

CRISP Component C2A: Knowledge, management, rehabilitation and beneficial use of coral ecosystems

“Using indicators to assess coral reef ecosystem and fisheries health”

Workshop

10th-14th April 2006, Southern Cross Hotel

Suva, Fiji

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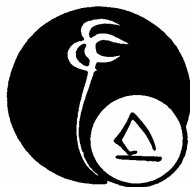


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INTRODUCTION

The Coral Reef Initiative for the South Pacific (CRISP) programme, initiated in France in 2002, is made of 15 projects which cover at least 15 Pacific islands countries and territories (SPREP countries). The programme has received €12 million in funds from the French Development Agency (AFD). Funds from other institutions and non-government organisations include about €500,000 from the World Wildlife Fund and €600,000 from the French Pacific Fund.

The CRISP Programme has 3-year duration and its approach is to support existing efforts to better protect and manage coral reefs ecosystems; and to improve collaboration between French territories and English-speaking Pacific Islands States.

The specific objectives of CRISP initiative include:

- ◆ Gaining a better understanding of coral ecosystems in terms of their biodiversity, current status and functioning
- ◆ Conducting operations to protect and manage coral reef ecosystems on a broad scale
- ◆ Promoting economic potential based on the biodiversity and use values of coral ecosystems
- ◆ Sharing information and knowledge, building capacities and managing local, national and international networks throughout the Pacific

The CRISP programme is divided into 3 main components: Component 1 addresses the definition of an ecoregional strategy for reef biodiversity conservation, the setting up of MPAs and support for existing ones and the development of tools for integrated coastal management; Component 2 encompasses knowledge development, monitoring, reef rehabilitation, and economic use of reef ecosystems; and Component 3 specifically targets communication, knowledge collection and sharing and coordination of the whole project. Each component is again divided into sub-components.

The goal of the sub-component 2A is to improve knowledge, monitoring, management capacity and development of the resources of these ecosystems to ensure of the sustainable development of corals. C2A program gathers several institutes from four different countries that are working together within 5 different broad projects and 25 activities. The main technical partners of C2A are Ecole Pratique des Hautes Etudes (EPHE) – Centre National De La Recherche Scientifique (CNRS), Institut de la Recherche pour le Développement (IRD) and The University of the South Pacific (USP).

Five main projects are included within the component 2A:

Project 1 - Harvesting of reef fish larvae and developing their economic potential

Project 2 - Improving knowledge about coral ecosystems and the capacity to manage them. Identification of indicators for reef fisheries monitoring.

Project 3 – Implementation of monitoring indicators of reef health status; Use of GIS and remote sensing tools.

Project 4 – Skills and knowledge transfer and capacity building

Project 5 – Effects of CO₂; Contribution to the development of ecotourism.

During the first meeting in January 2005, the CRISP partners decided to hold a workshop between the three main partners (EPHE, IRD, USP) after year 1 of the programme in order to harmonise methodology, share progress, knowledge and identify problems. The CRISP C2A workshop held in Suva from April 10th-14th 2006 was entitled “**Using Indicators to Assess Coral Reef Ecosystem and Fisheries Health**”.

The objectives of the workshop were to meet the different people involved in this component; to present the different actions inside each of the 25 activities and to share the progress made so far; to discuss the theory and use of indicators to assess coral reef health; to plan future actions and to develop coordination amongst partners.

WORKSHOP PROGRAM

Date: April 2006, 10th – 14th

Venue: Southern Cross Hotel conference room, Suva, Fiji

Each day, talks will follow the order of the number of the action of the C2A. The designated chairman will present the state of the art of the session at the beginning of the day. One scientist of the three institutes will lead the discussion at the end of the day. Discussion should be interactive session, where a summary of the actions and methods used is made, possible problems are discussed, and prospect of the future actions are planned.

DAY 1 Monday 10th of April: Introduction. Leaders Meeting

10 am – 1 pm: Meeting amongst the leaders
1- 2 pm: Lunch
2- 6 pm: Meeting amongst the French team

DAY 2 Tuesday 11th of April: Using indicators to monitor coral reef health (actions 11 to 17)

Chairman: C. Vieux and K. Mackay

9- 9:30 am: Opening Ceremony – Professor Leon Zann
Prayer – Sofia Shah and Veikila Vuki
Opening of workshop by the Dean of Faculty of Islands and Ocean, USP
Opening remarks by Eric Clua, Head of CRISP Project

9.30- 10 am: Leon Zann (USP), action 14, ‘The Use of Indicators in Monitoring Reef Health’

10- 10.30 am: Speakers

Sofia Shah (USP), action 13, ‘Paleosedimentary records from coral skeletons

Pascale Chabanet (IRD), action 13, ‘Impact of an expected disturbance associated with a mining project in New Caledonia: Which methods and indicators should be used to assess fish communities?’

10.30- 11:00 am: Morning Tea

11:00- 12:00 pm: Speakers

Ken Mackay (IMR), action 15, 16 and 17 ‘GCRMN Activities within the Southwest Node’

Ed Lovell (USP), action 16, ‘GCRMN Monitoring in Fiji’

Zaidy Khan (USP), action 16, ‘Habitat variation in seawater temperature assessment in relation to coral bleaching’

Caroline Vieux (EPHE), action 15, 16, 17, 22, "Coral reef monitoring activities in Polynesia Mana node countries, Cook Islands, Niue, French Polynesia, Kiribati, Tokelau, Tonga and Wallis and Futuna, planning for 2006 and update on ReefBase project"

12:00- 2 pm: Lunch

2- 6 pm: Discussion
Animators: P. Chabanet (IRD), C. Vieux (EPHE), K. Mackay (IMR)

DAY 3 Wednesday 12th of April : Using indicators to assess fisheries health in coral reef ecosystem (actions 5 to 10)

Chairman: L. Zann and J. Ferraris

9- 9.30 am: Presentation of the project and state of the art: L. Zann and J. Ferraris

9.30- 10.30 am: Speakers

Randy Thaman (USP), action 7, 'Indicators of marine biodiversity'

Michel Kulbicki (IRD) action 7, 'Use of biogeography on a regional scale for management on a local scale: case study of reef fishes'

Marc Leopold (IRD) actions 6 and 9, 'Social and ecological indicators for coral reef fisheries assessment'

10.30- 11 am: Morning Tea

11- 12.00 pm: Speakers

Veikila Vuki, action 8, 'Long-term trends in subsistence fishing patterns and coral reef fisheries yield from a remote Fijian island'

Ambroise Brenier (EPHE) action 9, 'Participating survey of coral reef resources'

Teri Tuxson (USP), action 8, 'Marine resource assessment in Rotuma I'

Denis Poignonec (IRD) actions 8 and 10, 'Cognitive mapping as a new methodological approach for the study of a coastal lagoon ecosystem submitted to a major increase of human impacts'

12:00- 2 pm: Lunch

2- 6 pm: Discussion
Animators: M. Léopold (IRD), E. Clua (CCU), E. Lovell (USP)

DAY 4 Thursday 13th of April: Fish Larvae. Tourism, Knowledge Transfer and Institutional Strengthening with cross-cutting actions of the projects. Conclusions

Chairman: P. Chabanet and E. Lovell

9- 9.30 am: Presentation of the project and state of the art 1 to 4 – R. Galzin (EPHE)

9.30- 10.30 am: Speakers

Dominique Ponton (IRD) action 1-4, ‘Research program on larvae and juveniles of reef fishes in New Caledonia’

David Lecchini (IRD), ‘Habitat selection and sensory abilities of coral reef fish larvae’

Gilles Lecaillon (Ecocean) action 1-4, ‘Post larval field experimentation in Fiji (collection and rearing) for the development of a new sustainable fishery technology’

Ed Lovell / Arpana Pratap (USP) action 5, Adaptation of legislation for larval fish collection and export in Fiji’

10.30- 11 am: Morning Tea

11 am- 1 pm: Tourism (action 25)
Randy Thaman (USP) and Helen Sykes (Resort Support)

1- 2 pm: Lunch

2- 6 pm: Final Discussion R. Galzin (EPHE); J. Ferraris (IRD); E. Lovell (USP)

- Actions 18 to 23: no designated speakers, overall discussion about DataBase and Communication.
- Overall discussion with all the partners involved.
- Set up future actions and collaborations between the teams
- Planning
- Reporting
- Conclusions

DAY 5 Friday 14th of April: Final Discussion and Fish Larvae Discussion

Chairman: R. Galzin

9 am- 1 pm: Discussion of the actions 1 to 4, presented on Day 4.
Animators: D. Ponton (IRD), Ed Lovell/Arpana Pratap (USP), G. Lecaillon (Ecocean)

1- 2 pm: Lunch

2- 6 pm: Meeting amongst J. Grignon PhD committee

OPENING BY THE DEAN OF THE FACULTY

I would like to welcome our French neighbours and partners, as well as our own participants and interested parties from Fiji to this very important gathering in Suva. During this workshop, a program will be formulated to launch research into establishing a knowledge base allowing more informed management and sustainable use of coral reef ecosystems. Its main objective is to make use of indicators to assess the health of this vital ecosystem. With the future sustenance of our island peoples of concern, understanding coral reef and fisheries health is a crucial focus of this meeting

The Coral Reef Initiative for the South Pacific (CRISP) **Component 2A** represents our French partners' commitment to this ambitious project.

The objectives of the **initiative** are to:

- gain a better understanding of coral ecosystems in terms of their biodiversity, current status and functioning;
- conduct operations to protect and manage coral ecosystems on a broad scale;
- promote economic potential based on the biodiversity and use values of coral ecosystems;
- and share information and knowledge, building capacities and managing local, national and international networks throughout the Pacific.

