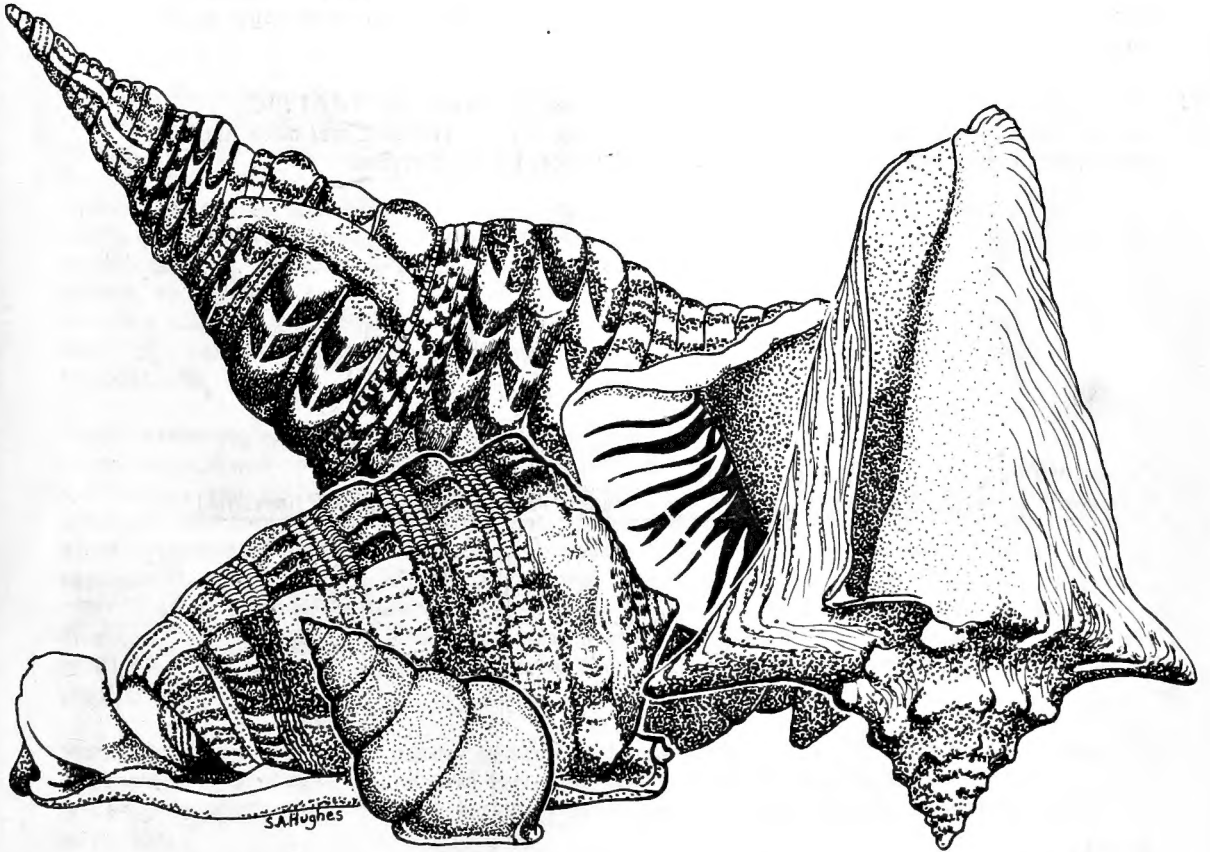




INTERNATIONAL UNION FOR CONSERVATION OF NATURE AND NATURAL
RESOURCES

International Trade in Ornamental Shells

by Susan M. Wells



IUCN Conservation Monitoring Centre

With the financial assistance of the United Nations Environmental Programme and
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This paper summarizes a report prepared by Susan M. Wells for TRAFFIC International (now the Wildlife Trade Monitoring Unit). The original data are deposited in the archives of the Conservation Monitoring Centre.

Cover drawing by Sarah Anne Hughes
(Charonia tritonis, Strombus gigas, Cypraecassis rufa, Papustyla pulcherrima)

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INTERNATIONAL TRADE IN ORNAMENTAL SHELLS

SUSAN M. WELLS

ABSTRACT

Considerable concern has been expressed recently over the scale of trade in ornamental shells. Foreign trade statistics have been analysed to give an indication of trends and to ascertain the main importing and exporting countries. The Philippines, Mexico, Haiti and a number of other Indo-Pacific countries were found to be the main suppliers, with the bulk of exports destined for the US and Europe. Exports from some countries have escalated over the last decade and there have been reports of depletions of commercially valuable species in some areas. Countries are increasingly introducing legislation to regulate or curtail the trade, but there is very little data available on which to base management plans. Although no mollusc species are likely to become extinct through commercial exploitation it is suggested that trade should be managed on a sustainable yield basis. Further research is urgently needed on the distribution and ecology of commercially valuable species.

INTRODUCTION

Molluscs have been exploited by man for a wide variety of purposes since prehistoric times. Food has probably always been the most important use, marine species having been gathered for centuries by coastal peoples to provide a major part of the protein in their diet. Currently, commercial fishing and cultivation of clams, oysters, mussels and scallops is a multi-million dollar industry. Since molluscan shells are composed mainly of calcium carbonate they have had a number of industrial uses. Ground shells produce the finest lime which is used in pottery glazes, toothpaste, poultry food additives and in South Asia for chewing with betel. Where shells can be dredged in large quantities, either dead or alive, they may be used for a number of industrial purposes such as road construction and building foundations.

Pearl producing species such as oysters and mussels have been collected for centuries and are now used for the production of cultured pearls. Some of these species are also collected for their nacre, known commercially as mother-of-pearl, which is used for decorative inlay work, buttons, jewellery, cutlery handles and other ornamental articles. The most valuable mother-of-pearl is obtained from four species: Pinctada maxima, P. margaritifera, Trochus niloticus and Turbo marmoratus, although a number of other Pinctada species, abalone (Haliotis spp.), chanks (Turbinella pyrum) and freshwater mussels (Unionidae) are also used. Many of these industrial uses of shells consume far greater quantities than the ornamental shell trade.

Shells have been valued as purely ornamental objects by many societies and cultures. Their variety of shape, colour and form has led to them being endowed with magical or religious attributes, used for personal decoration, as currency, or simply collected as curios.

Shell collecting as a hobby reached a peak of popularity in the nineteenth century when many extensive collections were built up. Currently shell collecting is again in vogue, not only with specialists and amateur conchologists but also with tourists and souvenir hunters. Shell jewellery, lampshades and other shellcraft articles have also suddenly become popular, probably as part of the trend away from plastics and synthetics towards natural materials. The sudden escalation in trade has given rise to concern among conservationists and biologists since large scale collection of species hitherto collected in only small numbers is occurring in many parts of the world. Unfortunately very few data are available on the quantities being taken or on the ecology of the species concerned. It is therefore very difficult to estimate the effect of exploitation on populations. This paper presents an analysis of foreign trade statistics in order to determine the extent of the trade and to highlight areas where further research is required.

