and present crises (through rapid developments in fish stock assessment techniques for (e.g.) southern bluefin tuna).

Thirdly, at what point do insidious and perceived events move into the 'crisis' league?

Look at the dugong fishery in PNG - where the resource is chipped away but it requires a survey to demonstrate that it is in crisis (Barry Kares' paper: this workshop). The point is, that the crisis wasn't recognised until the survey was done (hmmm - maybe we'll stop running surveys... the more we look, the more problems we find). Another example is the mullet fishery in Tonga which was fished heavily with fish fences, dynamite and nets before the community realised that the mullet weren't coming.

The insidious manifestation of resource crises are demonstrated by the Tonga mullet fishery - a subsistence fishery which became small-scale (artisanal) under the influence of market demand from an increased human population, or from more affluent sections of a population, or from more effective fishing gear.

Let's look at some more fisheries which could be or are in crisis:

- ☞ the (offshore) deepwater shark fishery in PNG - currently enormous harvests of squalene yet fisheries managers cannot predict any level of sustainability as they have no information on the resource size and little information on its composition and the fishing practices in train;
- ☞ aquarium fish, soft coral and 'live rock' harvesting in several western Pacific countries (Palau, Fiji, Kiribati, Tonga, Cook Islands, Vanuatu, Maldives). Is the only effect the increase in export earnings from fisheries? What is happening out there? Won't we know what effect the removal of live rock has until the next cyclone? Will stocks of larger reef fish be affected by removal of prey? How, or is the reef ecosystem being affected?;
- ☞ the bonefish fishery in Kiribati affected by destructive fishing gear;
- ☞ trochus and green snail fisheries in Vanuatu; and
- ☞ spiny lobster fisheries in several nations (e.g. American Samoa, Tonga).

Finally, a 'crisis' depends on the level of management or user interaction with the resource - i.e. the level of attention paid to a resource. To an under-resourced manager, a crisis in a well-managed fishery (such as the western rock lobster fishery in Western Australia, the prawn fishery in the Gulf of Papua, or the trochus fishery in Aitutaki in Cook Islands) may appear to be minor when compared with a fishery which is under-managed (as beche-de-mer fisheries often are). Yet the crisis in those well-managed fisheries can really be as significant as crises in under-managed fisheries. The difference is that perception of it will probably be faster, and there will be mechanisms available with which it can be addressed more rapidly. Ahhh... the sorry lot of an under-resourced fisheries manager.

Handling a crisis

Step one: the management environment

Decisions are made on a resource at any and at all times: whether it is balanced or unbalanced; the level of harvesting; the likely effects of the relative availability of the resource on the society.

Decisions are conditioned by the combination of information received and our level of understanding of

biological interactions. 'Conventional' crises are more likely to happen when there is inadequate information supply (and sadly - for the fisheries manager - information is always inadequate simply because of the complexity (depth/breadth) of biological systems). Ideally, fisheries managers know their resources, are able to monitor and regularly analyse and compare. Are fisheries managers allowed to manage a resource conservatively - even without supporting information - in order for it not to be over-harvested; and in so doing, avert a crisis? Examples are: rotating fishing areas, limiting the number of vessels and setting a ceiling on the harvest while estimating what 50% of the virgin stock might be. If a fisheries manager attempted to manage in this way, he might be forced to justify his strategies to affected users who may not be conservation minded.

Management decisions may not be popular with all (or even, with any) members of the community. Handling a crisis brings huge pressures on fishery managers - simply because a crisis is never a small event seen by few people. Instead, a crisis is significant to people affected by it (simply because of the 'recognition factor' of a crisis - above). A fisheries manager is all too frequently called upon to stand firm on decisions in the face of fishing companies (e.g. input controls in the Australian Northern Prawn Fishery), communities (e.g. removal of fish fences; seizure of undersized fish (and see Fiji's country paper)), politicians (e.g. live fish trade management in PNG; coral and turtle harvesting in Fiji) and businessmen (e.g. who either may disagree that the crisis exists or who may not want it acted upon because of their high value, short term markets). If the manager is part of a large, well-resourced institution he may. No-one however, can fault a lone or under-resourced fisheries manager who succumbs to a second-best form of management, or even to no management but for monitoring when faced with situations such as these.