The component 2A (C2A) CRISP gathers several institutes from four different countries that are working together within 5 different broad subject projects comprised of 25 activities.

Along with USP's School of Marine Studies, Geography Department and the Institute of Marine Resources, the meeting includes the partners:

- Ecole Pratique des Hautes Etudes (EPHE);
- Centre National de la Recherche Scientifique (CNRS);
- Institut de la Recherche pour le Développement (IRD) and
- the CRISP Project Manager Eric Clua is from the Secretariat of the Pacific Community.

This meeting has the central aims of harmonizing research methodology, sharing progress & knowledge, and identifying problems.

As crucial as the science is, the bridging of this endeavour across the Pacific is important in the bringing together of the Anglo and Francophone research efforts. The problems associated with marine resource exploitation are common to all island nations. Working together is the obvious solution for which we thank the French for such an insightful programme.

CRISP will cover at least 12 Pacific islands countries and territories, having received €12 million in funds from the French Development Agency (AFD). Assistance from

other institutions and non-government organisations include about €500,000 from the World Wildlife Fund and €600,000 from the French Pacific Fund.

Welcome again and may you be successful in your endeavours. Continued benefits from our coral reefs rely on your science underpinning our management of this essential resource.

ABSTRACTS OF THE PRESENTATIONS

Community-based monitoring of coral reef resources

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We can distinguish three level of monitoring: research level, government level, community level (community-based monitoring). What we define by community-based monitoring is the involvement, on a volunteer basis, of members of the local community in the monitoring of the state of resources, habitats and resources exploitation rates. The aim of our study is to experiment community-based monitoring methods on the field in order to test their feasibility. We want to answer the following questions: i) who can be involved, ii) which indicators and which methods could be used, iii) what is the validity of the data collected by the volunteers, iv) what feedback is efficient. In order to address these questions we have adapted reliable and low-cost protocols for gathering data that could be used by volunteer community groups. Now that appropriate participatory monitoring indicators and methods have been identified, we are testing their reliability and feasibility in four different sites (two in French Polynesia and two in Madagascar).

Impact of an expected disturbance associated with a mining project in New Caledonia: which methods and indicators should be used to assess fish communities?

Chabanet, Pascale.¹, Andrefouët S.¹, Baillon N., Ferraris J.¹, Guillemot N.¹, Kulbicki M.¹, Mou-Tham G.¹, Poignonec D.¹, Sarramegna S. & Vigliola L.

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The coral reefs of Koné, on the Northwest coast of New Caledonia, will be subjected to human impact linked to the settlement of a nickel-mining complex by the end of 2006. This industrial project, developed in a rural area, will generate a large demographic increase, followed by associated disturbances such as a rise in fishing activities. Given this context, a good knowledge of coastal ecosystems and their uses are essential in order to develop sustainable management of the resources used for subsistence by local populations. The monitoring of the reef ecosystem, before, during and after the industrial disturbance, is essential for the management of a potential impact. A research program was initiated in order to better understand the interactions between the environment, resources, and fishing activities by proposing: 1) monitoring methods integrating suitable indicators, with a focus on the spatio-temporal variability of resources and their uses; 2) appropriate tools to communicate and assist interactive feedbacks between local stakeholders. During the ecological survey, data on fish assemblage and associated habitat were collected from 2002 to 2004, that is just prior the construction of the mine. Stations were sampled mainly on the barrier reefs and on inner reefs. The surveys were carried out by underwater visual census methods (UVC), using LIT (Line Intercept Transect) and MSA (Medium Scale Approach) for benthic communities and abiotic substrata. The transect line was used as the centre of a 50 m belt transect in order to count fishes (abundance and size per species). Preliminary results revealed the magnitude of spatio-temporal variability in reef fish communities of Koné. Fish density and biomass decreased between 2002 and 2003, and increased again in 2004. These trends could be related to hurricane Erica, which had a major impact on coral reefs in 2003. Our results also suggest that natural

variations may present large amplitude, rendering difficult the detection of future changes linked to mining activities. This indicates that long term monitoring will probably be mandatory to detect the effects linked to human perturbations. Besides, seasonal variations of fish assemblages and the choice of the best indicators, sensitive to the rising fishing pressure and/or the deterioration of their habitat, will assist in refining our understanding of the functioning of fish communities. In the future, other fish assemblages, such as those from soft bottoms or mangroves need to be assessed with others methods, as UVC are not adapted to their sampling. Ultimately, the results will help to better understand the interactions between ecological, fisheries and socio-economic surveys.

Using indicators to assess fishery health in coral reef ecosystem

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The state of the art on reef fisheries is presented on basis of a paper on indicators and reef fisheries (Clua et al., 2005). Five publications on this subject were made after a workshop on indicators and coral reef ecosystem (Noumea, July 2002): 1) indicators and fisheries (Clua et al., 2005); 2) indicators and MPA (Pelletier et al., 2005); 3) indicators and natural variability (Adjéroud, 2005); 4) indicators and habitat disturbance (Chabanet et al., 2005); 5) indicators and anthropogenic inputs (Fichez et al., 2005). The goal of the paper about reef fisheries was to establish a synthesis of the bibliography on fisheries studies and to propose a description of these fisheries with a panel of indicators from three components of the "Fishery System": Ecology / Exploitation / Socio-Economics. Knowledge on reef fishery underline the following major points: a) the "Fishery System" is a complex system; b) it is necessary to develop an integrated approach to better understand the relationships between environment, resource and uses ; c) a pluridisciplinary approach to improve the knowledge on the natural variability the impact of man on resources and habitat and the behaviour of fishers to the variability of the system are necessary; d) it is important for Pacific inlands to involve the local population in the process (traditional knowledge, monitoring, MPA). From a conceptual framework on "Fishery System", a list of variables for each component as potential indicators is proposed. Definition and criteria to establish a good indicator are given (relevance and effectiveness). Lastly, the pilot sites during CRISP program in New Caledonia (Ouvea and Voh-Kone-Pouembout) and French Polynesia (Tikehau and Moorea) are presented, and the five activities concerning reef fisheries of component C2A are introduced (activities 6 to 10).

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Long Term Monitoring of Sea Surface Temperatures

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1.) Objective

1. To establish and maintain a temperature logger program at major reef regions around Fiji islands to provide fine scale and accurate sea temperatures to co-relate with temperature –related perturbations on the reef such as coral bleaching.
2. To involve tourism industry in the temperature logger program and in basic coral reef monitoring.
3. To augment regional satellite-based ‘hotspot’ alerts and bleaching events to NOAA and Reef Base with national sea surface temperature record.

2.) Introduction

Elevated sea temperatures are thought to be a major stress to reefs causing widespread bleaching. Current bleaching records are obtained from NOAA/NESDIS graphs. NOAA graphs do not provide national level temperature or bleaching records. Reef Base provides a detailed coral bleaching GIS map, due to inadequate communication between data fed and presented on the GIS map of Fiji islands there have been data inaccuracy. In this project temperature data loggers are deployed on the reefs around Fiji islands to collect in situ, time-integrated bleaching thresholds and their spatial variation, over local scale. It is essential to better understand the role of temperature anomalies in structuring coral assemblages. This data will be useful to detect early warning of local conditions likely to cause coral bleaching, also it could augment regional satellite-based ‘hotspot’ alerts and assist in (1) science, in documenting and researching the phenomenon; (2) public relations, in keeping reef-based tourism operators, and the general public informed; (3) coral reef managers, in ameliorating local-scale human impacts which might exacerbate coral bleaching.

3.) Site selection

Resort and dive operating sites have been chosen for temperature deployment stations for easy access and regular site visit. Future plans are to involve resorts in basic coral reef monitoring and reporting of their reef status.

4.) Activities and Methodology.

Vemco Minilog 8-bit data loggers are deployed on the reef flat generally at or near lowest astronomical tide level. Activities involve in this project are:

Activity A: Collect existing temperature logger deployment data. Design logger deployment and retrieval protocols.

Activity B: Deploy temperature loggers to 3 major sites Yasawa, Mamanuca and Beqa. This will involve traveling to sites and networking with dive operators to cooperate in the temperature logger deployment program.

Activity C: Collect qualitative data from dive operators and resorts involved in the program. This will involve interviewing or questionnaire surveys conducted in field with dive operators, resorts and live boats to collect information on how tourism industries can contribute to coral reef monitoring

5.) Project Outcome.

To design a temperature logger monitoring program for Fiji islands and to integrate temperature data with Global Coral Reef Monitoring program database.

Use of biogeography on a regional scale for management on a local scale: case study of reef fishes

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Reef fishes are unevenly distributed across the Pacific. It is possible to define a « biodiversity » centre in the Indonesia region where reef fish diversity is the highest. Meta-community diversity (as determined by checklists) decreases as the distance from this centre increases. There are also other factors intervening in setting the diversity level of the meta-communities, the most important ones being: island size, latitude, reef size and isolation of the islands. Local diversity (the species richness observed on a given reef) is linked to the meta-community diversity, if the latter is high, all other factors being equal, local diversity will also be high. In addition the organization of the local reef fish assemblages is linked to the characteristics of the meta-community, e.g. if there are many piscivorous species in the meta-community, chances are that the local assemblages will also display a high proportion of piscivores. Last, abundance and biomass are related to species richness both in theory and in practice. The relationships between local diversity and biomass are linked to both local factors (e.g. fishing effort, reef type, coral cover ...) and large scale factors (e.g. island size, distance to the biodiversity centre ...), these two types of factors (local and large scale) having approximately the same contribution in explaining the variance of the diversity-biomass relationship. This chain of relationships (diversity of the meta community- local diversity – local biomass) is very important in the context of the South Pacific. There are more than 5 000 inhabited islands in the tropical Pacific and there is no way managers can survey each of them. The present data strongly suggests that it is possible to elaborate statistical models which may yield useful information on the organization and resource levels of any island given a restricted number of factors which are easily available, such as island size, island type, human population, reef habitat distribution and diversity...From the same approach it is possible to develop simple indicators to evaluate species diversity (e.g.

derived from Allen index) or fishing potential (e.g. size spectrum, species-biomass curves).