Foreign trade statistics are published by most countries and for this study were consulted in the library of the Department of Trade at Export House in London. There are a number of problems in using them as a basis for analysis. Although most countries have a tariff heading under which imports and exports of shells are recorded, this rarely gives details of the species concerned. Tropical shells for the curio trade may be included with those dredged for industrial purposes or with coral. Shells obtained as a by-product of shellfish culture or from edible molluscs are not separated from those collected in the wild specifically for the shell trade. They may also be recorded under a number of other tariff headings, such as those dealing with natural history collections, furniture, jewellery etc.

Unworked corals and shells are recorded under the tariff heading BTN (Brussels Tariff Nomenclature) code 05.12 (or SITC - Standard International Trade Classification - 291.15); worked or carved coral and shells are recorded under BTN 95.05 (SITC 899.11) Worked mother-of-pearl is often recorded separately under the BTN heading 95.02. Some countries break these codes down into further subdivisions and one or two actually specify species. For the purpose of this paper, unless otherwise indicated, statistics which are known to refer to shells only have been used. A complete analysis of the statistics available is given by Wells, (1980). Experience has shown that such statistics are rarely complete, and certainly likely to be inaccurate at times as far as the species are concerned; therefore any interpretation should be limited to broad trends, and care should be taken not to read significance into anomalies and discrepancies.

INTERNATIONAL TRADE

Europe

European countries give very little detail in their foreign trade statistics and most countries have a single tariff heading for corals and shells. By estimating exports from the import data of other countries it can be seen that the Netherlands and Denmark are among the major shell exporters (Table 1). Since these exports cannot be tropical shells, the figures probably refer to shells for industrial purposes. West Germany, Belgium, France, Italy, the UK, Switzerland and other European countries import large quantities from these two countries. France is also a major exporter of shells (Table 1) possibly for industrial purposes, although it may also re-export ornamental shells.

TABLE 1

Exports of unworked shell (including unworked mother-of-pearl) in tonnes. Figures in brackets have been calculated from the imports of other countries.

	1977	1978	1979
Netherlands	(6 774)	(4 004)	
United States	5 805	4 790	5 588++
Denmark	(4 886)	(3 321)	
Philippines	4 073	4 164	4 269
Mexico	(3 933)	2 743*	2 176*
Japan	2 745	4 431	7 603
Indonesia	1 875	2 395	3 018
France	1 295	1 393	
South Korea	919	1 730**	
Australia	1 965	911	
Haiti	(1 100)	(802)	
Turkey	(893)	(1 153)	
Solomon Is.	418	313	
Fiji	486	(142)	
Marshall, Mariana & Caroline Is.	(398)	(243)	
Taiwan	182	164	248
Spain	212	263	
Thailand	186	160	
West Germany	204		
Greece	(195)	(173)	
Papua New Guinea	(187)	(197)	
Belgium	(639)		
Singapore	(109)	(296)	
New Hebrides	(139)	(209)	
India	66+	151+	466+
Kenya	(84)	(90)	
Tanzania	(13)	(21)	

Data taken from official government foreign trade statistics, Department of Trade Library, Export House, London

* = obtained from the British Embassy, Mexico City

** = Jan-Nov only

+ = 'Statistics of Marine Products', Government of India Publication

++ = Abbott, 1980

European countries are among the principal shell importers (Table 2). France, as well as recording imports from other European countries, obtains shells from Madagascar: nearly 100 tonnes a year in 1976 and 1978. Most Spanish shell imports come from the Philippines (70 per cent) and Haiti (10 per cent) which are major suppliers of ornamental shells (see below). Italy has long been the centre of the cameo-carving trade and so might be expected to be a major shell importer. Unfortunately Italian statistics include shells with corals but large quantities are involved. In 1978, 4,416 tonnes of coral and shells were imported; half came from Denmark, the rest from a large number of countries. For example, in 1976 when a detailed breakdown of countries of origin was given, imports of corals and shells included 544 tonnes from Japan, 427 tonnes from Indonesia, 419 tonnes from the Philippines, 312 tonnes from the Sudan, 117 tonnes from Haiti, 115 tonnes from Australia and 115 tonnes from New Caledonia. The species most commonly used for cameo-carving are helmet shells (*Cassis* spp.) and the pink conch (*Strombus gigas*) although some cowrie species (*Cypraea* spp.) are also used (Ritchie, 1974; Barletta, 1976). In 1977 the Bahamas exported 11,000 conches to Italy.

The UK also uses a combined tariff heading for corals and shells; in 1978, 4,257 tonnes were imported. In 1977 one firm was importing 10 tonnes of assorted ornamental corals and shells from the Philippines every two months (Anon, 1977a). In 1978 it was reported that another was selling three tonnes of shells a week which came from the Philippines, East Africa and the Seychelles (Anon, 1978). In 1979 the Philippines recorded exports of 212 tonnes of shells to the UK.

European countries import large quantities of worked shells but only imports of worked mother-of-pearl are recorded (Table 3). France, West Germany, Italy and the UK import most from the Philippines; the bulk of Spain's worked mother-of-pearl comes from Japan. Italy and West Germany are major exporters (or re-exporters) of worked mother of pearl (Table 3), and Italy must be one of the main exporters of cameos although no statistics are available. The US has a tariff heading for imports of 'coral and cameos, cut, not set, for use in jewellery'. and until 1978 Italy was the main supplier of these commodities a peak being reached in 1975 when the US imported nearly 5 million US \$ worth from this country. In 1979 just over 1.4 million US\$ came from Italy and over 1.5 million US\$ from Taiwan (Fig.1).

United States

The US is the second largest exporter of shells (Table 1). Exports increased dramatically in the 1960s reaching a peak of nearly 30,000 tonnes in 1966 (Fig.2). A drop followed and between 1970 and 1979 exports averaged 4,337 tonnes a year. These large figures are mainly accounted for by exports to Japan. In spite of the tariff heading 'marine shells', exports to Japan consist largely of freshwater pearl mussels (Unionidae), which are crushed and used for seeding cultured pearl oysters. Earlier in the century the Japanese obtained these from the Yangtse River in China, but in the 1950s they were forced to turn to North America for supplies. Subsequent exploitation has led to the rapid depletion of many rivers (Stansbery, 1971), and in many US states legislation has been introduced to control collection (Abbott, 1980). The peak in exports in 1966 may have been in anticipation of such controls. Although Japanese imports from the US are now substantially lower than they were in the 1960s, they have been steadily increasing since 1971 (Figs.2 and 3).

TABLE 2
Imports of unworked shell (including mother-of-pearl) in tonnes

	1977	1978	1979
Japan	9 431	10 289	10 223
France	7 442	8 764	
United States	4 621	4 297	4 160
South Korea	3 887	6 387*	
West Germany	7 623		
Hong Kong	1 061	1 506	3 059
Spain	1 460	1 382	
Switzerland		2 637	
Portugal	1 539		
Taiwan	458	556	323
Yugoslavia	28	21	
Mexico		21	
India	6		
Brazil	4		
Thailand	2		

Data from official government foreign trade statistics, Department of Trade Library, Export House, London.

