

ABSTRACT

Holothurian fisheries have a very long history and the increase in the catches could be interpreted as a sign of sustainability. A dozen Indo-Pacific coral reef species constitute the major part of world catches of these export fisheries, which are yet poorly documented and generally not rationally managed. From different sets of statistics (captures, processing, national exports by producers or imports by consumers, international markets in Hong Kong and Singapore) the main characteristics and the recent trends are analyzed. The annual world captures are around 120,000 t, valued over US\$ 60 million. It appears also that new fisheries have developed in many non-traditional fishing areas, such as Mexico and the Galapagos. The main life-history traits of the species, though showing variety, could explain that they constitute fragile stocks. With the increasing market demand, biological overexploitation occurs well before economic overexploitation. Effective collaborative management is needed. Development of information exchange is now in progress through the Bêche-de-mer Newsletter published by the South Pacific Commission.

INTRODUCTION

During the last decade numerous publications and symposia, including this symposium, have emphasized the need for rational management of reef resources (Richmond 1993; Wells 1995). During the same period, more attention has also been paid to coral reef invertebrates because their commercial value is generally high (Wright and Hill 1993; Dalzell and Adams 1995). Holothurian fisheries, mostly for export of the dried product (trepan or bêche-de-mer or Hai-som) have a very long history. They have been traditionally located in the Indo-Pacific and can be divided into the temperate fisheries in the North Pacific, which are generally monospecific and the tropical multispecific fisheries in the Indian Ocean, the tropical Pacific islands and the western central Pacific countries (Conand 1990, 1995; Conand and Sloan 1989; Conand and Byrne 1993). The development of these fisheries have been reviewed up to 1989 by Conand and Byrne (1993). Statistics for the tropical fisheries for 1990-1994 are presented here in order to better understand sustaining sustainability. An attempt will also be made to find indices of overexploitation of the resource. The question

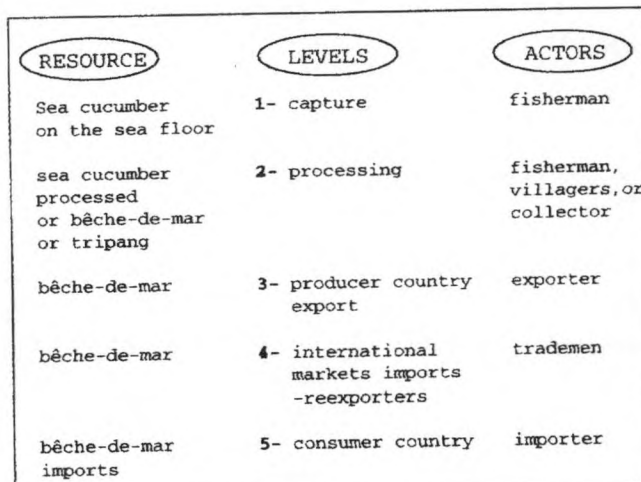


Fig. 1: The "holothurian system".

of user conflicts will be addressed and in conclusion some recommendations will be proposed.

METHODS

Fishery and trade statistics have been collected from several sources including producer countries (catch and export statistics), main markets (data for import and re-export from Hong Kong, Singapore and Taiwan) and international FAO trade data (annual yearbooks for catches and commodities). These data have been processed to show evidence of the main producer countries, appearance of new producers and the relative importance of the South Pacific Islands. Recent trends in the quantities and values of bêche-de-mer trade in the producer countries are analyzed, as well as the main markets.

A few case studies, based on recent information about New Caledonia, Madagascar and Galapagos are presented to show some characteristics of the present fisheries and of the target species population parameters.

Table 1: Processed sea cucumber imports and re-exports by the Hong Kong market. T: tonnage. V: value. P/kg: price per kilogram in US\$.

