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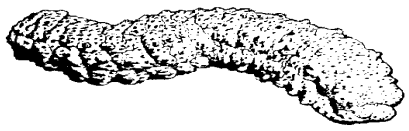

BECHE-DE-MER
INFORMATION BULLETIN

NUMBER 1 **JANUARY 1990**

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ABOUT THE BÊCHE-DE-MER SPECIAL INTEREST GROUP

This bulletin is the first to be produced by the SPC Fisheries Information Project. It is intended for circulation to registered members of the SPC Special Interest Group (SIG) on beche-de-mer.

The concept behind SIGs is to establish networks of individuals working in similar subject areas, so as to encourage the sharing of information and ideas in the region. There are currently two SIGs in operation, on beche-de-mer and on pearl oysters. We anticipate that the number will rise to about 12 by the end of 1990.

The SIGs are being established in response to the needs of Pacific Island fishery scientists and development workers, as expressed at the SPC Workshop on Pacific Inshore Fishery Resources in March 1988, and at the 21st SPC Regional Technical Meeting on Fisheries in August 1989. In both cases, representatives of the Commissions 22 Pacific Island member countries and territories urged the SPC to become more active in the collection, repackaging and dissemination of information on the key fishery resources of the region, as a step towards reducing the problems faced by fisheries workers because of isolation from other workers and poor communications in the islands.

As a first step, the Commission circulated questionnaires on the establishment of SIGs to the Fisheries establishments of the region and beyond. The questionnaire responses were used to gauge the relative interest of different subject areas to Pacific Island fishery workers, and to identify individuals who might provide technical information. As a result, several SIG subject areas have now been identified. In the case of bêche-de-mer, we have received about 60 questionnaire responses, and this is the first SIG to become active.

As part of the support offered to each SIG, the South Pacific Commission will undertake to circulate literature, technical materials, and correspondence relevant to the interests of group members on an occasional basis, mainly in the form of this type of bulletin. In return, we would ask group members to keep us informed of their own work activities in the subject field, and to send us single copies of any material or information that may be relevant to the interests of other members of the group.

The goal of this first beche-de-mer information bulletin is to give group members an idea of the type of information we hope to include, as well as to provide a stock-take of currently available bibliographic information relevant to the interests of the group. A list of SIG members is also given to facilitate preliminary contacts between members.

To make the bulletin worthwhile, we would stress that it is extremely important for members to keep us informed of their activities with the aim to supply items such as:

* research activities in biology and ecology;
* fishing and marketing activities;
* information on books, conferences and various publications;
* questions by members or information requests;

Jean-Paul Gaudechoux
Fisheries Information Officer
South Pacific Commission

u P u I u M u R u I u S u

Pacific Islands Marine Resource Information System

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We had received completed questionnaires from the individuals listed below at 31 December 1989. If you are on the list and your name and address is wrong, please send us a correction. If you are not on the list and want to be, fill in the form enclosed with this bulletin or write to us for a new one.

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BECHE-DE-MER NEWS

Mass beche-de-mer production in Fiji

The beche-de-mer industry in Fiji has undergone some major changes over the past couple of years. From a small industry producing some 20-30 tonnes of dried product a year, the annual production began to rise dramatically in 1984, and in 1988 total production was about 665 tonnes. Assuming a somewhat generous conversion ratio of 10% (see article on p 7) this represents some 6,650 tonnes of fresh sea cucumber - about the same as all other seafood production in Fiji combined, including the 2,800 tonnes of tuna caught by the Government fishing company, Ika Corporation, that year.

Unfortunately, this increase in production has not been accompanied by a corresponding increase in the value of the final product. The 33 tonnes sold in 1983 fetched F$ 394,800 (F$ 11,963 a tonne), while the 1988 production of 665 tonnes sold for F$ 1,850,800 (F$ 3,709 a tonne). Although factors such as fluctuating foreign exchange figures play a part, the main reason for the decline in average value of Fijian beche-de-mer is that processors are making use of low-grade species that were previously considered worthless. In fact, in 1988, some 95% of the beche-de-mer exported from Fiji was blackfish (**dri loli** in Fijian), *Actinopyga miliaris*, a species which rarely appears in the export figures prior to 1984.

There are several reasons that blackfish processing is now economically feasible in Fiji when previously it was not. One is an undoubted increase in acceptance of this species by buyers, partly because it is now in demand as a barter currency for trade with mainland China. However, the value is still low - F$ 1-2/kg - and for many individuals and rural fishing groups who have previously been involved in harvesting higher-value species, such as teatfish *(Holothuria nobilis and Holothuria fuscogilva)*, it is not worth the time and energy to process.

A major reason why blackfish processing can now be carried out economically is that the establishment of centralised processing facilities in some areas has enabled mass-processing, resulting in greater cost-effectiveness. Coastal villagers from the area around the processing site undertake collection of fresh sea cucumbers and deliver them at the end of each working day. They are paid according to the weight of what they collect (with some allowance made for the size of the animals), and are not involved in the further processing of the catch. Processing is done in large batches, and a facility such as the one pictured below is able to produce 1-2 tonnes of dried product a day.

Centralised beche-de-mer processing facility in Vanua Levu, Fiji.
(Photo: Steve Roberts)

Such centralisation encourages the exploitation of a resource which might otherwise go unused. However, under this system, villagers are not receiving the full value of their resource because, by selling fresh rather than processed product, they are not realising the value-added component that derives from processing. As a result, a large part of the income from beche-de-mer processing ends up concentrated in a few hands, rather than many, and much of the benefit of beche-de-mer processing as a village-level income-earning activity - one of the few that exist in some rural areas - is lost.

Beche-de-mer collection rafts like this allow intense harvesting of the resource by coastal villagers.
(Photo: Garry Preston)

Centralisation of processing may also have another unwanted effect, namely that of encouraging overfishing. Any large processing plant is going to need a certain amount of product to keep it going, and, for logistical reasons, much of this will be harvested from the plant's immediate vicinity. In the case of species such as the blackfish, that naturally occur in high densities, it may be possible to achieve sustainable harvest levels even close to a processing plant. However, other species that occur in lower densities may be less resilient. This group may include the sandfish, *Holothuria scabra*, which is also the target of centralised processing activities. Last year, concerns were expressed in Fiji that this species, which is also used locally as a foodstuff, was being depleted in some areas. As a result, a ban on exports of *H. scabra* has been imposed by the Fiji Government since January 1989.