Post larval field experimentation in Fiji (collection and rearing) for the development of a new sustainable fishery technology (CRISP project).

Lecaillon, Gilles

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The aim of our fieldwork is to start post larval collection and rearing in partnership with Fijian communities and select the collection areas. The first trip, which started in October 2005, was to meet Fijian partners and to inform them on the field project, settle a growth facility and identify the future collection areas. Four collection areas were targeted. The collection in the first area (SITE SUVA) started in February 2006 and should start on April 2006 for the second one (SITE HOTEL). Site Hotel is developed in collaboration with a dive centre, a resort and the Tagaqe village. The third area (SITE HAIR) will probably be focus on crest netting may be in collaboration with ICLARM. Finally a fourth new interesting site (SITE RANDY) could become a regular collection area proximate to the USP facility, with high interest rising from the school, the MPA, and because the village is aware of marine environmental conservation. The current purpose of this post larvae rearing is restocking. Depending of Julien Grignon thesis subjects, some fishes will be repopulated in MPAs, in *qoliqoli* and in front of the resort of SITE HOTEL. As soon as the collection started, knowledge transfer concerning sorting, weaning and growing immediately initiated as a permanent continuum activity. One Fijian fisherman and one Fijian technician are currently hired to start this capacity building and operate the daily work.

In conclusion, this PL operation component will bring additional knowledge on Fijian coral reefs (bioindicators) and will answer main CRISP targets the possibility to transfer a sustainable capacity building to South Pacific communities on two different activities: fisheries and aquaculture.

Habitat selection and sensory abilities in coral reef fish larvae

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One of the great mysteries of coral reef fish ecology is how larvae locate the relatively rare patches of coral reef habitat on which they settle. The answer must lie partly in the sensory abilities of fish because it seems unlikely that successful settlement is solely a matter of chance. The present study attempts to estimate, by experiments in aquaria, the sensory abilities of coral reef fish larvae when they search for a settlement habitat. Larval recognition of settlement habitat may involve the detection of conspecifics or of shelter characteristics (e.g., shape of coral colony, odour of anemone) determined by emissions of visual, chemical and mechanical cues. These cues could be recognized by five senses of fish larvae: visual cues by sight, chemical cues by smell or taste, and mechanical cues by hearing (sound is captured by otoliths) or vibratory sense (vibrations are captured by lateral line). For this study (conducted at Moorea in 2002), larvae were captured with crest nets and were then introduced into experimental tanks that allowed testing of each sense separately. Among the 19 species studied, 15 chose their settlement habitat due to the presence of conspecifics and not based on shelter characteristics, and 4 species did not migrate toward their settlement habitat. Among the different senses tested, only sight, smell and vibratory sense were used in the recognition of conspecifics. Some species (*Parupeneus barberinus*, *Ctenochaetus striatus*) used three senses, others used two (*Myripristis pralinia*, *Lutjanus fulvus*) or one sense (*Gymnothorax sp.*, *Chrysiptera leucopoma*) and some species (*Pomacentrus pavo*, *Canthigaster janthinoptera*) apparently used no sense. These results demonstrate that many coral reef fish larvae have the ability to discriminate species-specific sensory cues and could in practice use these sensory cues for successful integration into settlement habitat (connectivity between larvae population on reef crest and juvenile population on settlement habitat).

Using indicators to assess coral reef ecosystem and fisheries health

Social and ecological indicators for coral reef fisheries assessment

Leopold, Marc, Jocelyne FERRARIS, Michel KULBICKI, Mecki KRONEN, Pierre LABROSSE

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Research projects contributed to gather ecological, socioeconomic and fishing data in 12 Fijian and Tongan villages in 2001 and 2002. These snapshot surveys aimed at determining easy-to-use indicators of the health of fish resource. We used factorial analysis to find out possible linkage between selected parameters to assess the status of the social and ecological system in our case studies. Three factorial analyses were first conducted on thematic variables: 1) ecological indicators: size structure of target fish; 2) socioeconomic indicators: household expenditures, income origin, fish and can consumption; 3) fishing indicators: fishing activity and fishing gear. Then we performed hierarchical classifications of the observation units among villages (line transects, households or fishermen). Finally we considered the resulting classes as three groups of new quantitative variables at the village scale. A multiple factorial analysis (MFA) was performed on these three groups of homogeneous variables. Villages were used as observation units.

Results showed that MFA is an appropriate method to deal with thematic groups of variables and to analyse the linkage between them. Particularly, dependence on fishing for food and income is linked with fishing activity, fish biomass and fishing ground area. Relation between classes of distinct groups suggests that complementary ecological and social variables can describe the fishing system of the case studies. Indeed the combination of social and ecological parameters varies among villages and leads to different diagnosis of resource uses. This co-evolution and the remaining uncertainty are points for multidisciplinary assessment of coral-reef fisheries through a set of social and ecological indicators.

Global Coral Reef Monitoring Network in Fiji

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The Global Coral Reef Monitoring Network (GCRMN) in Fiji has had a successful four years under the Canadian (C-SPOD) funding (2000-2004). Long term Reef Check and GCRMN sites have been established for coral reef monitoring. General information has been compiled, a series of temperature loggers deployed and a resort network for reef reporting established. The program summarized useful information regarding coral health in terms of coral cover and other benthic issues such as eutrophication, coral bleaching and the incidence of crown-of-thorns starfish. GCRMN/Reef Check monitoring has allowed quantification of good coral growth since the major coral bleaching events of 2000 and 2002.

Under the Coral Reef Initiative for the South Pacific (CRISP), the programme has been revived with a recent GCRMN review and strategy meeting setting the stage for programme development for the next three years. Drawing on lessons learned from the previous programme and highlighted in the strategy meeting was the recommendation for the funding of a coordination and database person for Fiji. As well financial support is required for the continued monitoring of the established transects, directed research and general programme requirements.

The need for coordination is essential as there are diverse groups in Fiji engaged in coral reef work who have expressed interest in being part of the network (NGO's, USP, SOPAC, dive operations). Providing liaison and prompting for information is necessary, if these varied sources of information are to be collated for annual reporting.

Report on Activities 15, 16 and 17

MacKay, T Kenneth

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The Global Coral Reef Monitoring Network (GCRMN) aims to improve management and sustainable conservation of coral reefs by assessing the status and trends in the reefs and how people use and value the resources. GCRMN does this by:

- Linking organisations and people to monitor ecological and social, cultural and economic aspects of coral reefs within interacting regional networks.
- Strengthening the existing capacity to examine reefs by providing a consistent monitoring program, that will identify trends in coral reefs and discriminate between natural, anthropogenic, and climatic changes;
- Disseminating results at local, regional, and global scales on coral reef status and trends, to assist environmental management agencies implement sustainable use and conservation of reefs

GCRMN operates through 17 regional nodes of countries and states. Each with a regional coordinator and most countries within a node have a national coordinator. In the Pacific CRISP is supporting the *Polynesia Mana Node* consisting of Cook Islands, French Polynesia, Kiribati, Niue, Tonga, Tokelau, and Wallis and Futuna; and the *South-West Pacific Node* consisting of Fiji, Kiribati, New Caledonia, Nauru, Solomon Islands, Samoa and Vanuatu. This report deals with the SW Pacific Node.

This node has been in existence since 2001 and has considerable strengths. This is due to previous Canadian Funding for capacity building, methodology training, networking, and in-country activities. There are coordinators in each country and they assisted in producing the 2004 Status of the Coral Reef report for each of the seven countries.

The summary of these 2004 reports were:

Coral reefs in the Southwest Pacific are generally in good condition. The coral reefs have shown highly variable recovery from the extensive bleaching in 2000 and 2002. Some reefs have recovering fully to pre-bleaching levels, whereas others have shown virtually no recovery. Major events have been:

- Nauru experienced coral bleaching and mass fish kills in October-December 2003, possibly due to unusually high sea surface temperatures while in mid-2004 an unprecedented number of seabirds died on Nauru; the cause is unknown
- Cyclones damaged reefs of New Caledonia, Samoa, Solomon Islands and Vanuatu. Cyclone Erica in 2003 destroyed 10-80% of live coral cover on New Caledonia. Cyclone Heta struck Samoa in 2004, damaging 13% of the coral reefs.
- The momentum in the protection and conservation of coral reefs in the region has been boosted by increased participation of governments, NGOs, scientists, volunteers and local communities, especially in the implementation of resource management strategies to mitigate human pressure.
- The SW Pacific Node has established an important network and conducted training, which will contribute greatly to coral reef management in the Pacific. However, these initial investments and initiatives were compromised by lack of funding in 2005 but are now being assisted by the CRISP funding.
- National reports were to be published in their entirety in December 2004, however they are currently expected to be published in mid 2006.