Year	Tonnage	Value US\$	Price/kg US\$	Imports by main country of origin								
				Philippines			Indonesia			Pacific Islands		
				%T	%V	P/kg	%T	%V	P/kg	%T	%V	P/kg
1990	6,596	29,628	4.5	18	10	2.5	32	27	3.7	11	8	6.5
1991	7,885	35,293	4.5	18	12	2.3	33	30	4	12	16	6
1992	7,030	32,425	4.6	17	8	2.3	32	29	4.1	17	21	5.7
1993	7,300	28,708	3.9	26	13	2	36	34	3.7	10	15	5.7
1994	4,583	18,114	5.1	38	21	2.1	?	?	?	19	27	7.3

Year	Tonnage	Value US\$	Price/kg US\$	Re-exports by main country of destination						
				China			Other Asia			
				%T	%V	P/kg	%T	%V	P/kg	
1990	2,789	8,906	3.2	76	43	1.8				
1991	3,429	13,042	3.8	80	50	2.3				
1992	3,021	11,143	3.7	81	59	2.7				
1993	4,166	13,815	3.3	84	65	2.6	9	15	5.6	
1994	3,768	13,935	3.7	84	59	2.6	11	19	6.7	

Table 2: Processed sea cucumber imports and re-exports by the Singapore market. T: tonnage. V: value. P/kg: price per kilogram in US\$.

Year	Tonnage	Value US\$	Price/kg	Imports by main country of origin								
				Tanzania			Madagascar			Pacific Islands		
				%T	%V	P/kg	%T	%V	P/kg	%T	%V	P/kg
1990	1,068	12,321	11.5	10	5	6.8	15	17	13.4			
1991	1,434	10,556	7.4	11	10	6.5	22	9	2.9	23	31	10.2
1992	1,381	10,975	7.9	16	10	4.6	20	8	2.9	29	44	12.1
1993	879	6,886	7.8	13	10	6.3	28	14	3.8	22	26	9.3
1994	1,242	10,718	8.6	20	12	5.2	27	14	4.5	16	18	10.1

Year	Tonnage	Value US\$	Price/kg	Re-exports by main country of destination								
				Hong Kong			Malaysia			Taiwan		
				%T	%V	P/kg	%T	%V	P/kg	%T	%V	P/kg
1990	1,026	11,022	10.7	63	56	9.6	15	9	6.7	12	21	18.9
1991	1,289	8,999	7.0	60	54	6.3	17	8	3.5	14	28	13.8
1992	1,191	8,141	6.8	66	56	5.9	13	9	4.5	14	28	13.6
1993	942	6,582	6.7	59	59	6.9	20	11	3.9	14	22	11.4
1994	1,054	10,275	9.7	69	48	6.7	17	18	15.6	6	13	21.2

RESULTS

The "holothurian system"

The whole "Holothurian Fishery System" in the tropical Indo-Pacific is presented in Fig. 1. It partly highlights the complexity of the different levels and the numerous interactions which take place. It appears that it could be taken as a good example of artisanal fisheries for export and should be considered as a whole for integrated management.

The main markets

Hong Kong is the major world market. Table 1 shows the overall imports and re-exports of processed sea cucumbers, for the period 1990-1994, in quantities, values and price per kilogram. The imports appear to have increased since the previous analysis (Conand and Byrne 1993) and the quantities are now about 7,000 t per year (equivalent to catches > 70,000 t), compared to the 400 t twenty years ago (Conand 1990). A dozen countries export over 50 t to Hong Kong. The relative contributions of the main countries of origin are also presented (Table 1). Indonesia and the Philippines are still the major suppliers of low value products; Japan and the South Pacific Islands have higher grades. Half of the imported products are then re-exported at a lower mean price than the imports. The main destination for re-exports is China with over 80% of the tonnage, which represents only 60% of the value.

Singapore is the second most important market and it appears more stable from its trade statistics with about 1,200 t imported and 1,000 t re-exported annually (Table 2). Compared with the data presented by Conand (1990) and Conand and Byrne (1993), the increase is slight and regular. Its major suppliers come from the Indian ocean (Tanzania, Madagascar, the Maldives) but Papua New Guinea is also significant among the half dozen countries exporting over 50 t. The destination of the re-exports is mostly Hong Kong (high quality products), then Malaysia and Taiwan.