The high level of beche-de-mer exploitation in Fiji looks set to continue, at least in the near future. The explosive growth of the industry raises some serious concerns about the long-term sustainability of these harvesting levels. Biological information on which to base a management system is almost completely lacking, and even if information were available, the difficulties of effectively managing a geographically scattered, multi-species fishery that is of such importance in generating rural incomes, are great. The only realistic means of monitoring and controlling the fishery is via the exporting companies, which are not too numerous and mainly operate from three urban centres. The Fiji Government is presently encouraging the development of an Association of Seafood Exporters, with a strict code of practice that includes providing information to the Fisheries Division, and encouraging the addition of value to the product at the village level. Exporters must be members of the Association to obtain an export licence for beche-de-mer. This system may be expanded to cover other inshore marine resources in the future.

Garry Preston
Senior Inshore Fisheries Scientist
South Pacific Commission

New Caledonia export statistics

New Caledonia exported a total of 135 tonnes (dry weight) of beche-de-mer during the period January - December 1989. Three local companies between them exported the entire volume. No details on species composition of exports are presently available.

Garry Preston
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Beche-de-mer production from three Papua New Guinean atolls between 1982 and 1983.

Annual harvests of sea cucumber or beche-de-mer in Papua New Guinea (PNG) for export are low and amount on average to about 5.5t/ yr dry weight or about 55t/ yr wet weight (Dalzell & Wright 1986). By comparison exports of beche-de-mer in Fiji rose in the late 1980s to about 1,000 t/ yr or an equivalent of 10,000 t/ yr in wet weight production. Research on beche-de-mer in PNG has been limited to several species found in coastal lagoons along the South Papuan coast (Shelley 1981). No other accounts of beche-de-mer fisheries occur in the literature on PNG fisheries other than a few unpublished reports listed in the PNG fisheries bibliography (Lock & Waites 1985). This short note summarises the brief history of a beche-de-mer fishery in the Nuguria, Carteret and Mortlock and Islands of north eastern Papua New Guinea.

The three island groups are coral atolls to the north and east of the large island of Bougainville (North Solomons Province). The traditional fisheries of these islands has been described by Wankowski (1979) who mentions that beche-de-mer had previously been harvested on these islands in the past. Due to the efforts of the fisheries extension staff beche-de-mer harvesting commenced again in these islands in 1982 and lasted until the end of 1983. Beche-de-mer were collected and processed by villagers on the islands and collected periodically by dealers based in the provincial capital of the North Solomon Province, Kieta. The fishery targetted mainly on the black and white teat fish Holothuria nobilis. A total of 18.4t dry weight of beche-de-mer were produced by these three island groups over this two year period, 66% of which came from the Carteret Islands (Table 1).

Table 1. Production of beche-de-mer from three northern Papua New Guinea atolls for each six month period in 1982 and 1983.

Period	Beche-de-mer production (kg)			
	Carteret Is	Nuguria Is	Mortlock Is	Total
Jan-Jun 1982	4575	497	2316	7388
Jul-Dec 1982	4750	1201	770	6721
Jan-Jun 1983	1618	365	268	2251
Jul-Dec 1983	1136	536	339	2011
Total	**12079**	**2599**	**3693**	**18371**

The dried beche-de-mer were graded into three classes based on size; grade 1 ≥ 20cm, grade 2 = 17-20cm and grade 3 = 15-17cm. The production by size grades were recorded by the beche-de-mer dealers in Kieta. Summaries of these records for each six month period are given by Ito (1984). At both Nuguria and Mortlock Islands catches consisted mainly of grade 1 and grade 2 beche-de-mer throughout the history of the fishery. At the Carteret islands, however, grade 1 and 2 beche-de-mer were virtually eliminated from the fishery in the first six months of collecting by the villagers (Fig 1). Grade 1 specimens which accounted for 38.0% of the harvest in the first half of 1982 comprised only 1.4% of collections in the subsequent six months of the same year.

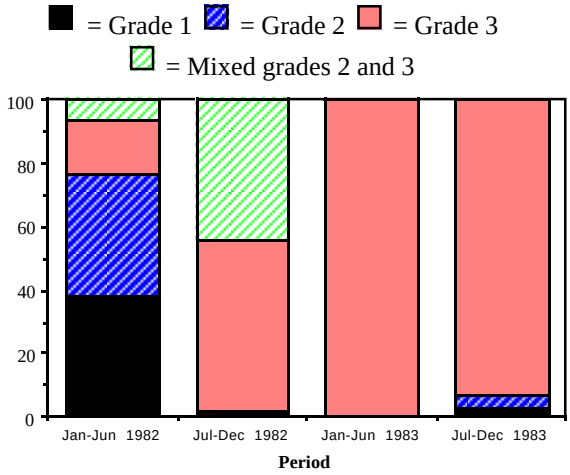

Figure 1. Grade (size) proportions of beche-de-mer harvests from the Carteret Islands, 1982-1983

Harvests at the Carteret Islands during 1983 were comprised almost entirely of small grade 3 specimens although in the latter half of the year a few grade 1 and grade 2 specimens were collected. Ito (1984) suggested that the virtual absence of larger beche-de-mer in the Carteret Island production after the first half of 1982 was a probable consequence of over fishing. The more modest harvests from the other two atolls was not accompanyed by an elimination of the larger beche-de-mer specimens. According to Ito & Selemet (1985) buyers in Kieta ceased operations after 1983 since most of the production was based on the Carteret Islands and the quantity and quality of the beche-de-mer from this location had declined appreciably as detailed above.

There is little that can be added to the documentation of this short lived fishery. No information is available on the size of the harvesting grounds at each atoll or the relative amounts of effort used to generate production. However, these limited data lend support to the general concept of beche-de-mer fisheries being governed by boom or bust cycles. Further, declining harvests and reduction in mean size of harvested animals are symptomatic of overexploited fisheries. Members of the beche-de-mer SIG are encouraged to send in similar short accounts of fishery case histories for comparrison, particularly where the information concerned is presently in a form that will receive limited circulation in the region.