* = Jan-Nov only

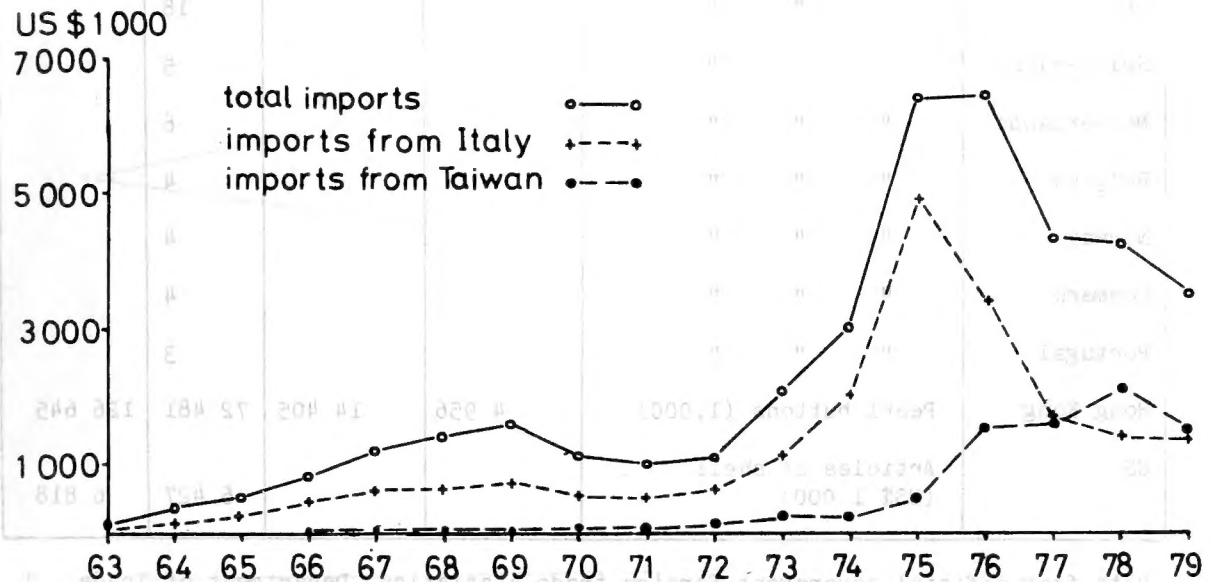


Fig. 1. Value of US imports of 'corals and cameos, cut but not set, for jewellery', 1962-1979.

TABLE 3
Exports and Imports of worked shell and mother-of-pearl

		Exports		Imports	
		1977	1978	1977	1978
Philippines	Shell handbags (no)	1 700	63 465		
	Worked capiz shells (no)	2 499 200	2 349 484		
	Worked m.o.p. (no)	117 837	140 140		
	Shell lanterns (no)	235	85		
	Shell lampshades (t)	634	969		
	Shell buttons (t)	5			
	Other worked shells (t)	1 809	1 401		
Taiwan	Worked m.o.p. (t)	456	609	2	3
South Korea	" " "	59	59*		
Japan	" " "	33	35	97	109
Thailand	" " "	7	38	10	2
West Germany	" " "	15		96	
Italy	" " "	11		42	
Spain	" " "		6	81	41
France	" " "	3		100	
UK	" " "			18	
Switzerland	" " "			5	
Netherlands	" " "			6	
Belgium	" " "			4	
Norway	" " "			4	
Denmark	" " "			4	
Portugal	" " "			3	
Hong Kong	Pearl buttons (1,000)	4 956	14 405	72 481	126 645
US	Articles of shell (US\$ 1 000)			6 427	6 818

Data from official government foreign trade statistics, Department of Trade Library, Export House, London.

m.o.p. = mother-of-pearl

no = number

t = tonnes

* = Jan-Nov only

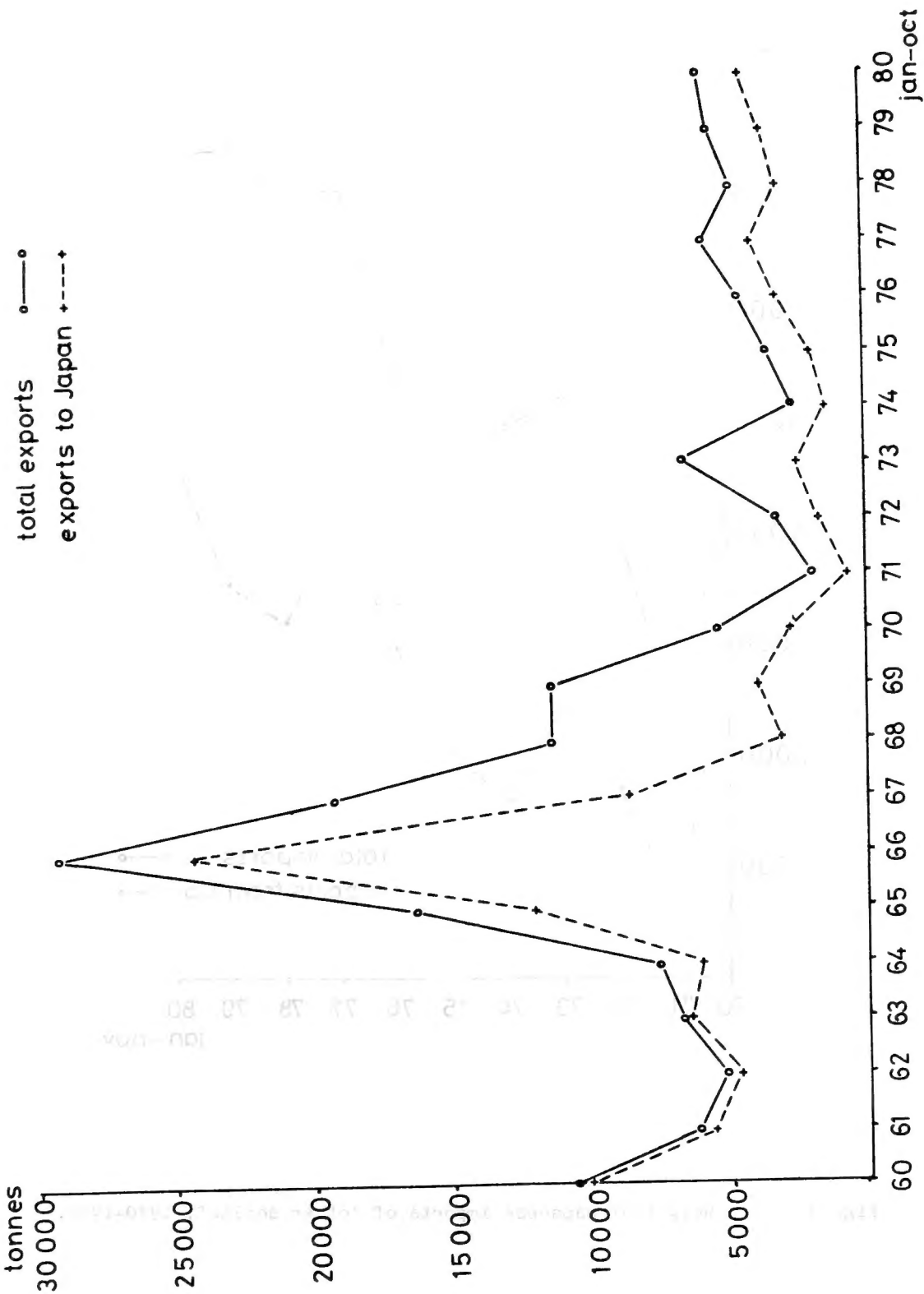


Fig. 2. Weight of US exports of 'marine shells', 1970-1980.