Cognitive mapping as a new methodological approach for the study of a coastal lagoon ecosystem submitted to a major increase of human impacts

Poignonec, Denis

IRD UR-CoReUs. BP A5. 98848 Nouméa cedex, New Caledonia, France

The settlement of a mining complex in the north-western lagoon of New Caledonia will lead to a two to three fold increase in the population size, within the next 10 years. Hence, the demand for using the lagoon will increase, mainly for the living resources, in addition to other impacts on the habitats. The lack of scientific studies on the functioning of the local ecosystem instigated the use of a social based methodology to harvest the local people's knowledge. Cognitive mapping is mainly used for social conflict solving in firm. The understatement of this methodology is that each one has its own representation of a partially observed world due to its own experience, believes and experiments. A Cognitive Map (CM) is a sketch representation of those believes, in a shape of a web of concepts, linked together by causal relationships. In the study area about 40 individual CM were collected on the functioning of the socio-ecological system. During interviews, each stakeholder was asked to draw his own CM by defining natural and human factors from the watershed to the lagoon that impact fish resources. To compare the different CM, a common framework is created by setting up an ontology, based on those different stakeholders' concepts. The distances between maps are then calculated, and stakeholders clustered. The identification of the most significant concepts among a group's set of maps is a good basis to define easily appropriable indicators. Finally groups' maps are gathered in a single synthetic map. This CM is a global representation of a group's vision of the functioning of the system, and illustrates the synergic properties of this methodology. Moreover those maps can be used to model and simulate trends in the evolution of the system. The lack of adequacy between the simulated evolutions and individual expectations can trigger the willingness of developing an integrated management process among stakeholders.

Research program on larvae and juveniles of reef fishes in New Caledonia

Ponton, Dominique

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IRD started its research program on larvae and juveniles of the reef fishes of New Caledonia in 2004. The program has three main objectives: 1) understanding the biotic and abiotic processes that influence the distribution and growth of larval stages in the coastal areas; 2) identifying the role of benthic habitats for the distribution and growth of the juveniles; 3) developing tools for the identification of larvae and juveniles to species.

The first objective corresponds to the PhD research program of Laure Carassou, EPHE Perpignan. Her aim is to construct synoptic pictures of larval distribution in two experimental areas of the New Caledonia lagoon by using light-traps and towed-nets, associated with environmental measures at different spatial scales. This work will help identify the habitats that provide the most favourable growth and feeding conditions for larvae and to estimate the role of coastal zones of New Caledonia for the survival of fish larvae. The second objective is addressed through Camille Mellin's PhD at Univ. Pierre & Marie Curie, Paris and EPHE Perpignan. Her aim is to understand how the diversity, the abundance, and the individual growth of reef fish juveniles relate to environmental factors. Based on several sampling methods (underwater visual censuses, underwater seine, rotenone sampling, and artificial reef units) in different habitats (coral reefs, sea grass and sea weed beds), her work will help to define a single Habitat Quality Index that will allow focusing on conservation priorities based either on the diversity or on the abundance of reef fish juveniles. The last objective is based on the fact that so far very few efficient keys are available for identifying larvae or juveniles of reef fishes to the species level. A traditional morphometric and meristic approach is used for creating series of development based on digital images and drawings (D. Ponton & G. Mou-Tham). For Lethrinidae and Siganidae, these series are validated by molecular tools (P. Borsa). All the information (digital images, digital drawings, morphometric and meristic characters,

etc.) will be integrated in Lucid3 software in order to provide an effective identification key (G. Mou-Tham & D. Ponton).

Determination of the Distribution of the Reef Fish Larvae on the Settlement versus the Productivity of Laucala Bay, Fiji

Pratap, Arpana

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This research project will determine the general distribution of coral reef fish larvae in the Laucala Bay. Laucala Bay is located in the Southeastern part of Viti Levu, Fiji. On the Northwest is the Suva Peninsula and the Rewa Delta is located on the northeast. On the South, bordering the lagoon of Laucala Bay is the Suva Barrier Reef. Zooplankton samples will also be collected to see the correlation between the fish larvae abundances and species richness of the area and the productivity of the area in terms of zooplankton. Fish move out of the plankton cycle after metamorphosis and the rate depends on the productivity and seasonality of the environment. High productivity environments support faster growth with a short time period for metamorphosis and vice versa. According to the “recruitment limitation” model, the larval supply is not enough to reach the carrying capacity and that the input variation is reflected by population changes and age structure which does not depend on post-recruitment processes. Therefore, larval studies are more important rather than post-recruitment events to determine the processes limiting the abundance of reef fish populations. The sampling will be done once every three days for every season. The first sampling will be in May/June, then in August/September and the final one in November/December. The sampling will be done using 350µm plankton net and samples collected in sample bottles. These will be preserved in formalin for later identification. Other environmental parameters will be taken with a CTD which include salinity, temperature and dissolved oxygen. The current regime of the study site will be obtained from previous work done in the area.

Paleosedimentary records from coral skeletons

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Reef corals have been found to be excellent recorders of environmental history such as sea surface temperature (SST), rainfall, carbonate geochemistry, freshwater runoff, and impacts from coastal land use and pollution. In this study, *Porites spp* will be used to reconstruct past environmental data regarding sedimentation and land use. Sediments can be of natural as well as anthropogenic origin and affect the biodiversity of corals once in the marine environment. In recent times there has been changes in land use patterns (due to logging and agricultural activities), resulting in the release of sediments to the marine environment. This study focuses on the mineral nature of the sediments. *Porites spp* are used as the indicator species as they grow continuously over several hundred years and accurately record the ambient conditions of the marine environment. *Porites* cores will be obtained from the Savusavu logging catchment of Fiji Islands and analysed to assess the sedimentary regime of the catchment area for the last 20 years. The cores would be slabbed and then x-rayed to reveal the annual density bands. Each annual density band would then be analysed to reveal the mineral content. The minerals that would be analysed are Ba, Sr, Cd, Pb and Ca. Analysis would be carried out using Atomic Absorption Spectroscopy (AAS).

Coral Reef Ecosystems and Sustainable Tourism in Small Islands States: Areas for Synergy in Action and Development

Sykes, Helen (Resort Support), Thaman, Randy (USP)
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Objective: To develop guidelines, supportive materials and models for accreditation or certification that can provide a basis for using good coral reef ecosystem science, including both the most up-to-date modern and traditional hard and social science, as a basis for making tourism more ecologically, economically and culturally sustainable in the Pacific Islands.

Rationale and Issues:

- Tourism is already the major and most sustainable form of income generation in many Pacific Island
- Most Pacific Island tourism depends on a healthy marine environment as one of its major selling points
- Most detrimental changes in coral reef health have been linked to human activities, including tourism among many others
- Academic and scientific institutions have gained an increased understanding of the factors affecting coral reef ecosystem health over the past 20 years
- There is an urgent need to put this knowledge into practical application within the tourism industry

Sustainable tourism and ecotourism certification programmes are already in place around the world (e.g. Costa Rica). Standards for sustainable diving and snorkelling tourism are more recent, but also in place, (E.g. Australian Great Barrier Reef Marine Park). Many of these rely on a well-educated general population. For Fiji and the South Pacific region, a combination of sustainable practices needs to be supported by suitable education and awareness, and PRACTICAL application of programmes to coral reef-friendly tourism. In response to this we are developing and testing an education and certification programme for tourism operatives and tourism operations: Blue Star Coral Reef Tourism; an education and recognition programme with a

sliding scale that can be awarded as tourism operations attain improved levels of sustainability.

The purpose of this component of the project is to build upon existing efforts and expertise to strengthen the synergies between our rapidly increasing knowledge of the seriousness of the crisis facing coral reefs, the reasons for their demise and proven or potentially viable options for rehabilitating, conserving and sustainably using coral reefs, with a focus on synergies between tourism as a leading development sector and good coral reef research.

Main goal and outputs of the CRISP Tourism component:

- To identify the services and benefits that coral reefs and associated marine ecosystems provide to the tourism sector and show how these are/can be affected both negatively and positively (e.g., enhanced through interventions).
- To more precisely identify the roles that the tourism sector, through all tourism operators and stakeholders, could play to make tourism more “coral reef ecosystem friendly (BlueStar).
- To develop, upgrade or synthesise and adapt for the Pacific Island context, guidelines that can be used by all tourism operators to realize this objective, with the ultimate aim to develop training and certification guidelines for all tourism stakeholders.
- To develop models, guidelines and appropriate interpretive materials that could enrich the tourism experience through the application of good coral reef science and knowledge, both modern and traditional. It is stressed that this component would have multiple spin-offs, which could include 1) increased enjoyment and understanding of the complexity of coral reefs ecosystems and their importance, both globally and to island communities; 2) increased awareness within the tourism industry of the importance of coral reefs, their current declining status and what we can do to address the situation; and, 3) increased public and official awareness of the very complex issues related to the sustainable use of coral reef ecosystems, an ingredient needed to insure official and private sector support for coral reef conservation and BlueStar tourism initiatives.
- Develop and trial programmes to train trainers and actual service providers using the certification and interpretive materials developed.

Community-based biodiversity and ethnobiodiversity surveys as a basis for improved assessment of indicators of the status of coral reef and marine biodiversity: A preliminary model

Thaman, Randy

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The purpose of this paper is to propose a simple model for reconnaissance biological surveys that could be used in proposed or existing marine protected areas and associated control sites to provide us with an in-depth understanding of the past, present and future status of nearshore marine ecosystems. The relatively in-depth methodology, which has been tested in MPAs and proposed MPAs along the Coral Coast in Nadroga Province, Viti Levu, Fiji Islands, a number of other Fijian Villages, the Funafuti Conservation Area in Tuvalu and in Kiribati, the Tuamotu Archipelago and Ouvea in New Caledonia. The proposed, three-part model includes:

- 1 An ethnobiodiversity questionnaire survey to gather information from the local community on the current and past status of the biodiversity of the proposed MPA and the surrounding marine environment;
- 2 Reconnaissance surveys and the inventory and assessment of abundance of a wide range of marine organisms; and
- 3 If the expertise, money and time exists, the compilation of species lists and estimated relative abundance of most organisms.