The question of the reciprocal exchanges between Hong Kong and Singapore is summarized in Table 3. As observed previously (Conand and Byrne 1993), the data spread is the same but the figures do differ. The general flux is still from Singapore to Hong Kong, with Hong Kong importing yearly about 1,000 t of lower grade products.

Taiwan is the third largest market (Table 4). The trade statistics are very detailed, the sea cucumbers appearing under many categories such as: "live, fresh or chilled", "frozen", "dried spiced", "dried not spiced" and "dried other". The imports have increased during the last years, with nearly one third coming from temperate countries (Canada and USA). The tonnage coming from other markets such as

Table 3: Reciprocal exchanges between Hong Kong and Singapore.

	1990	1991	1992	1993	1994
HONG KONG					
Imports from Singapore					
Tonnage (MT)	1313	1308	943	756	920
Value (1,000 US \$)	4,921	4,159	3,594	3,177	4,927
Price per kg (US \$)	3.7	3.2	4.1	4.2	5.4
Re-exports to Singapore					
Tonnage (MT)	69	111	48	62.4	55
Value (1,000 US \$)	742	1307	665	908	863
Price per kg (US \$)	10.7	11.8	13.8	14.6	15.7
SINGAPORE					
Imports from Hong Kong					
Tonnage (MT)	47	79	48	44	46
Value (1,000 US \$)	1,060	1,239	692	713	590
Price per kg (US \$)	22.6	15.7	14.4	16.2	12.8
Re-exports to Hong Kong					
Tonnage (MT)	651	769	781	558	734
Value (1,000 US \$)	6,221	4,839	4,578	3,859	4,936
Price per kg (US \$)	9.6	6.3	5.9	6.9	6.7

Singapore seems decreasing. Few products are re-exported to Hong Kong and Singapore, as they are mostly consumed locally.

International statistics

Another source of data on the world trade is presented in the yearly FAO's statistics on imports and exports, which are presented in Table 5 in quantities and values. However some data are still incomplete (Indonesia for example). It appears that the annual world catches are around 120,000 t, valued at over US\$ 60 million.

The yearly FAO statistics on catches provides data for the main producer countries. They are presented in Table 6, arranged by area. Though the data are still incomplete for 1994, it appears that, apart from traditional producers, there are several new producers in non-traditional zones. In particular the fisheries are expanding to the eastern Pacific, both temperate and tropical.

Case studies

These include the traditional fisheries in New Caledonia and Madagascar and the new fishery in the Galapagos. The data for New Caledonia (Table 7), collected by the Territory Customs Department, show a decline from 1992, which does not appear in the FAO statistics. This is an example

Table 4: Processed sea cucumber imports and re-exports by the Taiwan market. T: tonnage. V: value. P/kg: price per kilogram in US\$.

Imports by main country of origin															
Sea cucumber fresh, salted or frozen															
Year	Tonnage	Value	Price/kg	Canada			USA								
				%T	%V	P/kg	%T	%V	P/kg						
US\$															
1990	-	-	-												
1991	531	1832	3.5	61	63	3.6	30	32	3.6						
1992	486	2103	4.3	47	47	4.4	50	50	4.3						
1993	322	1423	4.4	89	83	4.1	5	3	3						
1994	463	1514	3.3	36	43	3.9	54	53	3.2						
Sea cucumber dried															
Year	Tonnage	Value	Price/kg	Indonesia			Singapore			Japan		Pacific Islands			
				%T	%V	P/kg	%T	%V	P/kg	%T	%V	P/kg	%T	%V	P/kg
US\$															
1990	356	3023	8.5	40	22	4.8	20	18	7.7	12	40	26.9			
1991	622	3873	6.2	30	17	3.6	24	29	7.4	5	16	22.3	17	16	5.9
1992	693	4528	5.6	37	27	4.8	8	9	7.4	7	23	21.0	16	14	6.1
1993	686	3765	5.5	32	25	4.1	5	4	4.5	7	21	17.4	19	16	4.6
1994	652	3336	5.1	42	32	3.9	3	4	7.7	4	13	15.7	6	5	4.1
Re-exports by main country of destination															
Year	Tonnage	Value	Price/kg	Hong Kong			Singapore								
				%T	%V	P/kg	%T	%V	P/kg						
US\$															
1990	-	-	-												
1991	34	212	6.2	64	58	5.6	16	12	4.7						
1992	17	238	14.0	47	27	7.9	47	57	16.9						
1993	10	133	13.3	80	43	7.1									
1994	12	123	10.6	20	9	4.7	52	73	15.1						