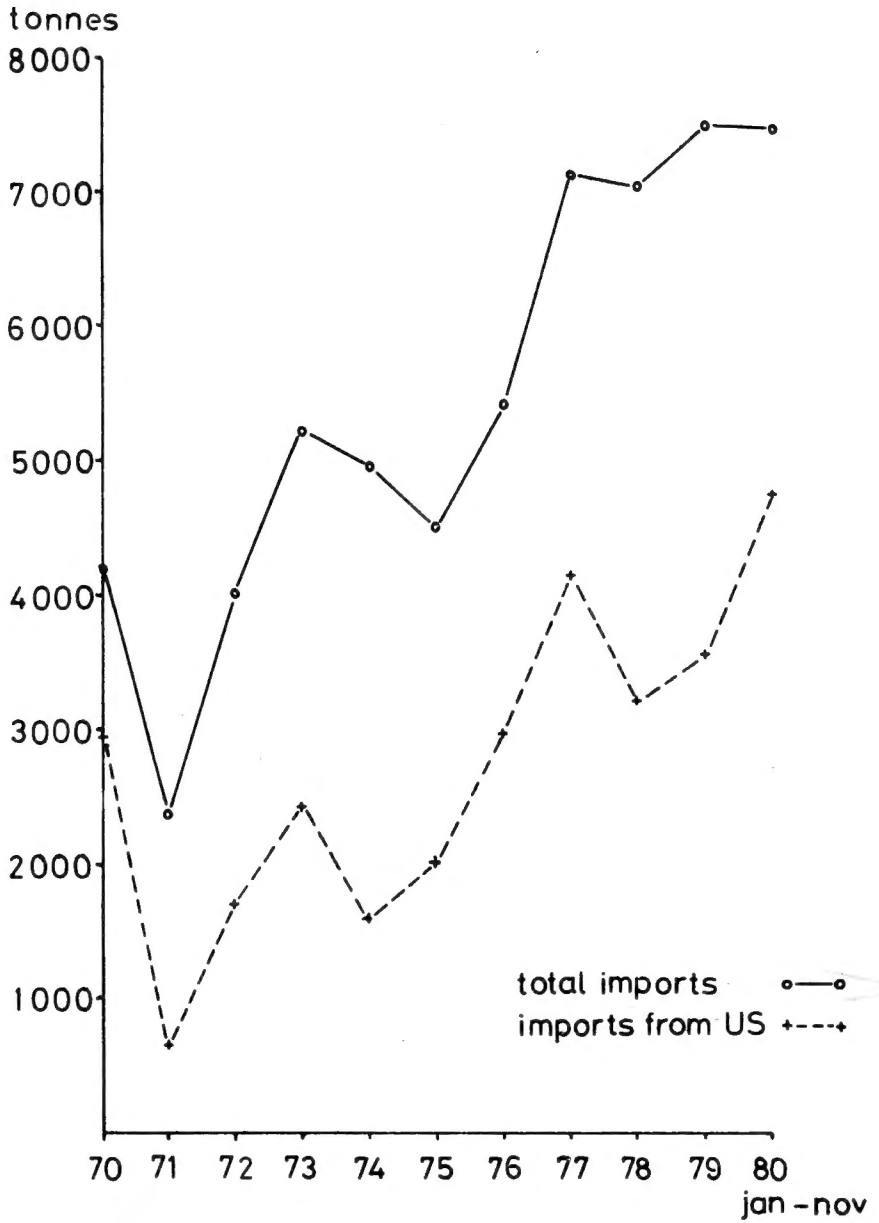


Fig. 3. Weight of Japanese imports of 'other shells', 1970-1980.

The US is one of the major importers of shells (Table 2), and there are probably about a thousand shell dealers of some kind to be found throughout the country (Abbott, 1980). Imports of marine shells increased from an annual average of 1,483 tonnes in the 1960s to over 4,600 tonnes in 1977 (Fig. 4). The biggest increase was in shells from Mexico but imports from the Philippines and Haiti also increased markedly (Fig.4). During the 1960s the Bahamas and Jamaica were important suppliers with annual imports from Jamaica averaging 323 tonnes between 1960 and 1964, and from the Bahamas 61 tonnes. However in 1980 only 6 tonnes came from the Bahamas and none from Jamaica. Since 1977 imports into the US have been declining, particularly those from the Philippines and Haiti.

A survey of shell shops in Florida in 1980 showed that 85 per cent of shell wholesalers obtained their shells in bulk from overseas. The main sources, in descending order of importance, were the Philippines, Mexico, Haiti, India, Taiwan, Japan and East Africa (Abbott, 1980). Abbott identified some 300 species on sale and estimated that another 4,700 were likely to appear on the market from time to time. The most popular selling species were the queen or pink conch (Strombus gigas), tiger cowrie (Cypraea tigris), pink Mexican murex (Phyllonotus erythrostomus), chambered nautilus (Nautilus pompilius), scallops, large clam shells (Hippopus spp. and Tridacna spp.), large showy gastropods (Voluta spp., Tonna spp., Syrinx spp., and Pleuroploca spp.), small specimen cowries, cones and murex.

Imports of worked shells into the US also increased dramatically during the 1970s (Fig.5). In 1970 imports of 'articles of shell' were valued at US\$807,000 but by 1976 imports to the value of over US\$8,000,000 were recorded. Since then, the value of worked shell imports has fallen slightly and in 1980 US\$7,280,000 were recorded; about 75 per cent comes from the Philippines (Fig.5). Imports of cut corals and cameos showed a similar dramatic increase, from US\$95,998 worth in 1963 to US\$6,497,000 worth in 1976 (Fig.1) but have also fallen slightly since then. In 1979, imports to the value of US\$3,510,900 were recorded, most of which came from Italy, Taiwan and Japan.