Step two: setting the procedures and identifying the options

In spite of the commutations and permutations of crisis management discussed above, identifiable options and clear procedures for management emerge irrespective of the variety and source of the fisheries crisis.

Crisis come at different levels. Accordingly, there can be no 'set play' or formula for handling them. All fisheries managers nevertheless run through a checklist which would include:

- ☞ assessing
(recording and preparation,
resource allocation
deciding,
eliminating); and
- ☞ responding
(negotiating,
consultation and collaborating,
taking action);

They vary the priority depending on the source of the crisis (for example, cf political vs societal).

The most effective control may be a simple one - even as simple as 'ignoring' it. Consider the examples of the papers presented in this session. Coconut crab management can be quietly managed as the demise of the resource is long term and not startlingly apparent to most of the community. On the other hand, millions of pilchards suddenly dying is not ignored by the community and so requires an obvious, immediate response even though its effects are short term. The crisis that lasts for a long time however, is the more serious and uses up more resources in its handling.

When faced with limited human and/or financial resources, a manager has to set priorities carefully. This situation may mean that he has to decide when, or what (resource), to let go. This situation faces many managers in smaller nations. Popular or conspicuous resources are never let go (public sympathy).

There is a need to be able to effect rapid legislation to deal with certain crises (resource; environmental), even though the response of the resource to the legislation may take a very long time (and the unpopularity of the manager may remain for an amount of that time). Consider the difference between taking time to respond to an impending crisis (above) and taking time to act/react to a recognised crisis. There is no breathing space once the second level is attained.

Offering an alternative resource while managing a crisis in fisheries may or may not be desirable. Frequently, community awareness programs about fisheries resource management are said to fail because people still harvest beyond sustainable levels - they do so through a combination of real or perceived need (food, money), acceptance of the decline in fish stocks (God's will), and tradition. At this workshop, turtle stocks in Solomon Islands and Fiji, and giant clam stocks in Tonga and Western Samoa have been reported to be heavily affected by the combination of all factors.

Public relations comes into the picture here. The community may be more kindly disposed to fisheries management if it sees that the managers are helping, rather than their taking the moral high ground of "we told you so, and you didn't listen".

The Tongan community will be offered farmed mullet during the peak mullet run, if the people will open their fish fences. Guam (Noah Idechong: this workshop) is one country proposing to close its export fisheries so that the previously exported fish can meet domestic demand (facing this anomaly in money turn-around is something many nations are reluctant to do: i.e. gaining export revenue from exporting locally caught fish while importing fish (often canned) to feed their community. Dalzell et al. (this workshop) also pointed out that one of the challenges of fisheries managers in the region is to ensure that the importance of coastal fisheries for local consumption is truly appreciated by the region's politicians and civil servants).

Very often however, there is no alternative resource.

Crisis management does not have to be practical (i.e. policeable) over the LONG term. That is, there is `crisis' management (reaction) and `ordinary' management (long term treatment or husbandry). A manager needs to identify the level of recovery when a resource (or politician, or society, or economy, or habitat) is `off the hook'.

A crisis should be managed in consultation with ALL players (stake holders; users). Firstly, this measure is the best public relationships exercise in which a manager can engage; secondly, it elicits a full range of possible controls as well as concerns; and thirdly - by establishing a middle ground - it ensures that the management steps will be supported by all players. Be aware however, that some crises don't allow time for full consultation.

Trust yourself and your staff. Believe in your abilities and analyses. If results show that you made a slip, treat the error as a learning experience. Don't `knee-jerk' to a consultant: hold that resource in reserve, but certainly employ one if the situation develops to that need.

However well-intentioned and able outsiders are, it is your nation and your resources. Your decisions are what you and your community live with.

Conclusion

I have analysed crisis management (did you notice how it equates with normal fisheries management? Then McIlgorm's and Lewis's statements are vindicated). My investigation has led me to conclude that although there is no formula for responding, there are flexible guidelines (no, this statement is not an escape route...).

Look again at the definition at the beginning of this paper. I've analysed the danger and suspense bit; but now I ask that you consider the first phrase.

"crisis, n. - turning-point, esp. of disease; ..."

Towards the end of my presentation at the workshop I called upon participants to share examples of crises they have faced. From each crisis described by seven participants and from three described in workshop papers, good things have come. Not only were the crises solved (or disappeared) but positive results in management, community relationships and consultation had emerged.