Table 5: Nominal catches by fishing areas and countries. (from FAO, Fishery statistics, Table B76).

Species	1990	1991	1992	1993	1994
1-Stichopus japonicus					
Japan	6426	6591	6072	5996	6106
Korea	2491	2027	1583	2068	2117
Total 1	8,917	8,618	7,655	8,064	8,223
2-Other holothuridae					
USA	3	0.0	0.0	0.0	1605
Total 21	3	0.0	0.0	0.0	1,605
Kenya	88	78	277	14	41
Madagascar	203	600	423	450	1800
Maldives	748	405	118	72	66
Sri Lanka	62	65	65	65	92
Tanzania	167	426	535	980	1590
Yemen	63	140	48	65	63
Total 51	1,331	1,714	1,466	1,646	3,652
Indonesia	70	82	38	56	60
Total 57	70	82	38	56	60
USA	0.0	0.0	481	472	636
Total 67	0.0	0.0	481	472	636
Fidji	1251	589	447	191	195
Indonesia	1652	2363	2075	2308	2850
New Caledonia	1294	960	890	777	788
Papua	600	850	800	650	600
Philippines	4023	3635	3679	3109	1497
Solomon	119	622	500	500	560
Vanuatu	50	50	39	40	40
Total 71	8,989	9,069	8,430	7,575	6,530
Chile	0.0	1601	237	13	4
Ecuador	12	29	29	12	12
Total 87	12	1630	266	25	16
TOTAL 2	10,405	12,502	10,683	9,776	12,501

of the difficulties of getting reliable data at each level. The number of companies has increased and the destinations of export are more diversified. More details on this fishery are given in Conand and Byrne (1993) who showed the shift in species collected, from high to medium quality, due to overharvesting. Previous studies by Conand (1990, 1995) have shown that the holothurian resource is very vulnerable and that the maximum sustainable yields are probably low, with only a few dozen of kilograms per hectare per year. The population parameters also need more attention, as many species have not yet been carefully studied; growth and mortality rates are still mostly hypothetical (Conand 1990 1995).

In Madagascar, the fishing pressure is said to be very high nowadays; a fact also appearing in market and FAO data, but precise observations from the field are lacking. Evaluation and management programmes are now starting (IH-SM pers. com. 1996). It appears that all species, available on reef flats or in shallow waters, regardless of size or commercial interest, are collected. About 20 species, are collected (Conand pers. obs), including rare and unidentified species.

The recent extension of the fisheries into the eastern tropical Pacific is notable. The exploitation in Galapagos is very disquieting, as it has, since 1993, raised conflicts between "pepineros" fishermen, who catch sea cucumbers illegally in the National Park, and members of the Charles Darwin Foundation. Details have been provided in the Bêche-de mer Information Bulletins (SPC, 1994, 1995, 1996).

Other problems have resulted from fishermen from Indonesia and Papua New Guinea fishing illegally in Australian waters. They have been reported in the most recent Bêche-de mer Information Bulletin (SPC, 1996).

DISCUSSION

As far as the trends in fisheries and trade are concerned, it appears that the number of producing countries has recently increased, both in tropical and temperate re-

Table 6: International imports and exports, by country (from FAO, Fishery statistics, Table J56).