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References

Dalzell, P. & A. Wright. 1986. An assessment of the exploitation of coral reef fishery resources in Papua New Guinea, p477-481. In J.L. Maclean, L.B. Dizon and L.V. Hosillos (eds.) The First Asian Fisheries Forum. Asian Fisheries Society, Manila, Philippines.

Ito, K. 1984. Annual Report, Fisheries Section, North Solomons Division of Primary Industry, mimeo pag.var.

Ito, K. & Selemet. 1985. Annual Report, Fisheries Section, North Solomons, Division of Primary Industry, mimeo, pag. var.

Lock, J.M. & D.C. Waites. 1985. Papua New Guinea Fisheries Bibliography., Tech. Rep. 85/3, Dept of Primary Industry, Port Moresby, 102p.

Wankowski, J.W.J. 1979. Subsistence fishing on Nuguria, Nukumanu and Takuu atolls. Harvest 5 (3), 179-185.

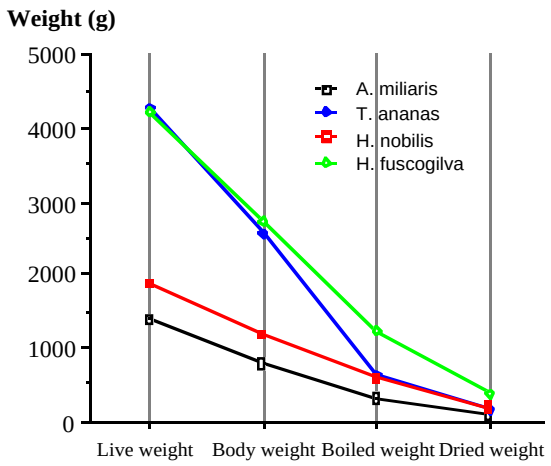
Beche-de-mer recovery rates

Recovery rates (ie the percentage of dried product obtained from a given amount of fresh material) for beche-de-mer have been estimated by several researchers over the last few years. Some recent drying experiments were carried out by Veikila Vuki and Filipe Viala, both formerly of the Fiji Fisheries Division in Suva. A report on these trials will be presented in a forthcoming SPC publication. Below is a summary of results from this and previous studies by other workers, expressed as weight and length retained by specimens after processing.

Species	English name	% weight retained	% length retained	Reference (see below)
Actinopyga mauritiana	Surf red fish	6.7	44	1
Actinopyga mauritiana	Surf red fish	4.9	46	5
Actinopyga miliaris	Black fish	5.6*	--	2
Actinopyga miliaris	Black fish	9.7	52	5
Actinopyga echinites	Deepwater red fish	3.0	--	3
Actinopyga echinites	Deepwater red fish	11.2	47	4
Holothuria atra	Lolly fish	2.6	--	2
Holothuria atra	Lolly fish	7.7	48	5
Holothuria fuscogilva	White teat fish	7.6	51	4
Holothuria fuscogilva	White teat fish	9.8	53	5
Holothuria fuscopunctata	Elephants trunk fish	9.3	50	5
Holothuria nobilis	Black teatfish	8.7	--	2
Holothuria nobilis	Black teatfish	9.8	44	4
Holothuria nobilis	Black teatfish	8.1	55	5
Holothuria scabra	Sandfish	5.0	--	3
Thelenota ananas	Prickly red fish	3.0	--	2
Thelenota ananas	Prickly red fish	4.6	38	4
Thelenota ananas	Prickly red fish	5.6	36	5
Stichopus chloronotus	Green fish	2.7	32	5
Stichopus variegatus	Curry fish	3.9	34	5

* Recalculated from original data

(Sources [see bibliographic listing this issue]: [1] Zoutendyk, 1989b and c: [2] Harriott, 1984: [3] Conand, 1979: [4] Shelley, 1981, cited in (2): [5] Vuki and Viala [in press])



Weight loss during processing of four beche-de-mer species. Based on Harriott (1984) and Conand (1979)

There is a fair degree of consistency among the results, especially considering the variations in experimental methodology used by the different researchers. Few, if any, species will yield more that 10% of their original weight as dried product, and some, such as *Stichopus chloronotus*, may yield as little as 3%. Some of the largest species, such as *Thelenota ananas* (prickly red fish) undergo the greatest weight loss. For most beche-de-mer species, shrinkage is relatively consistent, with the length of the dried product being between 30 and 50% of the live length. Dried length of the finished product is probably consistent enough in relation to live animal size to serve as a basis for size limits in cases where this form of management is considered desirable.

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Potential Market for Frozen Beche-de-mer in New Zealand

By-Pro Marketing (P.O. Box 38679, Petone, New Zealand), is trying to establish itself as a beche-de-mer middleman in the Cook Islands, as well as other South Pacific nations. By-Pro's field representative and co-owner, Raymond Joe, has met with Cook Islands Marine Resources to discuss the market potential of its beche-de-mer. Besides wanting to deal in the normal smoked/sun dried product, he claims that By-Pro has located a market for frozen beche-de-mer that has simply been gutted, or gutted and then boiled, depending on the species. Another interesting claim is that besides for any of the established commercial species, he has found a market for gutted/frozen leopard fish (*Bohadschia argus*), which is traditionally not a commercial species. The species found in the Cooks that they wish to buy, and rough prices for the different processing methods of each are as follows:

Species	**NZ$/kg dried**	**NZ$/kg frozen**
Thelenota ananas	5	3-4
Holothuria nobilis	4-5	3-4
Actinopyga mauritiana	2-3	2
Bohadschia argus		2-3

It is interesting to note that the price for gutted/frozen *B. argus* is in the same league as for the high commercial value species *T. ananas* and *H. nobilis*. *B. argus* may only be gutted and then frozen, because boiling water causes its body wall will disintegrate.

By-Pro Marketing is seeking as much beche-de-mer as it can get, and has proposed setting up a sea freight container/freezer, for storing beche-de-mer produced in the Cook Islands, and then shipping it off when full. If By-Pro Marketing's claim pan out, beche-de-mer processing in areas with freezers may become much simpler, and for those who also have commercial quantities of *B. argus* it may provide an opportunity to tap another profitable resource.