The Philippines

Trade statistics and circumstantial evidence from the retail end of the trade suggest that the Philippines is currently one of the major suppliers of ornamental shells (Table 1). Exports are recorded under headings for 'mother-of-pearl' and 'other shells'. Since 1970, exports of the latter have risen rapidly (Fig.6). About 50 per cent are destined for the US, including Hawaii; other major countries of destination are Italy, Spain, the UK, the Netherlands and Hong Kong.

The Philippines is the second largest producer of mother-of-pearl shell (Table 4); in 1978, 467 tonnes of pearl shell (Pinctada spp.) and 127 tonnes of Trochus niloticus were exported. All four species of commercially important mother-of-pearl producing species are found in the southern waters of the Philippines around the Sulu Archipelago (Anon, 1969). Another commercially important species is Placuna placenta, the window pane oyster (or capiz shell), the virtually transparent valves of which were used as a substitute for glass by the Chinese and Philipinos (Saul, 1974). They are currently used for lampshades, wind chimes, boxes and other ornamental articles and have become very fashionable in western Europe. In 1970, 80 tonnes of this species were exported from the Philippines but by 1972 exports had dropped to a little over one tonne. A sudden decrease in abundance of this species has been reported, thought to be a result of an unknown ecological change (Kinne & Rosenthal 1977). However it is possible that the decline in exports of unworked capiz shells may also be due to the boom in the shellcraft industry in the Philippines. Exports of worked capiz shells rose from just over one million (presumably either cut shells or shell articles) in 1976 to nearly three and a half million in 1979.

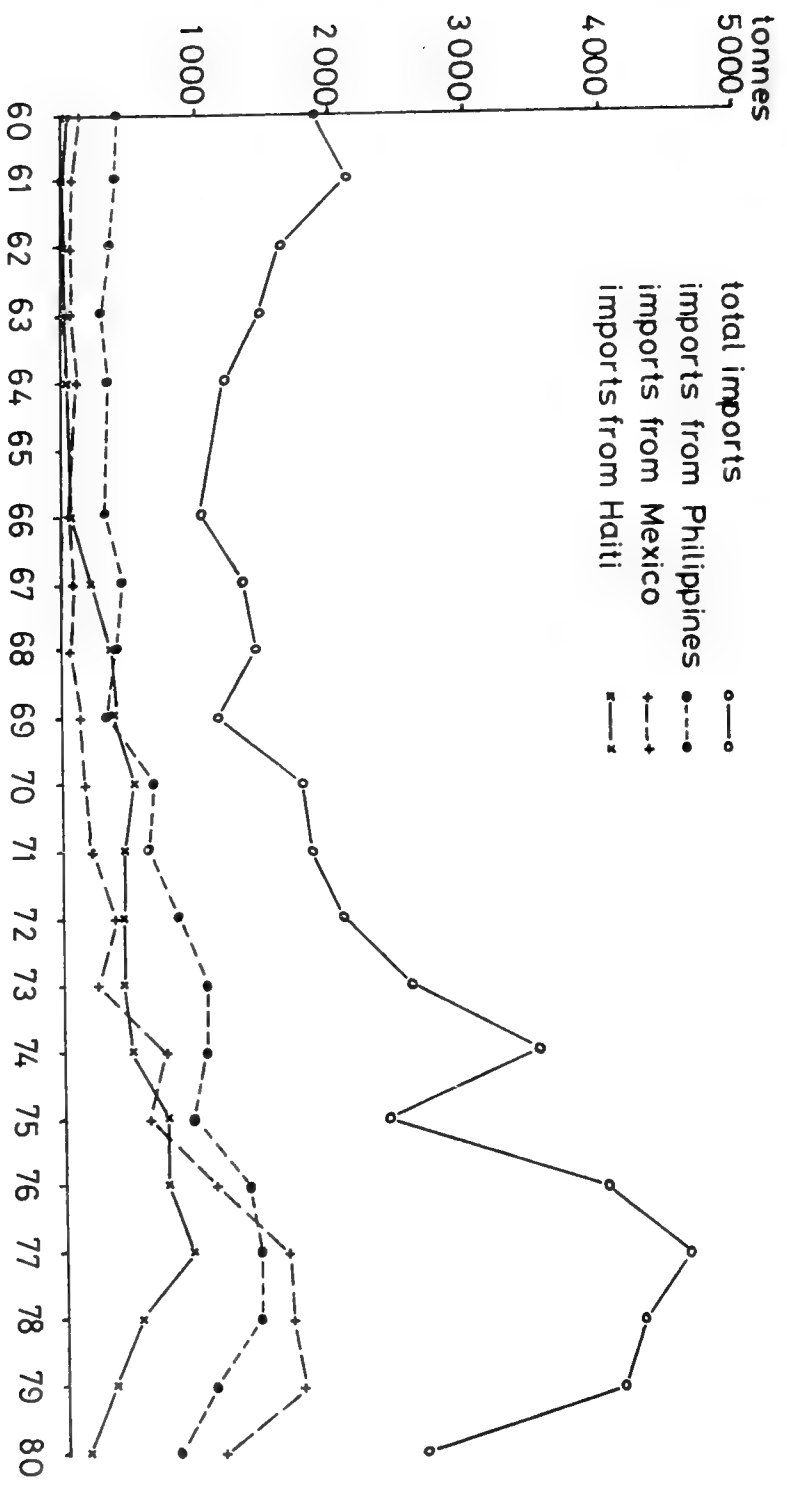


Fig. 4.

Weight of US imports of 'marine shells', 1960-1980.