	IMPORTS q= mt v=1000 US\$				
	1990	1991	1992	1993	1994
TOTAL q (mt)	9817	11136	11379	10103	9837
TOTAL v (1,000US\$)	50384	58687	54432	45040	52843
China	0.0 0.0	0.0	1301 1367	320 689	173 380
Hong Kong	6596 29714	7885 35481	7030 32378	7401 29959	7281 35353
Singapore	1068 6806	1415 10555	1359 10978	855 6885	1213 11148
Other Asia	1124 5663	1156 5771	1191 6817	1135 5714	1124 5237
Malaysia	432 1021	452 1176	401 1081	335 761	0.0 0.0
Korea Rep	452 4860	364 4275	18 265	21 327	3 24
Japan	134 2265	41 1324	40 1263	17 635	22 613
	EXPORTS				
TOTAL q (mt)	7744	9298	8400	9595	7422
TOTAL v	30535	41151	39175	38334	35453
China	0.0 0.0	0.0	37 758	55 490	64 1203
Fiji	406 2450	391 2797	408 3483	149 1169	0.0 0.0
Hong Kong	2789 8932	3442 13244	3023 11158	4166 13820	3769 13935
Madagascar	98 506	398 1231	423 1497	357 1016	655 2564
Maldives	746 3308	405 2003	119 799	72 594	66 431
Malaysia	125 271	42 186	72 144	18 55	0.0 0.0
Papua New Guinea	275 1984	582 5070	631 5005	645 5100	0.0 0.0
Philippines	1752 3253	1952 3560	1565 3216	2049 3986	1692 4120
Singapore	1026 6089	1264 8998	1163 8141	923 6582	1013 10689
Sri Lanka	32 439	28 553	37 683	28 415	60 955
Solomon Islands	119 736	622 2816	715 3487	720 3500	0.0 0.0
Tanzania	186 820	142 374	178 416	327 502	0.0 0.0
Other Asia	11 123	12 77	14 239	10 140	14 212

gions. However, tonnages are still incompletely recorded and do not show much increase. It remains important to collect, better and standardized, statistics at all the levels of the complex "holothurian system".

The life-history traits of the populations of the commercial species are yet incompletely described, particularly

Table 7: Exports from New Caledonia, total and by destination.

DESTINATION	1990	1991	1992	1993	1994
TOTAL (t)	126.6	123.6	80.2	39.5	79.9
Hong Kong	122.6	119.9	76.5	37.4	66.9
Singapore	0.0	0.0	0.0	0.0	8.4
Taiwan and Japan	3.9	3.7	3.7	2.0	4.6
Nb of companies	4	4	4	3	6

concerning recruitment, growth and mortality; these species appear as slow-growing and very vulnerable animals and therefore constitute fragile stocks (Conand 1990, 1993, 1995). More research intended to quantify the population parameters is necessary.

The recent conflicts appearing within, or between, several countries might be interpreted as signs of overexploitation of the resource, and/or of a high level of demand. Current prices in the retail markets reach high levels which are not apparent from the general overview of the values from the international trade.

It is urgent to make proposals for rational management of these fisheries. More information on the fishery biology of sea cucumbers is now available and circulates much more efficiently since the establishment of the Bêche-de-mer Information Bulletin, published in collaboration with the South Pacific Commission (S.P.C. 1994, 1995, 1996). Its increasing audience gives the opportunity to widely share experiences and organize networks. Integrated management is a spreading concept and should involve all the actors of the "Holothurian System". Different measures could be efficient in different countries; taxes on the exports could sometimes be appropriate to help organize the fishermen collectives. Conservation measures are urgently needed to stop the depletion of most stocks. Yet, they should be based on a better knowledge of the fishery biology of the different species. Research for alternatives such as growth in cages or mariculture for enhancement should be encouraged. A few projects, generally located in the tropics, are presently underway, but also need this basic knowledge to succeed.

During the International Echinoderm Conference which will be held in San Francisco in August 1996, a special symposium will be devoted to echinoderm fisheries and mariculture. It will give the opportunity for interested scientists from around the world to exchange their experiences and plan some coordinated management actions, particularly concerning holothurians both from tropical and temperate regions (Conand, 1996).

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