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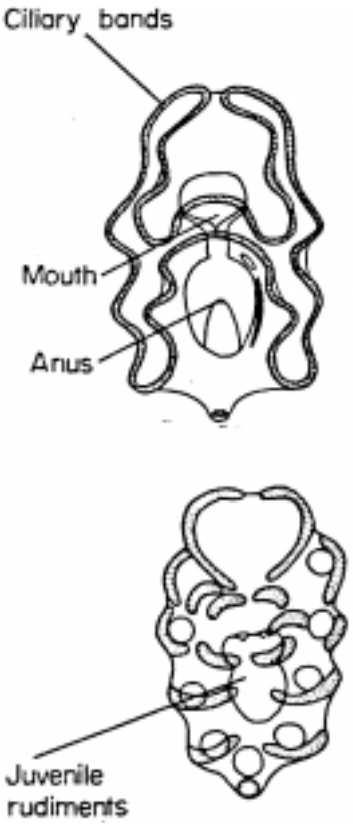
Beche-de-mer resource management studies in Guam

A team of researchers at the University of Guam, under the supervision of Marine Laboratory Director Bob Richmond, are undertaking a comprehensive research programme to investigate the biology and ecology of three commercially important sea cucumbers - *Actinopyga mauritiana* (surf red fish), *Holothuria nobilis* (black teatfish) and *Thelenota ananas* (prickly red fish). The programme involves experimenting with spawning induction and larval rearing, and artificial induction of fissioning (asexual reproduction), as well as abundance surveys in various parts of Micronesia. Much of the work is a preliminary to looking at the possibility of enhancing natural sea cucumber stocks by seeding with juveniles, and, ultimately, perhaps farming these animals.

Much of the work on reproductive biology is being carried out by graduate student Dave Hopper and colleagues. Sampling of local populations of the three species under study has enabled the periodicity of spawning readiness to be documented. At regular intervals samples are taken and the weights of the animals (whole and after evisceration) and their gonads recorded. This permits calculation of the gonadal index, or GI (weight of gonads divided by whole weight). Since the GI rises during the spawning period, monitoring the progress of the gonadal index allows the spawning regime of the species to be understood. For instance, the GI of *A. mauritiana* in Guam peaked in June 1988, and in April 1989, indicating that spawning in this species occurs at the end of the (northern hemisphere) spring or early in summer. This information, as well as contributing to our knowledge of the biology of the species, was valuable in allowing the UOG team to anticipate spawning and achieve success in the larval rearing work.



Auricularia (above) and doliolaria (below) larvae of a generalised holothurian.
(From Laverack, M. S. and J. Dando: Lecture Notes on Invertebrate Zoology. Blackwell Scientific Publications, London)

Results of the larval rearing experiments have been good. Adults of all three species collected from the wild have been successfully induced to spawn. Spawning is greatly enhanced by thermal shock (usually delivered by leaving the animals in a tankful of slowly heating water on the back of a flat-bed truck as they are driven from the collection site to the lab). Fertilisation and development through the first (auricularia) to the second (doliolaria) stage has been achieved in *A. mauritiana* and *H. nobilis*. The developing larve are raised in aerated water in glass containers and are dosed with penicillin to prevent bacterial and ciliate infection. The larvae are fed on dinoflagellates and this material can be seen in the gut canal, which is transparent, until metamorphosis to the doliolaria stage, at which time it becomes replaced by unpigmented detrital matter. Development of the larvae to juvenile sea cucumbers has not yet been achieved, and this is an area on which studies are focussing at present. Lab staff have recently built a larval stirring system which ahs proven useful. Using the system, all the larvae from a January 1990 spawning of *H. nobilis* have been induced to settle, and the research team are now experimenting with different substrates and diatoms on which to raise the larvae.

The UOG team has also been looking at aspects of adult culture, and in particular artificial induction of fission, by keeping wild-collected adults of a range of sea cucumber species in artificial enclosures. The adults are fed daily using homogenised *Sargassum* seaweed. Fission can be induced in *H. nobilis* and *A. mauritiana* (but not *T. ananas*) by placing a tight rubber band around the animal for several days. The sea cucumber will eventually divide into two at the point where the rubber band constricts it. Although this may ultimately prove to be a useful way of avoiding juvenile mortality and improving recruitment in sea cucumber farming, the experiments carried out so far have been of limited success. Additionally, the classic problems of negative growth rates (shrinkage) and necrosis in captive animals continue to plague the UOG experiments and there is still a lot to learn about keeping these animals in captivity.

As part of an overall effort to encourage sustainable exploitation of the sea cucumber resource in Micronesia, Bob Richmond believes it would be wise for Micronesian states to consider forming a marketing consortium so that harvesting and export could take place in a controlled, managed way. At present, beche-de-mer harvesting in Micronesia - as well as in many other localities - takes place in a sporadic, ad hoc way, with individual islands or communities producing small, irregular consignments and then trying to sell them. Small quantities and irregular production usually mean low prices, so foreign buyers are able to take advantage of this situation. A marketing consortium would enable production from the various island groups to be pooled and marketed as bigger lots on a more regular basis. As well as maximising economic returns from the resource, such a system would also enable harvests in particular locations to take place at regular, sustained levels, rather than the 'boom-and-bust' style of exploitation that has typically characterised beche-de-mer fisheries in small islands.

Garry Preston

Aspidochirote holothurians of the New Caledonian lagoon: biology, ecology and exploitation

Abstract of the recent thesis by Chantal Conand, published in 1989 by ORSTOM (see Conand, 1989, reference list this issue)

Some Aspidochirotid Holothurians (Ecinodermata) are fished and processed into bêche-de-mer (or trepang) for human consumption. At first the 48 species collected from the New Caledonian lagoon are presented and classified into commercial categories.

The main characteristics of the distribution and abundance of these species, in the different reefal and lagoonal biotops are defined by an autoecological study. Groups are also distinguished according to reefal and depth gradients, as well as by substrate preferences. Several holothurians assemblages (or taxocenoses) are described. Their richness (by number and by mass) decreases from the inner reef-flats to the inner lagoon, then the outer reef-flats up to the outer lagoon and the reef slopes. Populations appear to be stable. The study of the population biology of the nine main commercial species enables the determination of the main parameters of their biometry, reproduction, growth and mortality. Sexual reproduction exhibits rather homogeneous characteristics: these species are gonochoric and iteroparous, have an annual sexual cycle, late sexual maturity and high fecundity. Growth and mortality, whose study is particularly difficult, are both quite low. on the whole, the means mass of the species can be related to the biological and ecological parameters as a gradient in the adaptive strategies is shown.