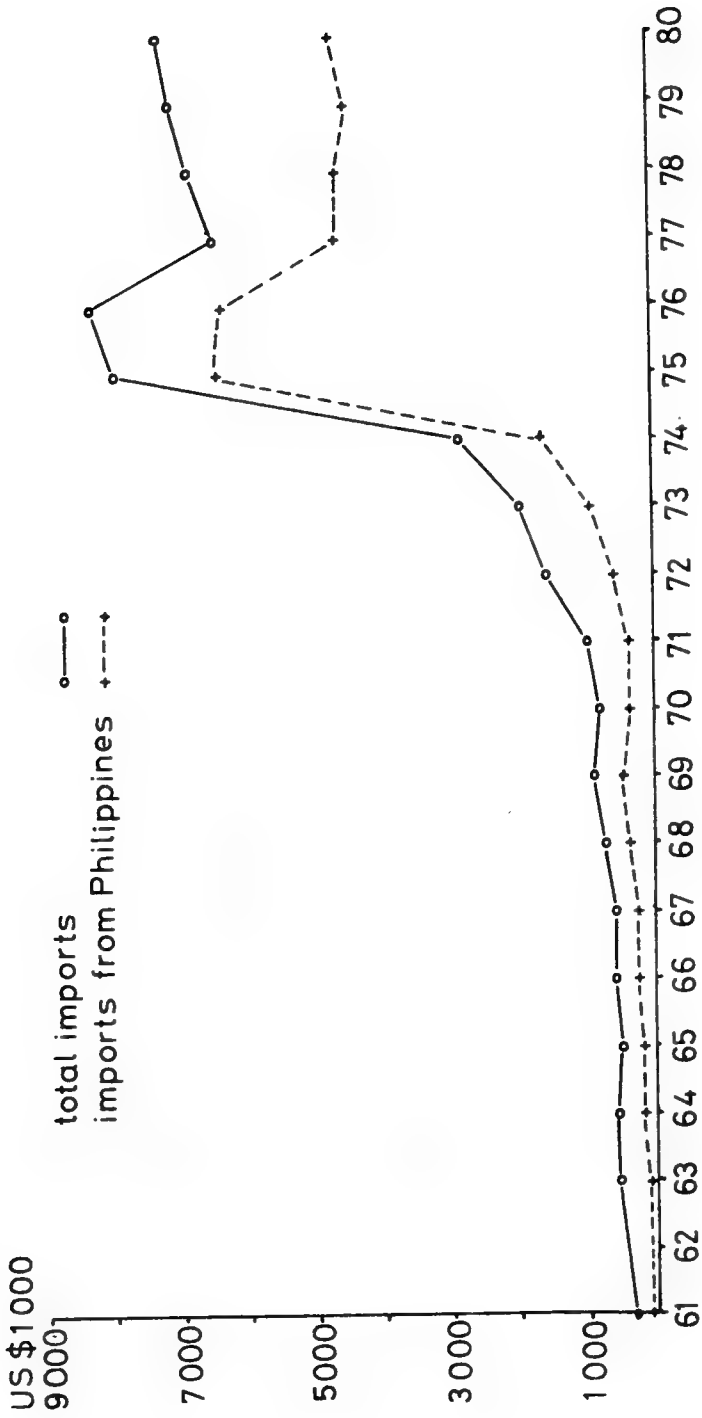


Fig. 5. Value of US imports of 'articles of shells', 1961-1980.

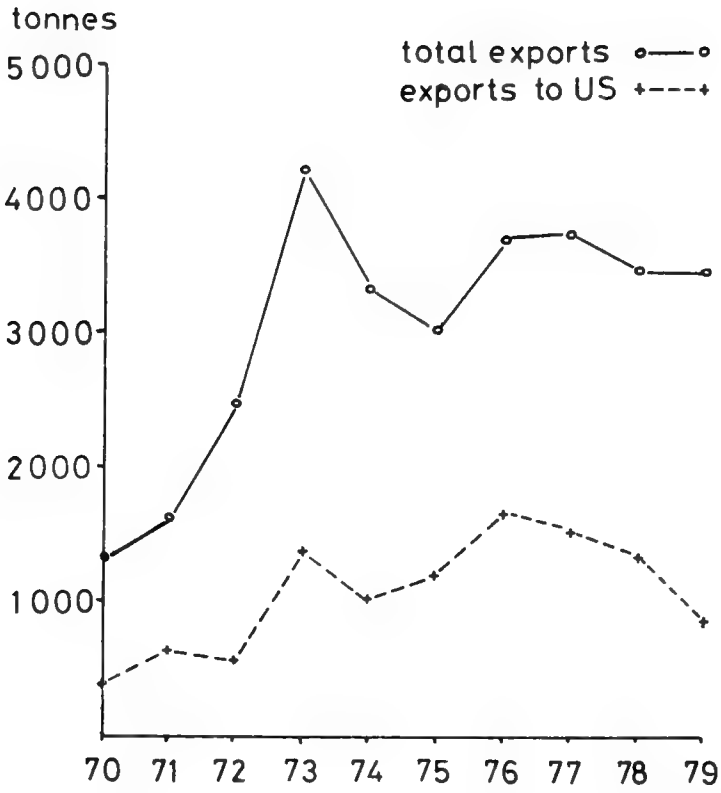


Fig. 6 Weight of Philippines exports of 'other shells', 1970-1979.

Large numbers of other shellcraft items were also exported from the Philippines (Table 3), to many countries worldwide of which the main destinations were the US, Hawaii, Japan, Australia and Europe.

Mexico

Statistics obtained from the British Embassy in Mexico City show that Mexican exports of unworked shells increased from 1,198 tonnes in 1976 to over 2,000 tonnes in 1978 and 1979. Exports estimated from import data in other countries were even higher; in 1978 the US imported 1,670 tonnes from Mexico compared with 148 tonnes in 1970 (Fig.4); Japan imported 1,296 tonnes; South Korea imported 959 tonnes of pearl, oyster, abalone and other shells, and Hong Kong and Spain also imported from Mexico, making a total of over 3,925 tonnes. Shells coming from Mexico include off-shore species such as *Murex*, *Oliva* and *Strombus*, together with abalone, a by-product of the food industry. In 1979 the US imported nearly 1,500 tonnes of frozen or canned abalone from Mexico (Abbott 1980).

Japan

Japanese exports of shells come under the tariff heading 'shells of shell-fishes' and may include the shells of pearl oysters. Between 1977 and 1979, exports more than doubled in volume (Table 1) but in 1980 between January and November only 4,678 tonnes were exported; 90 per cent were destined for South Korea, exports to this country increasing from 819 tonnes in 1976 to 7,048 tonnes in 1979. From trade statistics Japan appears as the major shell importer; specialist shell collectors have increased in Japan over the last fifteen years and dealers now travel widely buying shells for their customers (Clover, 1979). Major suppliers of ornamental shells to Japan include South Korea, Mexico, the Philippines, Indonesia, Taiwan, Haiti and Papua New Guinea. 50 per cent of Japanese shell imports are freshwater pearl mussels from the US (see above; Fig. 3).

Japan also imports large amounts of mother-of-pearl to supply its carving industry. Between 1970 and 1979 an average of 2,000 tonnes of *Trochus niloticus* were imported annually, mainly from Indonesia, the Marshall, Mariana and Caroline Is., the Solomon Is., New Caledonia, Fiji and the Philippines. About 400 tonnes of *Pinctada margaritifera* and of *P.maxima* are imported annually, mainly from the Philippines and Indonesia. Japan is also one of the leading importers of worked mother-of-pearl, but approximately 50 per cent of this is for button making and is therefore presumably just rough cut. It is probably the third largest exporter of worked mother-of-pearl (Table 4).

Indonesia

Indonesia's shell exports are mainly of mother-of-pearl (Table 4). An average of 1,511 tonnes of *T.niloticus* was exported annually between 1976 and 1979, most of it destined for Japan and Singapore. About 500 tonnes of 'mother-of-pearl' (*Pinctada* sp.) and 100 tonnes of 'green snail shell' (*Turbo marmoratus*) were exported annually to Japan, Singapore, South Korea, and other countries. Smaller quantities (an average of 164 tonnes a year between 1976 and 1979) are exported under the heading 'other shells', mainly to Japan.