It is suggested that this relatively in-depth methodology could:

1. Help us gain a better idea of the very complex composition and structure of coral reef communities and how it changes over time.
2. Improve the scientific understanding of species and community relationships on the part of persons conducting biological monitoring and to better enable them to translate these into, or to obtain, vernacular names.

3. Help persons working in community-based marine conservation strengthen their scientific backgrounds and knowledge of marine communities and species.
4. Provide a firm basis for working with local communities in a rather relaxed and enjoyable “semi-quantitative” manner.
5. Provide an indication of the current extent of community breakdown and overfishing/overexploitation (e.g., from local fishing or the aquarium trade).
6. Help in the assessment the current and future ecotourism potential of MPAs for snorkellers, SCUBA divers, etc. (e.g., identify interesting species, habitats, coral concentration and the best site for snorkelling trails).
7. Gather information that can be used by local guides to enhance ecotourism potential.

It is stressed that participation by as wide a cross section of the community as possible is important (e.g., male and female, young and old, high-ranked and low-ranked, farmers and fishers, long-term and short-term residents, formally educated and non-formally educated, etc.). All parts of the methodology, including the actual administration of the questionnaire survey, the in-the-field (in-the water and on-the-reef), and the presentation and discussion of results, showed to be highly educational and informative, and should help to gain consensus, on a long-term basis, in terms of total village support marine protection initiatives.

Marine Resource Assessment in Rotuma

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Objective: Marine resource assessment by using indicators of fisheries health

Overfishing is a problem faced by all South Pacific nations today. Rotuma is an isolated island community fortunate to possess a small population which still relies on subsistence fishing. Commercial fishing is virtually non-existent and the sale of fish on the island occurs only to meet household, community and church obligations. A previous study conducted by *Laje-Rotuma Initiative*, who will be our project partner for this study, resulted in basic information on the population, households and the fishing community at large. Knowledge and importance placed on marine resources is considered to be quite high. In terms of fisheries, marine related concerns included:

- 1.) Fish size and numbers have decreased in comparison to what community remembers 10-15yrs ago
- 2.) Poison fishing and other destructive fishing practices
- 3.) *Kama* phenomenon – *Pavona* sp. clogs up fishing holes and overgrows everything else including other coral species

Site selection

Rotuma is a small volcanic island located 465km North of Fiji. The island is 43km² in area and has a population of 1,358 (2003 census). The population is made up largely of young people most of which leave the island for mainland Fiji to further education and employment opportunities. Therefore, there has been a steady decrease in population over the last 50 years. Rotuma is considered to be an ideal site for this study for the reasons listed below:

- Isolated community
- Commercial fishing non-existent – subsistence fishing or minimal sale within village

- Population structure and trends
- Baseline data already compiled by *Laje*-Rotuma Initiative
- Conservation through remittances – community does not have to fish as much
- Seasonality of marine resources and *kama* phenomenon
- Rotuman culture influenced from neighbouring cultures
- Differences in tenure system from mainland Fiji. There are no *i qoliqoli* issues or fishing rights problem. However, still needs management.
- No government fisheries officer present on island.

Methodology

- Research in Rotuma – 3 visits per year to conduct surveys

Also try to engage a member of community in each district to keep track of sizes and quantity of fish caught within that district biweekly Creel survey, log books and stakeholder training

- Sampling area – 3 districts (low, moderate, high use of fishery resources)
- Consultation with stakeholders: historical vs. current trends
- Use fish landings to calculate quantity of fish caught
- Determine fishing effort in districts using log books and interviews. Interview will include the use of a standard questionnaire
- Time Frame – 2yr Masters Thesis

Project Outcome

To describe the fisheries resources of Rotuma by utilizing indicators of fisheries health

Monitoring activities in Polynesia Mana countries

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Polynesia Mana was created in 1999 by Clive Wilkinson and Bernard Salvat but really came to life with funds provided by AFD in 2004 and the CRISP program in 2005. Polynesia Mana gathers 7 countries of the Polynesia region, the Cook Islands, French Polynesia, Niue, Kiribati, Tokelau, Tonga and Wallis and Futuna. Monitoring activities have started in all the countries except Tonga. French Polynesia is the most advanced country with important time series and different types of monitoring conducted, research, Reef Check and community-based. Wallis and Futuna are also well-advanced thanks to the regular venue of scientists from FP and New Caledonia but there is a need for local training. The Cook Islands have had an on-going program since 2000, recently extended to other islands; using sophisticated techniques. They are almost completely self-sufficient and just asked for more training and equipment. Kiribati started monitoring in 6 sites of the Gilbert group in 2004. Polynesia Mana assisted in coral monitoring training and equipment. More training, equipment and funding to carry out the data collection is still required. Niue and Tokelau started their monitoring in 2005 with an assessment of 2004 cyclone Heta damages in Niue and a status of the outer slope in Fakaofu. Polynesia Mana presents a disparity of capacities in its countries and as a consequence, a disparity of methods used, the aim being to find a suitable method for each country. In order to involve remote and low capacity countries such as Kiribati and Tokelau, a free diving, photographic method called the random photo-quadrat was developed. The activities planned for 2006 are divided in three major themes, equipment, training and collaboration. Equipment such as GPS, camera will be purchased and monitoring grants will be given to countries. Training will be conducted on the photo-quadrat method, fish surveys as well as on the new COREMO database. Collaborations will be pursued with the Southwest Pacific node, Mallardé Institute working on ciguatera, SPC, Department of Cimatology of the Princeton University and FSPI in Kiribati. Polynesia Mana has contributed in COREMO database development which is shortly coming to an end. This database

currently developed by a laboratory in Reunion Island will give countries an easy tool for data entry, analysis and storage and will contribute to standardize monitoring reports on a regional scale.

Long-term trends in subsistence fishing patterns and coral reef fisheries yield from a remote Fijian island

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Household surveys were conducted at Ono-i-Lau Island, Fiji, in 1982 and 2002 to examine long-term changes in subsistence fishing patterns, coral reef fisheries yield, and socio-economics. The population of Ono-i-Lau has decreased by 24% from 767 people in 1982 to 583 people in 2002. The mean weekly income of subsistence fishing households has doubled from \$F 5.7/week in 1982 to \$F 11.7/week in 2002 (\$ Fijian 1.00 = \$US 0.61, November 2002). Fishing continues to provide the main source of protein on Ono-i-Lau and mean per capita consumption of finfish remains high ($261\text{g} \pm 90\text{ SD man}^{-1}\text{day}^{-1}$ in 1982 and $269\text{g} \pm 100\text{ SD man}^{-1}\text{day}^{-1}$ in 2002), largely a result of villagers having insufficient income to purchase other sources of protein on a regular basis. Catch Per Unit Effort (CPUE) has increased from $0.89 \pm 0.46\text{ SD kg man}^{-1}\text{hr}^{-1}$ in 1982 to $1.6 \pm 0.2\text{ SD kg man}^{-1}\text{hr}^{-1}$ in 2002 because of the greater prevalence of fishing technology and the introduction of outboard-powered vessels. This has resulted in a reduction in fishing effort ($124\text{ hr capita}^{-1}\text{ year}^{-1}$ in 1982 to $68\text{ hr capita}^{-1}\text{ year}^{-1}$ in 2002), rather than an increase in yield from the fishery because fisher's continue to catch only what they can consume, in the absence of cold storage facilities and access to markets. Under the present circumstances further increases in fishing efficiency are likely to have little effect on the yield from the fishery which is governed largely by population size. The present study suggests that the coral and rocky reefs of Ono-i-Lau have sustained a yield of between 2.9 to 3.7 tonne $\text{km}^{-2}\text{ year}^{-1}$ of reef-associated fish over the 20-year period from 1982 to 2002 without any significant change in catch composition. Non-selective harvesting of fish and invertebrates is likely to be a contributing factor in the sustained catch composition. Despite the indications of overall sustainability of catch volume, there may be overfishing of some individual vulnerable species.

Use of indicators to monitor health of coral reefs and fisheries

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Coral reefs and fisheries are under pressure. Major issues include: global climate change, (coral bleaching); decline in water quality from terrestrial runoff (elevated sediments & nutrients; eutrophication); ecosystem effects of fishing (algal growth, outbreaks etc); loss of reef biodiversity (especially threatened species); and declines in reef fish landings.

Because of limited scientific knowledge in the region, there is a need to develop simple, scientifically accurate and cost-effective environmental indicators to assess the above impacts, and complex reef ecosystem changes. These must measure physical, chemical, biological or socio-economic factors which best represent key elements of complex ecosystems or environmental matters; be relevant to management objectives, part of management cycle; and utilize key species or key ecological process.

The USP/CRISP program will initially focus on developing indicators to assess major issues: global climate change and coral bleaching (utilization of coral cores, networks of data loggers); eutrophication and ecosystem-effects of over-fishing (UVC, coral/algae surveys, remote sensing, tiles); inshore resources inventories (coral cover, biodiversity using remote sensing and in situ surveys); biological indicators of fisheries (focused UVC); and socio-economic indicators of fisheries (landings, catch & effort, household).

DISCUSSION

PROJECT 1: CAPTURE AND ECONOMIC USE OF REEF FISH LARVAE

PRESENTATION OF THE TALKS RELATED TO THE PROJECT

Chairman:

RG presented the state of the art of the session by explaining the different stages of the fish life cycle and the remaining critical questions about dispersal, connectivity and settlement. He explained that fish larvae can be used for aquarium market, live-food in aquaculture, or fish restocking of the lagoon. The main difficulty for restocking studies is to reduce the mortality between larvae arrival at shore and settlement.