Exploitations in New Caledonia and other countries of the South Tropical Pacific are described. The causes of their wide fluctuations are analysed and connected with Hong Kong and Singapore markets. Maximum sustainable yields are estimated at about ten to thirty kilograms per hectare per year in the rich assemblages. Their thematic mapping, an example of which is given using high resolution images from SPOT silulation, remains necessary for the lagoon as a whole. Lastly several options for fishery management are discussed.

Recent beche-de-mer surveys in the Pacific Islands

A number of agencies have recently been involved in surveys of sea cucumber populations in various of the Pacific Islands. Mostly, these are aimed at assessing the potential for development of commercial beche-de-mer processing activities, given the present climate of high prices and consequent renewed interest in beche-de-mer production as a profitable cottage industry.

The University of Guam beche-de-mer team carried out surveys at four sites in Guam - Cocos Lagoon, Pago Bay, Apra Harbour and Tumon Bay - late in 1987. Three commercially important species - *Holothuria nobilis, Thelenota ananas* and *Actinopyga mauritiana* - were encountered in numbers considered adequate for commercial development. In Tumon Bay, catch per unit effort (cpue), expressed as number per diver per hour, was, for the three species noted, 24, 18 and 35 respectively.

In conjunction with the Truk Maritime Authority and the Truk Department of Marine Resources, the UOG team also carried out survey work at eight sites in Truk, Federated States of Micronesia, early in 1988. Truk has at least five commercially valuable species, as well as several others which may have commercial potential.

Elsewhere in FSM, the atolls of Ulithi and Ngulu, in Yap State, were surveyed by James Moore, Pius Pului, Kurt Jacobsen, and Florien Mareg, of the Yap Fishing Authority, in 1985. At Ulithi the survey focussed on *Holothuria nobilis*, and densities considered adequate to make commercial collecting worthwhile were found at 9 of 31 sites surveyed, with lower densities at a further 6 sites. At Ngulu, where the large size of the atoll meant that only a small part could be surveyed, some areas of reasonable *H. nobilis* density were found, but *Thelenota ananas* was seen in much greater abundance, and were thought to have more commercial potential. The survey team noted that the men of the island told them that sea cucumbers occurred in much greater abundance in the northern part of the atoll, where surveying could not be carried out.

Research Officers David Zoutendyk, Ian Bertram, Kelvin Passfield and others of the Ministry of Marine Resources (MMR) in the Cook Islands have carried out beche-de-mer surveys on several islands in the group, including Rarotonga (a high island) and Aitutaki (a semi-atoll). Some beche-de-mer survey work was also done in connection with a general marine resource survey on Palmerston atoll, in late 1988, carried out jointly by MMR, SPC and the Forum Fisheries Agency. The only traditionally high-valued species found so far is *Holothuria nobilis*, and this is scarce, only being found at a few locations in deep reef passages around Rarotonga, and there only in low densities (typically less than one individual per 100 m^2). Some Thelenota ananas have also been found in similar locations. The somewhat less valuable *Actinopyga mauritiana* was more abundant at all three locations and was considered to be the only species of any commercial potential in the Cook Islands. The highest density of this species, expressed as number of individuals per 100 m^2 of reef flat, was observed at Aitutaki, a value of about 14: densities at Palmerston were about 8 animals per 100m2, and at Rarotonga about 4. Based on area estimates, standing stocks of this species at the three islands were estimated as 171 tonnes, 14 tonnes and 21 tonnes respectively. If the entire standing stock were harvested, it would yield an estimated 16 tonnes of dried product.

All these surveys have been written up in varying amounts of detail, mainly in informal documents that have not been widely circulated outside the country in which the survey was carried out.

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BIBLIOGRAPHIC REFERENCES ON BECHE-DE-MER

All the documents in the list below are catalogued in the Fisheries Information Projects beche-de-mer bibliographic database and are held either in the SPC library or in other collections known to us. Some are publications, but many are internal documents, mimeo reports and other forms of ephemera. In some cases we can provide single photocopies of references free of charge to SIG members or bona fide fisheries officers in Pacific Island countries. In other cases, where confidentiality requirements or copyright restrictions apply, we may be limited to advising enquirers of contact addresses through which they may be able to obtain the document in question.

If there are documents that you feel should be added to the database, please send us a copy, or, if this is not possible, a photocopy of the cover page. Documents do not need to be formal publications - many of those in the list are not - and we are keen to archive as much 'grey literature' - meaning internal reports, correspondence, unpublished data, etc - as possible.

Jean-Paul Gaudechoux

Alcala, A.C.; Alcazar, S.1984. **Edible molluscs, crustaceans and holothurians from North and South Bais Bays, Negros Oriental, Philippines.** Siliman J. 31(1/4): 25-45, (ICLARM library)

Alu R.; Cook D. 1987. **Bêche-de-mer market survey - Department of Fisheries and Marine Resources, Konedobu, Papua New Guinea** - 16 pp, (SPC library).

Amir, A.A. 1985. **Democratic Yemen Fisheries: Cuttlefish and Sea cucumber.** - ICLARM Newsletter pp 15-16, (SPC library).

Anon 1967. **Bêche-de-mer factory for the Solomons.** Pacific Islands monthly (38) 4, 1pp, (SPC library).

Anon (1973). **Marau bêche-de-mer industry.** 2pp, (Solomon Islands Fisheries Department - Registry).

Anon (undated). **The bêche-de-mer industry in the Western District.** 8 pp, (Solomon Islands Fisheries Department - Office of PFO).

Anonymous **Proposed Equipment for Bêche-de-mer Fishery** - 3 pp (SPC library).

Anonymous. **Bêche-de-mer and vasua - 2nd quarterly report** - Fisheries Division (Fiji) 1979 pp 1, (SPC library).

Anonymous. **How to process Bêche-de-mer.** Prepared by the fisheries Section - British Solomon Islands Protectorate - pp 4, (SPC library).

Anonymous.1988. **Bêche-de-Mer exploitation in Fiji** - Report to Chief Fisheries Officer, (SPC library).

Anonymous. **Sea Cucumber Fishery Development in Micronesia, Guam - 1987/1988** - 22 pp (SPC library)

Anonymous. **Sea Cucumber Fishery Development in Micronesia, year 3** - 11 pp, (SPC library)

Bakus, G.J. 1968a. **Defensive mechanisms and ecology of some tropical holothurians.** Mar.Biol.2 : 23-32, (SPC library).