South Korea

South Korea is an important centre for the mother-of-pearl industry. Its imports of green abalone shell almost doubled between 1976 and 1978 from just over 1,000 tonnes a year to nearly 2,000 tonnes, most coming from Mexico, the US, Australia and Japan. Imports of pearl shell (*Pinctada* sp.) have also risen from just under 400 tonnes a year to nearly 1,000 tonnes a year, mainly from Japan and Indonesia. Oyster shell is exported in large quantities (2,000 tonnes in 1978) to Japan and South Korea is the third largest exporter of worked mother-of-pearl (Table 3), mainly to Japan, the US, and Hong Kong.

TABLE 4

Exports of unworked mother-of-pearl (tonnes)
 Includes pearl shell (Pinctada sp.), top shell (Trochus niloticus)
 and green snail (Turbo marmoratus)

	1977	1978
Indonesia	1 713	2 249
Philippines	340	594
Japan	(565)	(297)
Australia	418	318
Solomon Is.	418	287
Marshall, Mariana & Caroline Is.	(398)	(243)
Fiji	486	(104)
New Caledonia	(102)	(852)
New Hebrides	(102)	(191)
French Oceanic Territories	(197)	(214)
Papua New Guinea	(151)	(160)
Malaysia	(57)	(138)
Spain	76	34
West Germany	131	
India	(28)	(62)
Thailand	(61)	(34)
Hong Kong	(21)	(27)
Taiwan	(36)	(3)
Cook Is.	(17)	(12)
Singapore	(13)	(17)
Sudan		(39)
United States		(26)
New Zealand		(13)
Afars Issas	(13)	
Burma		(5)
Mexico		(2)

Data obtained from official government foreign trade statistics,
 Department of Trade Library, Export House, London.

Figures in brackets have been calculated from the imports of other
 countries.

Australia

Australia, with its rich coral reefs, has long been an important supplier to the ornamental shell trade. From 1976 to 1978 exports of shells other than pearl shell varied between 500 and 1,500 tonnes a year (Table 1) and were destined largely for Hong Kong and South Korea. In 1980, dealers in Florida reported receiving large quantities from Australia (Abbott, 1980).

A mother-of-pearl industry has existed in Australia since about the 1860s, based on Pinctada maxima from the Arafura Sea and Western Australia. The Japanese were heavily involved in this and at the beginning of this century became the main operatives under contract to Australian companies. At first shells were simply gathered from beds exposed at low tide but as stocks dwindled divers became necessary. Between 1934 and 1939 exports varied between 950 and 1,200 tons a year but the post war yield has averaged only about 300-400 tons a year. Prices fell dramatically between 1958 and 1962 with the introduction of plastics, but in the 1960s the Arafura Sea was reported to be producing 80-90 per cent of the world's mother-of-pearl (Highley, 1969). In 1978, 318 tonnes were exported, mainly to the US and the UK (Table 4).

Haiti

Although no trade statistics are available for this country, it is clear from import statistics of other countries that in the 1970s it became a major supplier. Imports into the US from Haiti increased from just over 7 tonnes in 1963 to 967 tonnes in 1977 but since then have dropped, to 176 tonnes in 1980 (Table 4). Japan, Spain and Taiwan also recorded imports from Haiti in the 1970s. Shells are collected primarily from the Bay of Gonave; in 1979 60,000 conches were leaving Haiti a month, along with helmet shells, tritons and murex (J. Rudloe, 1981, in litt.)

India

Exports of marine shells from India have risen from 20 tonnes in 1969 to 466 tonnes in 1979 (Table 1) when the main destinations were the US, Bahrain and Kuwait. US imports from India rose from less than a tonne in 1960 to nearly 70 tonnes in 1980. The Gulf of Mannar and Palk Bay, especially off Tuticorin and Rameshwaram, supply most of the ornamental shells collected, and about two dozen species are involved which are exported through Bombay (Jonklaas, 1976; Kannan, 1980 in litt.).

Indian foreign trade statistics record exports of cowries (Cypraeidae) and chanks (Turbinella pyrum). 45 tonnes of cowries were exported in 1977, of which 12 tonnes went to the US. Cowries are also imported: in 1976 India imported 17 tonnes from the Maldives and 22 tonnes from Tanzania. These are mainly Cypraea tigris which are used for engraving, but large numbers of C. lynx, C. caputserpentis, C. chinensis, C. diliculum, C. erosa and C. vitellus are also imported (Jonklaas, 1976). 55 tonnes of chanks were exported in 1976 and nearly 18 tonnes in 1977, mainly to Italy, Spain, France and the US. Chanks have been collected by man for many centuries; in India and Tibet they are used as trumpets and libation vessels in temples, and the rare sinistral ones are held to be sacred (Saul, 1974). They are also carved and used for making bangles. Chank beds are found on the west coast of India in the Gulf of Kutch, and on the east coast in the Palk Bay area and the Gulf of Mannar. The current status of the chank fishery is not known but Durve (1975) recommended that it should be monitored to ensure that depletion did not occur.

Taiwan

Taiwan, like India, is becoming increasingly important as a supplier of ornamental shells. An average of 170 tonnes of shells (Table 1) and 200 tonnes of shell waste are exported annually. A 1980 catalogue from a Taiwan shell dealer advertised a wide variety of species, including volutes costing up to US \$100, and cowries for as much as US \$500; the brochure mentions that the company's boat voyages widely in the South Pacific and that many of the species offered for sale come from Australian waters. Large numbers of shells are also collected by Taiwanese fishery and shrimp boats which range widely over the Indo-Pacific. Taiwan also imports large quantities of shells, probably mother-of-pearl or other raw material for the shell craft industry, from British and American territories in the Pacific (Table 2). It is the second largest exporter of worked mother-of-pearl (Table 3). In 1978 the 609 tonnes of shell craft articles which were exported all over the world included rings, bracelets, powder cases, beads tobacconists' sundries and other decorative items. The US is one of the main countries of destination: imports from Taiwan of articles made of shells increased from US \$1,800 in 1963 to US \$872,661 in 1980, and of corals and cameos for jewellery, from US \$8,400 in 1966 to US \$1,508,600 in 1979 (Figs. 1 and 5).

East Africa

Kenya and Tanzania have long been important suppliers of shells; Zanzibar was once the centre of the shell trade, particularly for helmets for the cameo industry (Boss, 1969) and for money cowries (*Cypraea moneta*) which were used as currency (Saul, 1974). Neither country supplies statistics for shells alone. Between 1974 and 1976 Tanzania exported 250-400 tonnes annually of corals and shells: Kenya's exports fluctuated more widely and the highest export (107 tonnes) of corals and shells was reached in 1978, possibly in anticipation of the ban on exports which was imposed in 1979 (see below). In 1979, 85 tonnes of coral and shells were exported. Both countries supply shells to the US, Japan and a number of European countries. Studies of the shell trade in Kenya have shown that the main collecting areas are now the more inaccessible places such as Lamu on the north coast and Shimoni in the south (Wells, 1977; Evans et al., 1977).