Comments:

RT: Why do the fish like to come near close to the shore?

RG: The shore area is an essential habitat for fish. They stay close to the shore for a few weeks where there are less predators and then swim back into the open ocean.

CV: What is the impact of restocking on habitat?

DPon: It is important to understand that there are different life cycles for different species due to different habitats or different hydrodynamics.

RG: We need more fundamental research on fish larval stage. When a MPA is created, it is necessary to include a lagoon channel inside it to protect this critical life cycle stage.

Speaker 1: Dominique Ponton; Research program on larvae and juveniles of reef fishes in New Caledonia

Comments:

JG: This is a very interactive tool. There are different numbers of levels according to the data or the request you have.

DPon: Using genetics to identify species is very expensive; however making drawings and adding characteristic levels is a very useful tool.

Speaker 2: David Lecchini; Habitat selection and sensory abilities of coral reef fish larvae

Comments:

HS: When using a chemical attractor, how do you do if the fish is attracted to the wrong or right habitat?

DL: You need to know the essential habitat of the species before putting attractor

ABK: Once you know which habitat is important, it might be better to work on restoration of this habitat rather than attraction process.

Speaker 3: Gilles Lecaillon; Post-larval field experimentation in Fiji for the development of a new sustainable fishery technology

GL presented the actions undertaken within the activities 3 and 4. The lab equipment was the most expensive part but once it is in place and it seems very efficient and allows to have many different species for different uses at the same time.

Speaker 4: Ed Lovell/ Arpana Pratap; Adaptation of legislation for larval fish collection and export in Fiji

Comments:

EC: It might be possible to obtain exceptions for the short term but to develop new adapted legislation for the long-term, and to adapt legislation step by step in each country according to the study conducted.

GL: The method of collect might be very different from one country to another, so it is important to precise the method in the legislation

HS: I actually think that the method of collection might be more important to control than the 'standard' size.

GL: There are different levels in MAC certification (Marine Aquarium Council) but it is important to adapt certification to goals. Another problem is that certification is very expensive

EC: First there is a need to adapt legislation, and then a need to simplify the way of obtaining certification

GENERAL DISCUSSION ABOUT THE PROJECT

Activity 1:

The main objective is to write some publications and to offer some academic diploma to students from Fiji. It is important to remind people that every document written under CRISP activities needs to be published with the CRISP's logo, as EC presented during the workshop.

Activity 2:

The larval manual must help identifying species at larval stages and must give information about how to capture the larvae, colonisation period, settlement, etc...

The aim for 2006 is to design a larval manual of fish larvae for French Polynesia. In 2007 and 2008 information will be added to the manual with data from Wallis, New Caledonia and Fiji. It will be necessary to work in synergy with World Fish Center.

Activities 3 - 4:

Activities 3 and 4 are now joined together and the main objective is to capture larvae with light trap in order to replenish the Fiji lagoon involving the EPHE (with PhD of Julien Grignon) and Ecocean (two students from Fiji already involved).

At the end of the project, Ecocean will have some information about the feasibility and profitability of a private firm capturing fish larvae in Fiji. And it has been agreed that the knowledge acquired by Ecocean during the CRISP project will have to be transferred to local fishermen if, one day, they would like to create their own private firm.

Activity 5

This is the role of the USP to develop legislation in order to allow the exportation of fish larvae. RG will send to USP the legislation reviewed in French Polynesia in order to develop the Fiji one and to allow the wild ornamental market of all marine organisms. USP will liaise with "Tony Naaki" to help them with the modification of Fiji legislations.

Finally, LZ and RG agreed to include more students within CRISP actions of Project 1.

PROJECT 2: IMPROVE KNOWLEDGE AND CAPACITY FOR CORAL REEF FISHERY MANAGEMENT

PRESENTATION OF THE TALKS RELATED TO THE PROJECT

Chairman:

JF presented Project 2 of the C2A and the state of the art of the session. She introduced the notion of indicators, their uses in management processes and the different steps necessary to identify a relevant and effective indicator. Then she presented the different activities of the project. The main goals of Project 2 is to develop integrated approach and standardized methods, using ecological surveys, socio-economic surveys and traditional knowledge to build and apply indicators, to create a regional database, and to develop tools to describe and manage the data.

RG: The main interest of an indicator is to be easy to perform

JF: Yes, that is the feasibility of the indicator, but the most important is its relevance compared to the question asked

LZ: You can describe a range of indicators from simple ones to more complicated ones.

RG: It would be interesting to select a common site in Fiji where the different partners could work together?

Aaron Jenkins, from Wetlands International, presented the FLMMA and EBM programs in Fiji. There are 121 LMMA (Locally Managed Marine Areas) sites in Fiji with community-based management plans, and the degree of success is variable according to the site and the population studies. It seems to work well for sessile invertebrates but it is harder for fish population because you need 3-4 years before significant increases. The main problems come from land-based activities. The EBM (Ecologically-Based Management) Project regroups social and fisheries sciences to quantify the influence of watersheds on reefs, and to define thresholds of land uses to manage freshwater systems linked to coral reef system.

RG: Is there connectivity between CRISP and EBM?

LZ: CRISP and EBM could be very complementary programs, especially at the Muaivuso site.

EC: EBM seems to fit with CRISP approach and people could share expertise and knowledge

Speaker 1: Randy Thaman; Indicators of marine biodiversity

RT talked about indicators of marine biodiversity and explained the way he proceeds in the field to gain information (survey in the field, verification with books, etc...).

Speaker 2: Michel Kulbicki; Use of biogeography on a regional scale for management on a local scale: a case study of reef fishes

Comments:

AJ: We considered that 10 to 20% of species are not observable. What contribution are they making to the total biomass?

MK: If you compare UVC versus rotenone studies, you observe that the number of species increases with rotenone but that the trend in biomass or trophic structure stays equivalent.

Speaker 3: Marc Leopold; Social and ecological indicators for coral reef fisheries assessment

Comments:

DPon: This type of tool is used to make predictions but does it take into account evolution and the fact that the needs of people are changing?

ML: Data collected at present only reflects the spatial environment, we need data on the same area for several years in order to measure temporal variation and to validate interpretations. It is planned to conduct a survey in Fiji with the same methods to be able to compare results.

Speaker 4: Veikila Vuki; Long term trends in subsistence fishing patterns in Ono-i-Lau

Comments:

AJ: Have you observed a shift towards a more algae-dominated community?

VV: Yes, there is a shift towards algae-dominated community even in isolated areas, and so the shift is even more important in fished areas.

Speaker 5: Ambroise Brenier; Community based monitoring of coral reef resources

Comments:

KM: I know a survey has been done in Samoa using school children and the quality of the data appeared really good.

Speaker 6: Teri Tuxson; Marine resource assessment in Rotuma

Comments:

AJ: The population in Rotuma is decreasing which is a usual situation so it will be interesting to compare the data with a site where population is increasing.

Speaker 7: Denis Poignonec; Cognitive mapping as a new methodological approach for the study of a coastal lagoon ecosystem submitted to a major increase of human impacts

Comments:

EC: I do not understand why you use the word 'map'

DPoi: Map is just a graphic representation of what you think

HG: Do you think these maps are easy enough to be used by the local population?

DPoi: Yes because there are different levels of interpretations of the same map. You can visualize the map differently if you are a fisherman, a manager, etc...It is a way to share visions of the same thing

EC: It could be useful in a database to include traditional, local knowledge along with science data.

DF: How can you be sure that the vision people are giving you is true?

DPoi: I consider that someone's vision is always true. It is important to compare scientific data with what people think about the system

EC: This is a tool that is part of a long-chain of information and that can be useful for improving database.

GENERAL DISCUSSION ABOUT THE PROJECT

Key issue 1: The GCRMN project would like to implement new method within the monitoring

The GCRMN project is aiming to develop a new method to count fish and to implement them within MPA monitoring. They are hoping that activities in project 2 will provide new monitoring techniques which they could use as soon as possible in the monitoring network.

However, developing methods takes time and a method often answers a specific question. That is why the method needs to be adjusted to fit the question asked. It might be too early to implement the methods that have been tried so far within CRISP. Nevertheless, monitoring is already taking place and needs new techniques as soon as possible.

Key issue 2: Possible collaboration between CRISP, ProcFish and EBM?

ProcFish is already a partner of the CRISP project, essentially based on people interactions. CRISP project could bring expertise on indicator choice and fisheries management and EBM could improve knowledge about the study sites as they have already been working in Vanua Levu. USP could be the link between CRISP and EBM and it is under their responsibility to choose a second site of study in Fiji.

Muaivuso has been chosen as the first 'common' site of study in Fiji, and it seems that the second one could be one of EBM's sites where they have already collected data from it. EBM work should also be linked with the component 1 of CRISP.

Activities 6 – 8 – 9:

Activities 6, 8 and 9 are now joined together.

A trip is planned next year to go back to Tonga which was the first site of the DemecoFish program in order to make some validation, see the evolution of socio-economic aspects and retribute results to the population. However, it seems important

to analyze data already collected and to reconstitute them to the population before undertaking new surveys. CRISP agreed that all data collected will be reconstituted to local population with feedbacks and explanations.

USP is trying to promote the involvement of students into CRISP actions but they are lacking scientific supervision. Consequently some training courses between IRD and USP should be developed this year in order to share knowledge.

At USP, a new student (most probably Akuila) will be recruited in two months and Teri will continue her work in Rotuma for 18 months.