Bakus, G.J. 1974. **Toxicity in Holothurians: a geographical Pattern.** Biotropica 6(4), pp 229- 236, (SPC library).

Bandjar, H.; Zubaidi, T.; Hutuely, L. 1988. **Density and some species structure of sea cucumber (*Holothuria* spp.) in Kulur, Sapara Island.** J.Penelitian Perikanan Laut/J. Mar. Fish. Res. (49): 99-103.

Barton, H. 1980. **Tuvalu international trade 1980** (information on the imports of fish and exports of beche-de-mer). United Nations Development Advisory Team, Suva, 69 pp, (Tuvalu Fisheries Division - Conference room).

Bola, S. 1987. **Not quite the treat you think.** Islands, April-June 1987, pp 9-11, (SPC library).

Borradaile & al. 1958. **The invertebrata (Phylum Echinodermata)** - 3rd edition, a revision by G.A.Kerkut, Cambridge University Press, 1958, (SPC library)

Bruce, C. 1983. **Sea cucumbers - extraordinary but edible all the same.** INFOFISH Marketing Digest n° 6/83 pp 19-21, (SPC library).

Caso, M.H. 1972. **El aspecto economico de las holothurias o pepinos de mar en la alimentacion humana. El trepang.** Revista de la Sociedad Mexicana de Historia Natural, pp85-98, (SPC library).

Clark, R. (1977). **On the origin and usage of the term "beach-la-mar".** Reo, Volume 20, University of Auckland, pages 71-82, (University of the South Pacific - Vanuatu Centre).

Clark & Rowe. **Monograph of shallow water Indo-West Pacific Echinoderms** - British Museum (Nat.Hist), Kensington, (SPC library).

Clerk, C.(1981). **The animal world of the Mangaians** (contains sections on beche-de-mer), Ph.D thesis, University college, London, 551pp, (Cook Islands Library)

Collenson, K. (undated). **Hao fo wakem beche-de-mer.** 14pp, (Solomon Islands Fisheries Department - Computer Room).

Conand, C (1979). **Beche-de-mer in New Caledonia: weight loss and shrinkage during processing in three species of holothurians.** South Pacific Commission Fisheries Newsletter 19 pp 14-17. (SPC library).

Conand, C. 1981. **Sexual cycle of three commercially important holothurian species (Echinodermata) from the lagoon of New Caledonia.** Bull.Mar.Sci.31(1) : 523-543, (SPC library)

Conand, C. 1982. **Reproductive cycle and biometric relations in a population of *Actinopyga echinites* (Echinodermata: Holothuroidea) from the lagoon of New Caledonia, western tropical Pacific.** pp 437-442. Internat. Echinoderm Conference. A. A. Balkema, Rotterdam, (SPC library).

Conand, C. 1985. **Are the Aspidochirote holothurians of the New Caledonia lagoon good indicators of the reefal features?** - Proceedings of the Fifth International Coral Reef Congress, Tahiti, 1985, Vol.5, (SPC library)

Conand, C. 1986. **Les resources halieutiques des pays insulaires du Pacifique. Deuxieme partie: Les holothuries**. FAO Doc.Tech.Peches, 272.2: 108 pp (in French), (SPC library).

Crean, K (1977). **The beche-de-mer industry in Ontong Java, Solomon Islands.** South Pacific Commission Fisheries Newsletter N°15, October 1977, 12 pp, (SPC library)

Cross, D. 1976. **An appraisal of the potential for exploiting marine resources other than those of the conventional fisheries in the islands of Tuvalu** (includes beche-de-mer), 43pp, (Tuvalu Fisheries Division - Research Section).

Crossland, J. (1983). **Fisheries management plans.** (includes tuna, deep bottom fish, reef and lagoon fish, crustaceans, beche-de-mer, trochus, and green snail), 8 pp, (Vanuatu Fisheries Department - Secretarial Office).

Department of Industry (1983). **Beche-de-mer feasibility study**. 25 pages plus appendices, (Vanuatu Fisheries Department - Secretarial Office).

Disney, J. 1977. **Fisheries development in Tuvalu** (contains information on beche-de-mer processing), Tropical Products Institute, 40pp plus appendices, (Tuvalu Fisheries Division - Office of Chief Fisheries Officer).

Domantey, J.S. 1954. **Some holothurians from Guam and Vicinity** - Natural Applied Science Bulletin 12: 336-357, (SPC library)

Durairaj, S. 1982. **Evolving Quality Standards for Beche-de-mer.** Seafood Export Journal, vol.14(3), 1982, (SPC library).

Ebert, T.A. 1978. **Growth and size of the tropical Sea Cucumber *Holothuria (Halodeima) atra* Jager at Enewetak Atoll, Marshall Islands.** - Pacific Science (1978) , vol 32(2), (SPC library).

Fakahau, S 1973. **Fisheries survey in Vava'u** (includes turtles, bêche-de-mer, lobsters, and pole-and-line fishing), 3pp, (SPC library).

Fisheries Division. 1979. **A tupe e mafai o maua mai funafuna (you can earn money from beche-de-mer),** Tuvalu Fisheries Division Extension Leaflet n 1, Funafuti, 6pp, (Tuvalu Fisheries Division - Extension Section).

Food and Agriculture Organization of the United Nations. 1972. **South Pacific Islands beche- de-mer fishery.** Report prepared for the South Pacific Islands Fisheries Development Agency, FAO, Rome, 32pp, (FAO/UNDP Regional Fishery Support Programme, Suva).

Gentle, M 1980. **Bêche-de-mer survey: Tonga May 1st-24th**, 2pp, (SPC library).

Gentle M. 1978. **Population Ecology of Bêche-de-mer.** South Pacific Commission Special Project. First Interim report 27 September 1978. pp 11, (SPC library).

Gentle M. 1979. **The fisheries biology of Beche-de-mer.** South Pacific Bulletin, Fourth quarter 1979, pp 25-27, (SPC library).

Gentle, M. 1979. **Survey of beche-de-mer resources in the Tokelau Islands.** 2pp plus appendices, (FAO/UNDP Regional Fishery Support Programme, Suva)

Green Mottet, M. 1976. **The fishery biology and market preparation of sea cucumbers.** Washington Department of fisheries, Technical report n 22, 44pp, (SPC library).