Fiji (through Saimone Tuilaucala) reported on his nation's 1987/88 military coup and subsequent political crisis that impacted on fisheries management. The restraint on fisheries personnel and fisheries administration actually generated significant fisheries legislation, including nomination of size limits for many fish stocks.

PNG (through Paul Dalzell) demonstrated that the tuna baitfish political crisis of the late 1970s engendered a modus operandi for handling that crisis when it was realised that 'nobody knew anything'. Solutions were found by thinking the problem through. On the other hand, the political ramifications of the so-called Morgado Square west of New Ireland led to an expeditious stock assessment of the tunas in the square, a piece of homework that has been of subsequent benefit.

Guam (through Todd Pitlik) described the user conflict between jet skiers and rabbitfish fishers in Guam and how under-resourced fisheries management at first gave officers a negative public image ("Princes of Darkness"). Yet the conflict led to the establishment of a committee comprising a variety of government agencies. This committee developed a management plan through negotiation with user groups and has been able to enforce it. With the passage of time the committee's management plan was seen to be justified. As a result, the Division of Aquatic and Wildlife Resources in Guam is held in high standing and co-management was proved effective in resource management.

PNG (through Chris Evans) narrated how fisheries staff conducting trial prawn trawling on a government chartered fishing boat in an area at that time closed to commercial operations actually beheld commercial fishing boats coming into and fishing in the area. The 'stand-off' though, resulted in the commercial fleet's acceptance of proposed management measures.

While on the prawn fishery in PNG, I can recount that in the 1970s there was a huge outcry from coastal villagers in the Gulf of Papua at the amount of fish (trawl bycatch) washing up on their shores. The political expediency of moving the fishery further offshore would have benefited the prawn resource and the nearshore marine habitat.

Solomon Islands (through Sylvester Diake) narrated the situation that developed when the Ministry of Agriculture and Fisheries nominated and allocated quota for the harvesting of turtles for domestic consumption and prohibited turtle (turtle shell) export. The Ministry came under considerable public pressure because it was seen as 'anti-development'. However, the Ministry's capacity to withstand the outcry has enhanced staff morale.

Hawaii (through Kimberley Lowe) described a crisis where a test kit being developed by the State Fisheries Department for the detection of possible ciguatera-causing toxins in fish was advertised and marketed before it had been fully tested. The use of the kit revealed points that had not been detected earlier however, resulting in correction and later careful marketing.

Although in the Pacific Islands (through Adams et al.'s paper) most fisheries research carried out by regional governments is extremely applied, it is usually motivated by a crisis in one form or another. Reported examples of where crisis management resulted in research are the great decline in yellow stripe goatfish catches in Guam (Todd Pitlik: this workshop); stock assessment of groupers in Maldives (Hassan Shakeel: this workshop). In other words perhaps, if there weren't crises, there wouldn't be local research...

PNG (through Paul Lokani's paper) reported that illegal beche-de-mer fishing by PNG fishers in a section of Torres Strait under Australian jurisdiction caused pressure from Australia for PNG to keep its fishers in its own waters; and the fishers were prosecuted by PNG and Australia. The illegal fishing had negative impacts on the Torres Strait Treaty (signed by both countries), the beche-de-mer resource, costs (increased patrolling and legal actions) and management.

The reason the fishers moved into the Australian zone was because the resource on the PNG side had been over-exploited in the absence of any management controls on the fishery there. Apprehensions of the PNG fishers in Australian waters was the catalyst for PNG to take steps to manage its fishery. In the meantime, confiscation (loss) of fishing gear and fishing craft had a huge socio-economic impact.

Palau (through Tom Graham's paper) described how, having decided to regulate the Palau aquarium fish industry, the government was forced to explicitly define its management objectives. In developing unambiguous regulations, the government found that negotiation with the industry and clear interpretation of terms was beneficial.

My concluding remark at the workshop (that fisheries managers always come up `tops') seems trite yet it is true. With so much stacked against fisheries management in the western Pacific enormous efforts and significant achievements are made by fisheries personnel, and compromises are few. Look at what we know of and can project for the state of fisheries resources in the region, and consider how much worse it would be if it weren't for the adrenalin charged and often under-supported efforts of fisheries managers. It appears then, that the continuous crisis that is fisheries in the western Pacific is being managed well - but only just.

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6.5 *Appendix 4 — Press articles*