At IRD, some students are already working to develop indicators to monitor crab fisheries in the North of New Caledonia. They also conducted studies to compare fish count results between free-diving and scuba diving techniques, and the data will be analyzed before the end of the year.

A trip is also planned to Muaivuso. It could involve different partners and could be repeated every year in order to test at the same time different methods and indicators to find cost and benefit of the different approaches. This experiment could lead to a guide confronting methodologies with advantages, disadvantages and efficiency of the tools used to measure fisheries indicators.

Activity 7:

Several students are already working with MK on the use of the checklists. Now it is necessary to cross this species list with data from RT about common names and fishermen perceptions.

There is a possibility of producing a list of scientific names of commercial fish species around the Pacific.

Activity 10:

It appeared too soon to talk about the development of computer tools. The workshop previously planned during year one will not take place but be postponed until later.

PROJECT 3: DEVELOPMENT OF SYNOPTIC INDICATORS AND CORAL REEF MONITORING

PRESENTATION OF THE TALKS RELATED TO THE PROJECT

Chairman:

LZ talked about environmental indicators and how they can be used as communication tools to condense information and as management tools for monitoring program.

Speaker 1: Sofia Shah; Paleosedimentary records from coral skeletons

SS talked about paleosedimentary records from coral skeleton and presented the method of coral coring.

Speaker 2: Pascale Chabanet; Impact of an expected disturbance associated with a mining project in New Caledonia: which methods and indicators should be used to assess fish communities?

Comments:

RG: Do you think that the BACI method is efficient enough for a three-year program?

PC: You usually need at least 5 years to see some changes but BACI is still a very interesting method, and long-term studies are better.

EC: It is more important to test indicators within the BACI procedure than to test the BACI procedure itself.

Speaker 3: Ken Mackay; GCRMN activities within the Southwest Node

Comments:

EC: Is the collection of data based on Reef Check methodology?

KM: Yes, all countries within the GCRMN monitoring are using some form of the Reef Check methodology.

Speaker 4: Ed Lovell; GCRMN activities in Fiji

Comments:

DF: How do you define coral reef health? Do you think bleaching is a good enough indicator? It is probably important to define reef health before defining indicators.

ABK: The recognition of disease is also difficult, sometime degradation is due to a disease, sometime due to predation but people will state it 'disease' which increases the difficulty of comparing statements between different surveyors.

PC: It would be important to precise the definition of the Reef Check method to make sure that people are using the same methodology and that data are comparable.

HS: We need a standardized method in order to have a simple core system, usable and comparable amongst regions.

KM: Within the GCRMN, there is coordination among the 7 islands but there is a need for a Fiji-coordinator. Need some funding for a coordinator in Fiji.

Speaker 5: Zaidy Khan; Habitat variation in seawater temperature assessment in relation to coral bleaching

Comments:

EC: Did you find some resorts interested in having collaboration?

ZK: Resorts were keen on doing logger studies, but they want to have feedbacks from the studies and to be able to show the results.

Speaker 6: Caroline Vieux; Coral reef monitoring activities in Polynesia Mana node countries

Comments:

LZ: Is there a calibration among the UVC transect used in the 7 countries

CV: No, for the moment adaptation of UVC will depend on the island capacity

DF: Probably bleaching is not the only thing to monitor anymore and there is a need to standardize the method among the GCRMN and to focus on MPA monitoring.

RT: There is a need to find indicators of other systems linked to coral reef health.

EC: COREMO is a harmonization of the data entry and analysis, but first it is necessary to harmonize collection method.

GENERAL DISCUSSION ABOUT THE PROJECT

The Chairmen (KM, CV, PC) presented a summary of the morning talks by identifying some major questions: How to define an indicator? What are indicators trying to measure? Why is monitoring important?

They insisted on the fact that it is important to differentiate two types of monitoring: monitoring for research science and basic monitoring for local population.

They suggested several actions to be developed in the future:

Firstly concerning the method,

- To compare the photoquadrat method with other method of survey
- To create a coral reef monitoring method manual. This manual used in parallel with the COREMO training will give a sufficient basic knowledge to countries to monitor their reefs
- To develop free-diving fish surveys by organizing a workshop about the method
- To develop the video approach in the future

And secondly, concerning the indicators,

- To develop indicators for fish and invertebrates monitoring because the live coral cover is now a common indicator for benthic monitoring.

The Reef Check method is apparently the one commonly used, but it is possible to take it as a starting point and to build an improved or more complete method according to what the needs are. It is important to have a standardized method if data among region are going to be compared.

Monitoring manuals already exist and there is probably no need to create new one but rather to criticize the methods already described and improve them.

The method chosen will depend on the main question asked so first it is important to define indicators, to precise the users of the indicators and the actions that we want to conduct following the reading of the indicators. Integrated approach is necessary; indicators are used for management, not for science and there is an urgent need to develop some tools to observe the entire coral reef ecosystem.

Activity 11 – 12 – 13 - 14

Activities 11, 12, 13 and 14 are now joined together.

The objective is to have a review of the literature existing and leaders of this action will discuss a list of chosen indicators and will try to assess and improve them. Actions in activity 12 will help in the choice of indicators by adding more information.

A new action has also been added to this activity in order to observe and compare methodological approaches and to identify an easier technique to census fish and habitat. Methods such as UVC and video will be compared to each other. In order to test the video method, a student from Fiji could take part in this study. USP could also use the method of coral coring in Noumea in order to increase amount of data at sites already studied.

Activities 15 - 16:

Activities 15 and 16 are now joined together. CV and KM agreed to merge these two activities together because it follows the same problematic even if they might be at different level of progress. A report of their activities will be ready by June 2006.

It seems that it would be interesting to have a common coordination for the Pacific and thus to link the Southwest Node and the Polynesia Mana Node. By associating the two nodes together it could be a nice approach to obtain bigger funding, especially with the European Union. This larger coordination of GCRMN could be a very successful story within the CRISP program and could lead to new funding opportunities.

However, it seems that even if the regional coordination is working well, the 'in-countries' network does not have enough funding at local scale to improve properly. CV mentioned that it is possible to do monitoring without large funding by finding motivated people and that money needs to be invested with a long-term scale in mind. For this year the Southwest Node and Polynesia Mana Node will plan one action in collaboration in order to gather data about coral reef monitoring methods in the South Pacific.

PROJECT 5: TOURISM

Speakers: Randy Thaman and Helen Sykes

Tourism is the number one industry in Fiji and is mainly relying on the marine environment for tourists to come. The main problems linked to tourism are eutrophication and sewage treatment. It seems important to increase the knowledge of resorts and tourists about the marine environment and its fragility in order to develop 'sustainable tourism'. Tourists are enthusiastically willing to take part into monitoring studies and thus their involvement in research/monitoring programs must be taken into account.

Comments:

DPon: It is important to make a difference between the impact of the resort on the environment and the fact of involving the resorts into coral reef monitoring.

We are not sure that the involvement of the resorts into monitoring will increase coral reef health but proper sewage treatment will surely have some effects on the environment.

HS presented a draft for a new program called 'BlueStars' concerning training and certification program to promote coral reef ecosystems with coral reef tourism. It is a combination of existing programs to create a new guide and a new certification level. Each star will correspond to a certain level of certification.

Comments:

EC: Getting five stars should be made very difficult, and the first star(s) should concern proper sewage treatment and the general implication of the hotel in environment conservation before even teaching them about coral reef monitoring. It seems important to allow an assessment of the resort before allowing training specific to coral reef; and the training should be a complete program for all the staff.

HS: There will be an annual review of the resort. Resorts should pay a membership fees which will contribute to fund a coordinator, who will assess their commitment to the certification program.

CV: There is a problem if too many hotels are right next to each other and if some of them do not follow the same 'eco-friendly' management.

The goal for 2006 is to test this program in different resorts in Fiji and to observe the first results.

Progress and Action plans:

ACTIVITY	TIME FRAME
Review existing materials on REEF tourism and relevant knowledge on coral reef ecosystems to identify relevant material and gaps that need to be filled	✓ Nov /Dec 2005
Develop Relevant Draft Coral Reef Ecosystem Tourism Education Course	✓ March 2006
Review of Draft Coral Reef Ecosystem Tourism Education and Certification Course Modules	✓ March- April 2006
Identify and approach tourism operations willing to serve as test cases for course	✓ March 2006
Finalise initial partners and establish a E-group among CRISP members and other relevant person to identify and establish partnerships between projects	✓ April 2006
Develop Relevant Draft Certification Criteria	✓ April – May 2006
Production of Coral Reef Ecosystem Tourism Education and Certification Course Modules	May-June 2006
Workshop/Trial Training Using Draft Modules.	July-August 2006
Presentation to Ministry of Tourism, Fiji Visitors Bureau, Fiji Hoteliers Association and other relevant tourism bodies	August 2006
Production of Coral Reef Ecosystem Tourism Education and Certification Guidelines and Course Modules	Sept 2006
Distribution and Implementation	Oct 2006 – 2007
Train/involve postgraduate in the entire certification/training and evaluation process	Feb. 2006 – Feb. 2007 and possibly do thesis on the Accreditation Process.

FINAL DISCUSSION

REMAINING ACTIVITIES

Activities 17 – 18 - 19

Activities 17, 18 and 19 are now joined together.

The aim is to build a regional database concerning indicators for reef health and fisheries health. This large database should involve collaboration between GCRMN, IRD, FLMMA and should include all types of data. It is important not to make too many databases but to gather the one already existing to increase the amount of data. The main goal is to have a link with other database through the internet. The development of the database will start in 2006.

The COREMO database has been developed with the French funds and CRISP will assist in its implementation in the Pacific region. A technical workshop will take place in May in Noumea.