Grosenbaugh, D.A. 1981. **Qualitative assessment of the asteroids, echinoids and holothurians in Yap Lagoon.** Atoll Res.Bull. 255 : 49-54.

Hammond, L.S. 1981. **An analysis of grain size modification in biogenic carbonate sediments by deposit-feeding holothurians and echinoids (Echinodermata)** - Limnol.Oceanogr , 26(5), 1981, 898-906, (SPC library).

Hammond, L.S. 1982. **Patterns of feeding and activity in deposit-feeding holothurians and echinoids (Echinodermata) from a shallow reef lagoon, Discovery Bay, Jamaica.** - Bulletin of Marine Science, 32(2): 549-571, 1982.(SPC library)

Hammond, L.S. 1982. **Analysis of grain-size selection by deposit-feeding holothurians and echinoids (Echinodermata) from a shallow reef lagoon, Discovery Bay, Jamaica.** - Marine Ecology, Progress series , Vol. 8: 25-36, 1983.

Hammond, L.S. 1983. **Nutrition of deposit-feeding holothuroids and Echinoids (Echinodermata) from a shallow reef lagoon, Discovery Bay, Jamaica** - Marine Ecology, Progress series , Vol. 10: 297-305, 1982.

Hammond, L.S.& al. 1985. **Holothuroid assemblages on coral reefs across the central section of the Great Barrier Reef.** - Proceedings of the Fifth International Coral Reef Congress, Tahiti, 1985, Vol.2. (SPC library)

Harriott V.J. 1984. **Census techniques, distribution, abundance and processing of large sea- cucumber species (Echinodermata: Holothuroidea) on the Great Barrier Reef** - report to the Great Barrier Reef Marine Park Authority, June 1984, (SPC library).

Harriott V.J. 1985. **Reproductive Biology of Three Congeneric Sea Cucumber Species, *Holothuria atra, H. impatiens* and *H.edulis* , at Heron Reef, Great Barrier Reef.**- Aust.J.Mar.Freshw.Res. 1985, 36,51-57, (SPC library)

Harriott V.J. 1985. **The potential for a beche-de-mer fishery** - Australian Fisheries, June 1985, (SPC library).

James, D.B. 1973. **The Beche-de-mer Resources of India.** Proceedings of the Symposium on the Living Resources, Central Marine Fisheries Research Institute, 1973, pp 706-711, (SPC library).

James, D.B. 1983. **Sea cucumber and sea urchin resources and beche-de-mer industry.** Central Marine Fisheries Research Institute, Bulletin 34, 1983, (SPC library).

James, D.B. 1986. **Quality improvement in Beche-de-mer.** Seafood export journal, vol.18(3), 1986, (SPC library).

James, R.H. (1977). **Beche-de-mer in the Solomon Islands.** Working paper 17, Ninth Annual Fisheries Technical Meeting, Nouméa, New Caledonia, (SPC library).

Kobayashi, S. & Ushima, J. 1982. **Research on the propagation of Japanese common sea cucumber.** - Fukushima Prefectural Buzen Fisheries Experimental Station, FY Research Report, pp 75-81. 1982, (SPC library).

Kropp, R.K. 1982. **Responses of five holothurian species to attacks by a predatory gastropod, *Tonna perdix*** Pac.Sci. 36(4) : 445-452.

Lamberson, J.O. 1978. **Notes on the morphology, ecology and distribution of *Thelenota anax* H.L.Clark (Holothuroidea: Stichopodidae).** Micronesica 14(1) : 115-122.

Lawrence, J.M. 1981. **Echinoderms: Proceedings of the International Conference, Tampa Bay**, (SPC library)

Lewis, A. 1987. **Progress review - research activities,resources profile & management plans.** (progress on recommendations from an earlier visit, need for resources profile, management plans, aquarium fish export, seaweed, beche-de-mer), Ministry of Marine Resources, Cook Islands, 34pp plus appendices, (Ministry of Marine Resources - Central Service).

McCormack, G.(undated). **Rori (sea cucumbers)**(includes Rarotongan and scientific names), 12pp, (Ministry of Marine Resources - Central Service).

McElroy, S. 1972. **The beche-de-mer industry: its exploitation and conservation, findings of an exploratory beche-de-mer resource survey at Ontong Java Atoll.** Fisheries Division, Honiara, 15 pp, (Solomon Islands Fisheries Department - Computer Room).

McElroy, S. 1975. **Beche-de-mer survey of the Gilbert Islands.** - 6 pp, ((SPC library)

McEuen, F.S. (undated). **Phylum Echinodermata, Class Holothuroidea** - pp 574-597, (SPC library)

McKnight, D. 1972. **Echinoderms collected by the Cook Islands Eclipse Expedition 1965.** New Zealand Oceanographic Institute Records 1, pages 37-45, (Cook Island Conservation Service)

McKnight, D. 1974. **Echinoderms from Manihiki Atoll.** New Zealand Oceanographic Institute Memoirs 31, pages 45-47, (Cook Island Conservation Service).

Moore, J.D. 1986. **Report on the Sea Cucumber Development Project, Ngulu Atoll.** - Yap Fishing Authority - 29 pp, (SPC library)

Motokawa, T. 1983. **The viscosity change of the body-wall dermis of the sea cucumber *Stichopus japonicus* caused by mechanical and chemical stimulation.** - Comp. Biochem. Physiol. Vol 77A, n 3, pp 419-423, 1984, (SPC library).

Okamotu, K 1983. **Beche-de-mer (sea cucumber) stock survey: report 1 (Vava'u area),** Fisheries Division, Tonga, 8 pp

Okamotu, K. 1984. **Beche-de-mer (sea cucumber) stock survey: report 2 (Ha'apai area),** Fisheries Division, Tonga, 6 pp plus appendices.

Paulis, T. 1978. **Helen reef trepang pilot project.** Marine Resources Division, Koror, 3pp, (Marine Resources Division - Files)

Petaia, S. 1987. **Report on fisheries extension visit to Nukefetau Islands from 11th February - 13 March 1987** (includes beche-de-mer), 7pp plus appendices, (Tuvalu Fisheries Division - Conference Room).