The Reef Base funds should arrive soon and money will be shared between a salary for a manager, a salary for a technician based in Noumea, three part-time salaries (USP, EPHE, SPREP) and some equipment for the two nodes (computers and PDF scanner)

Activity 20

The idea is to make a short DVD with a booklet for school programs. The DVD will explain the different perception of people living near a coral reef ecosystem, will introduce the organisms living in this ecosystem, and will create little stories where children express their point of views.

Activities 21 - 22

Activities 21 and 22 are now joined together.

There is a need to develop UVC training courses in Fiji. The training could involve both fisheries monitoring and coral monitoring. It would be appropriate to set up a long-term partnership between IRD and USP in order to organize training courses (UVC, fish identification...). These courses could be put on DVD and dispatched

everywhere to help people in fish identification, UVC technique, size estimation, and monitoring.

MK pointed out that training sessions have been carried out a few years ago and that it takes at least two weeks to train people, and they need to have immediate field training after the course to apply what they have learnt during their training.

Activity 23

There is already some student exchange taking place between France and Fiji (Julien Grignon in Fiji, some Fijian students are in France).

JF is willing to take some Fijian students to work on her action at Muaivuso site.

A list of all students involved in the different actions will be made by June 2006.

KEY POINTS

- Activities merged:

3 - 4

6 – 8 - 9

11 – 12 – 13 - 14

15 - 16

17 – 18 – 19

21 - 22

It seemed important at the beginning of the workshop to reduce the number of activities, it will be easier to merge funds and to do a more complete job within less actions.

- Muaivuso has be defined as a ‘common’ site by IRD, EPHE and USP
- All documents written within the CRISP project need to be published with the CRISP logo; and reports published under CRISP name have to be done during the project, it can not include old surveys.

- Reporting:

EC presented the reporting standard model that will be due every 6 months. The first report is due by July 2006.

SUMMARY TABLE

Activity #	People involved	What has been done so far	Actions to be implemented	Deadline	New #	Project #
1: Research on larvae harvesting	Ponton Lecchini		Publications		1	1
2: Research on larvae identificat.	Ponton Lecchini	Utilisation of Lucid3 software	Build identification guide for FP	December 2006	2	1
3: Identify countries	Lecaillon	Operations started in 2005	Continuation of the project	Activity report ready for June 2006	3	1
4: Identify sites	Lecaillon	Operations started in 2005	Continuation of the project (new sites to be tested)	Activity report ready for June 2006	3	1
5: Legislation	Lovell Pratap		Development of the legislation in Fiji		4	1
6: Contin. of ProcFish	Leopold Kulbicki	Data analysis	Publication Presentation of DemEcoFish results in Fiji	December 2006	5	2
7: Biodiversity	Kulbicki Thaman	Master student survey (NC)	Checklist of fish	December 2006	6	2
8: Socio-economy	Zann Ferraris Leopold	Workshop USP-Fish Dept Contract in Rotuma (18 months) Suva Workshop (April 06) Surveys (2 sites in NC)	Contract Maivuso (1 year) Report Report Report	December 2006	5	2
9: Fisheries indicators	Leopold Ferraris	UVC survey Fisheries survey (FP)	Publication Workshop about methods in Suva Presentation at APCRS symposium	December 2006	5	2

	Zann	Postgrad. research Postgrad. research in Suva	Community-based monitoring (FP) Report			
10: Computer Tools	Pelletier	Master student (NC) Contract (2 months)	Report GIS product	December 2006	7	2
11: Literature	Ferraris Chabanet Lovell Vieux Sykes	In progress	Bibliography List of indicators discussed and improved	December 2006	8	3
12: Remote sensing	Zann	Imagery done for Fiji	Recruitment of students	December 2006	8	3
13: Test of indicators	Chabanet Vigliola Khan Shah	Test of methods (UVC, video)	Data collection Analysis of coral coring/ Temp. loggers	December 2008 December 2006	8	3
14: Guide	Zann		No activities planned for 2006	June 2008	8	3
15	Vieux	Implementa tion of monitoring activities		Activity reports ready in June 2006	9	3
16	McKay	Training Purchase of equipment Identificati on of the current situation in the countries	Gathering information about coral reef monitoring methods in the South Pacific	December 2006	9	3
17: Data bank	Vieux McKay	Adaptation of COREMO database to the Pacific	Technical workshop to test the database	December 2006	10	4

18: Regional database of reef health indicators	Ferraris		To link actions 17, 18, 19 to create a common database including all type of data	Nothing for June 2006	10	4
19: Regional database					10	4
20: Communication	Chabanet		To develop a DVD and booklet for schools	Nothing for June 2006 Presentation of Denis' results before the end of 2006	11	4
21: Training courses	Kulbicki Lecchini		To set up a UVC training in Fiji	First report before the end of 2006	12	4
22: Training courses					12	4
23: Student exchange		Julien Grignon is in Fiji Some Fijian students are in France	Possibilities of increasing numbers of exchange student Possibility for a Fijian student to work in Maivuso with IRD team	To make a list of students involved in the exchange (June 2006)	13	4
24: CO2					14	5
25: Tourism	Thaman Sykes		Creation of the 'blue stars' program	To test the program in Fiji before the end of 2006 To develop course modules	15	5

LIST OF WORKSHOP PARTICIPANTS

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PRESS RELEASES

Experts plan to save reefs

THE overuse of marine reef resources, extreme new weather patterns and loopholes in government legislation are some of the issues scientists around the Pacific have identified as critical to the preservation of our ocean ecosystems.

French and English speaking marine science experts from the region, in a first, are collaborating in efforts to determine the health of our marine ecosystems, particularly our coral reefs, one of the best underwater tourism attractions in the world.

At a Suva one-day workshop yesterday, the Coral Reef Initiative for the South Pacific (CRISP) mapped out plans on how to better protect and maintain our coral ecosystems while improving existing data bases on this ocean resource.

"I don't think people realise that we are now in a very difficult situation in terms of maintaining our reef ecosystems," said Dr Eric Clua, CRISP Program Manager.

THE FIJI TIMES — TUESDAY, APRIL 11, 2006 5

Protecting our coral ecosystem

The Marine Studies Program at USP will this week run a workshop on the knowledge, management, rehabilitation and beneficial use of coral ecosystems.

This workshop is part of the Coral Reef Initiative for South Pacific (CRISP) program initiated in France in 2002 which is working on developing partnerships with the English-speaking countries and institutions in the Pacific.

The program is broken up into several components – each looking at various areas of coastal management.

The goal of the project is to take initiative for the protection and management of coral reefs of the Pacific, championed by France, and open to contributions from all quarters.

It aims to develop a vision for the future for these unique ecosystems and the people who depend on them for their livelihood.

It seeks to put in place strategies and projects to preserve the biodiversity of the reefs and for the future development of the economic and environmental services that they both offer locally and globally.

USP is involved with Component 2A (C2A) of the program which gathers several institutes that are working together within five different outputs and 25 actions.

The goal of the C2A is to improve knowledge, monitoring, management capacity and development of the resources of the coral reef ecosystems to ensure sustainable development of coral reefs.

During the first meeting in January 2005, the CRISP partners decided to hold a workshop between the three main partners – EPHE (Ecole Pratique des Hautes Etudes), IRD (Institut de recherche pour le développement) and USP after year one of the project in order to share progress, knowledge and possible problems.

The objectives of the workshop which will be held in Suva, Fiji, with the theme “Using indicators to assess coral reef ecosystem and fisheries health” are as follows:

- To present the different operations inside each of the 22 actions of the C2A, and to present the different staff involved;
- To discuss the development of each operation and the progress made;
- To discuss the theory and use of indicators to assess general coral reef ecosystem health, major issues and threats, and sustainability of fisheries;
- To draw general conclusions, to agree on common and standard indicators to be applied in CRISP project, to plan future operations and to develop coordination amongst partners; and
- To present standard scientific report that each partner will be requested to present every six months.

Participants will include scientific teams from USP and EPHE, and IRD (both from French organisations) and project partners.

The program goal of C2A is to develop reef fish larvae harvest techniques, assist in formulating

fisheries management and coral reef surveillance indicators and optimise the transfer of knowledge to users of these resources.

The five outputs which several institutes are working together in component C2A are:

- Harvesting reef fish larvae and developing their economic potential. This will also include editing of a guide for larvae diagnosis, setting up of pilot operations with commercial purposes etc.
- Improving knowledge about coral ecosystems and the capacity to manage them. This will include identification and validation of indicators for reef fisheries monitoring etc;
- Formulating composite indicators and monitoring coral reefs. This will include review and monitoring indicators of reef health status, implementation of GIS and remote sensing tools etc.;
- Skills and knowledge transfer, and capacity building. This will include implementation of innovative methods for information transfer to local populations, technical officers and other users of reef resources, etc;
- Specific Studies – i) effects of atmospheric carbon increase on reef evolution and ii) contribution to development of ecotourism.

It is expected that by the end of the CRISP initiative in the Pacific, knowledge on coral ecosystems, including the effects of global changes,

continued on page 8

continued from page 2

would have made significant strides towards integrating cross-disciplinary fertilization and that such knowledge would be available to decision-makers and planners.

It is also expected that significant and carefully selected portions of these ecosystems will become protected or placed under participatory

and sustainable management, following a region-level decision on what the priorities should be and according to harmonised procedures.

Also expected is that economic potential of these ecosystems will be demonstrated by examples drawn from their principal functions (fishing and aquaculture,

tourism, biodiversity development etc..).

Finally, it is also expected that collaborative networks bringing together citizens of French overseas territories, developed countries of the Pacific and the small island states of the region will be strengthened or created.