Pita, E. 1979. **Nukefetau beche-de-mer survey report.** 1pp, (Ministry of Commerce and Natural Resources - General Office).

Pita, E. 1979. **The Tuvalu beche-de-mer project: quarterly report, August 1978**. Fisheries Newsletter 18, South Pacific Commission, Noumea, pages 15-17, (SPC library).

Pryor, P.1980. **Atoll survival - a century of Palmerston** (contains mention of collection of Beche-de-mer in early 1800s), South Pacific Bulletin, 4th Quarter 1980, South Pacific Commission, Noumea, pages 31-37, (SPC library).

Queensland Museum 1986. **Sea cucumbers of Northern Australia,** 66 pp, (SPC library).

Reyes-Leonardo, L.D. 1984. **A taxonomic report of shallow-water holothurians of Catalagan, Batangas.** - The Philippine Journal of Science vol 113 (3-4) pp 137-158, (SPC library)

Richmond, R. (undated). **The population Biology of three commercially valuable sea cucumber species** - 10 pp, (SPC library).

Rowe, F.W.E.; Doty, J.E. 1977. **The shallow-water holothurians of Guam.** Micronesica 13(2): December, pp 217-250, (Institute of Marine Resource library).

Rutherford, J.C. 1977. **Variation in egg numbers between populations and between years in the holothurian *Cucumaria curata*** - Marine Biology 43 , 175-180 (1977), (SPC library)

Sachithananthan, K. (1972). **South Pacific Islands beche-de-mer fishery.** SPIFDA, FAO, Rome, 32 pp, (SPC library).

Silver, H. 1982. **Beche-de-mer in the deeper waters of Tarawa atoll.** - Institute of Marine Resources: Atoll Research Unit Technical Report, October 1982, (SPC library)

Shelley, C., 1981. **Aspects of the distribution, reproduction, growth and "fishery" potential of holothurians (beche-de-mer) in the Papuan Coastal Lagoon.** M.Sc thesis, University of Papua New Guinea.

Shelley, C. 1985. **Growth of *Actinopyga echinites* and *Holothuria scabra* (Holothuroidea: Echinodermata) and their fisheries potential (as bêche-de-mer) in Papua New Guinea.** Proc. Fifth Internat. Coral Reef Cong., Tahiti, 5 : 297-302, (SPC library).

Shelley, C. 1986. **The potential for re-introduction of a Beche-de-mer fishery in Torres Strait.** Torres strait Fisheries Seminar, Australian Government Publishing Service, Canberra, pp 140-150, (SPC library).

Shelley, C. 1988. **The status of the beche-de-mer fishery in Queensland.** SPC Workshop on Pacific Inshore Fisheries Resources, New Caledonia, 14-25 March, BP 40, 3pp, (SPC library).

Smalley, T. 1979. **The feeding ecology of tropical marine holothurians.** - seminar abstract - 7 pp, (SPC library).

South Pacific Commission 1979 **Bêche-de-mer of the Tropical Pacific. A handbook for fishermen.** Handbook n° 18, (SPC library).

SPC/FAO 1985. **Bêche-de-Mer Training Course - Beqa Island, Fiji**, (SPC library).

Tenakenai, C.1988. **Some aspects of the resources and exploitation of the Papua New Guinea reef and lagoon associated commercial sessile invertebrates.** SPC Workshop on Pacific Inshore Fisheries Resources, New Caledonia, 14-25 March, BP 101, 12pp, (SPC library).

Tiensongrusmee B; Pontjoprawiro S. 1988. **Sea cucumber culture: Potential and prospects** - UNDP/FAO - 18 pp, (SPC library).

Trinidad-Roa, M.J. 1987. **Beche-de-mer Fishery in the Philippines.** - Naga, the ICLARM Quarterly , October 1987- pp 15-17, (SPC library).

Tyler, P.A. & al. 1985. **Life-history biology of *Peniagone azorica* and *P.diaphana* (Echinodermata: Holothuroidea) from the north-east Atlantic Ocean.** - Marine Biology 89, pp 71-81, (SPC library).

UNDP/FAO/SPC 1987. **Bêche-de-mer fishing and processing training course, Kavieng, Papua New Guinea**, (SPC library).

Van Eys, S. 1986. **The International market for sea cucumber.** INFOFISH Marketing Digest n° 5/86 pp 41-44, (SPC library).

Van Eys, S. 1986.**The market for sea cucumber from the Pacific Islands.** INFOFISH, 14pp plus appendices, (SPC library).

Vatoga, S. 1978. **Beche-de-mer brings cash to Rewa villagers.** SPC Fisheries Newsletter n 16, pp 14-15, (SPC library).

Vega, M.J.M. (undated). **Who's working on Echinoderm Fisheries.** - NAGA, the ICLARM Quarterly - 1 pp, (SPC library).

Vuki, V., and F. Viala (in press). **Shrinkage and Weight Loss of Nine Commercial Species of Holothurians from Fijian waters.** SPC library).

Wright, A. (undated). **An analysis of exports of marine produce from Papua New Guinea for the period 1980 to May, 1986 with emphasis on produce collected by small-scale fishermen.** - Dept of Primary Industry, Fisheries Research Laboratory - 1 pp, (SPC library)

Yanagibashi, S. & al. 1984. **A study on the rearing procedures for the newly settled young of a sea cucumber, *Stichopus japonicus* , with special reference to the supplied food items.** 10 pp (in Japanese), (SPC library).

Yamanouti, T. (undated). **Ecological and Physiological Studies on the Holothurians in the Coral Reef of Palao Islands.** - Contribution from the Palao Tropical Biological Station n 25. 30 pp, (SPC library)

Zoutendyk, D. 1988. **Progress report** (contains information on beche-de-mer survey), 2pp, (Ministry of Marine Resources - Filing system).

Zoutendyk, D. 1989a. **Beche-de-mer resource profile.** 3pp, (Ministry of Marine Resources - Filing system).

Zoutendyk, D. 1989b. **Trial processing and marketing of the surf redfish (*Actinopyga mauritiana*) beche-de-mer on Rarotonga, and its export potential in the Cook Islands.** Ministry of the Marine Resources, 13pp, (SPC library).

Zoutendyk, D. 1989c. **Beche-de-mer. Cook Islands Marine Resources Profile n 6**, 18pp, (SPC library).