Other countries

A number of South Pacific islands export mother-of-pearl (Table 4), the most important species being *Trochus niloticus*. The Solomon Islands and Fiji both export about 300 tonnes of *Trochus* annually, mostly to Japan; the Marshall, Mariana and Caroline Islands, New Caledonia and the New Hebrides also supply Japan with *T. niloticus*; Papua New Guinea exported 227 tonnes of this species between July 1975 and June 1976 to Japan and European countries. The Solomon Islands, Fiji and Papua New Guinea also export *Pinctada* sp. and *Turbo marmoratus*. *T. niloticus* has been exported from New Caledonia since the beginning of the century. Between 1910 and 1960 exports fluctuated between 100 tonnes and 1,250 tonnes a year; recently there has been a rapid increase and exports totalled 1,900 tonnes in 1978, of which about 54 per cent went to Europe and 41 per cent to Japan. These large exports were due to the fact that the fishery operated at a low level during the 1960s 'mining boom' on the island which gave stocks time to build up. New Caledonia is currently responsible for approximately 30 per cent of the world production (Bouchet & Bour, 1980).

Hong Kong is a major importer and re-exporter of unworked shells and is an important centre for the mother-of-pearl button industry. Imports of shells have been increasing (Table 2) and come mainly from Australia and South Africa; re-exports of unworked shells (which totalled 2,817 tonnes in 1979) go mainly to China. Both imports and exports of pearl buttons have increased; exports are destined mainly for Singapore, Australia and Taiwan and have increased from 1,915 thousand buttons in 1976 to 14,405 thousand in 1978; imports come mainly from Japan, but also from Taiwan, the US and West Germany and have increased from 34,876 thousand in 1976 to 126,645 thousand in 1978 (Table 3).

DISCUSSION

In spite of the difficulties in the interpretation of foreign trade statistics, the figures presented above strongly suggest that over the last decade there has been a big increase in the quantities of tropical ornamental shells on the world market. This is reinforced by reports on the retail end of the trade (e.g. Abbott, 1980) and by the fact that there have been a number of cases where popular species have become locally depleted in heavily exploited areas.

The increase in the shell trade is partly due to the huge expansion of the tourist industry, since shells are popular holiday souvenirs and established resort areas, such as Florida, Hawaii and East Africa, have been the first to see their shell stocks dwindle. In the Caribbean and Gulf of Mexico a number of species are now uncommon (although not endangered), almost certainly as a result of over collecting, such as the queen conch (Strombus gigas), the queen helmet (Cassis madagascariensis), the Florida horse conch (Pleuroploca gigantea), the angel wing (Cyrtopleura costata), the flamingo tongue (Cymphoma gibbosum), and the king's crown (Melongena corona) (Abbott, 1980). In East Africa large specimens of many of the popular species have disappeared from the developed coastal areas near Mombasa and Malindi (Wells, 1978; Evans et al., 1977). In the Seychelles molluscs were commonly seen on most reefs in the early 1970s, but by 1978 they had become very difficult to find, particularly in areas such as Port Launay, the reefs of North West Bay on Mahe, and even St Anne Marine National Park, although this locality is now better controlled (Salm, 1978). In Australia overcollection has led to depletion of some species and there are fears that the sudden infestations on some coral reefs by the crown of thorns starfish Acanthaster planci may have been the result of the decline in its main predator, the giant triton (Charonia tritonis) which is popular with collectors (Edean, 1977).

It is now generally cheaper for shops in holiday resorts to import shells from countries such as the Philippines, where most species are still very abundant and where labour is cheap for the time-consuming processes of cleaning and packing. As a result the Philippines, Mexico, Haiti, Taiwan, India and other developing countries are becoming increasingly prominent in the shell business.

Another factor which has contributed to the expansion of the shell trade is the current uncertainty of trade in ornamental corals. Collection of corals in state waters in Florida was banned in 1976 (Anon, 1979a) and the Philippines banned coral exports in 1977 (Gomez, 1979). As a result a number of US dealers have been expanding the shell side of their business.

Some marine molluscs, such as the glory-of-the-sea cone, Conus gloriamaris, have always been rare in trade and commanded high prices. In many cases their rarity is due to the fact that they are deep water species or come from other equally inaccessible places. Some of these are becoming increasingly common on the world market as a result of new fishing techniques, including SCUBA diving and submersibles. Australian divers found beds of Conus gloriamaris in the Solomon Islands in 1968 and 200 specimens were collected, which apparently represented 90 per cent of the population over a square mile (Abbott, 1980). Rare cowries have been found in deep waters in increasing numbers in the Philippines by fishermen with deep water nets (Anon, 1979c). Although prices of such rare species fall when they are discovered in relative abundance, the popularity of shell collecting ensures that prices in general remain high, further encouraging the search for the rarer species.

Even less is known of the ecology and distribution of rare species than other marine molluscs; it is, therefore, impossible to estimate the effect that collecting will have. Some species could be vulnerable; for example the volutes (Volutidae) are largely confined to Australian and some Pacific waters, and are highly prized among collectors. Unlike many marine molluscs the volutes do not have planktonic larvae but undergo direct development and as a result their powers of dispersal are poor and populations tend to be small and very localised. For example, *Cymbiola rossiniana* is endemic to the south west coast of New Caledonia and is highly sought after, fetching high prices on the international market. A reserve has been created for it around the island of Konare but unfortunately is not properly supervised (Bouchet, 1979).

For most species, however, it is unlikely that collection alone could reduce their numbers to the point of extinction. Most marine molluscs have huge reproductive capacities and their planktonic larvae ensure wide dispersal. Cowries have been collected by the thousand off the coast of Zanzibar and yet the popular species such as *Cypraea tigris*, *C. lynx* and *C. helvola* are reported still to be numerous (Halsted and Halsted, 1980). It is evident from species collected for food that some can support large takes; for example in 1979 the US alone imported nearly 2,000 tonnes of canned or frozen abalone, which represents many more individuals than the same weight in shells. The pink conch, *Strombus gigas*, forms a staple part of the diet in the Caribbean as well as being one of the most popular species in the shell trade. In the 1950s about 2 million conches were being collected annually on the Caicos Bank alone, about 1.4 million kg of dried conch meat being exported each year to Haiti where it provided an important source of protein. The Bahamas also had large conch fishery; in 1959 over 150 tons of conch was collected and a further 100-200 tons consumed in the outer islands (Boss, 1969). Fishery on this scale for the meat could easily provide the 13,000 conch shells exported from the Bahamas in 1977, or even the 300,000 shells exported a year at the turn of the century for the manufacture of fine porcelain in the UK (Boss, 1969). *Strombus* probably reaches maturity in only two years and may live for 10-25 years which accounts for the high level of exploitation that it can support. However, recently it has become apparent that many parts of the Caribbean have exhausted their supplies to the point where this species is now an expensive luxury. Fishermen in the Bahamas are said to have to range further from home; the price of conch meat has risen and research into maricultural seeding programmes is being carried out to maintain the fishery (Brownell and Berg, 1978; Attrill, 1981 in litt.).

The mother-of-pearl trade also consumes enormous quantities of shells. The industry reached a peak at the turn of the century, when for example, the UK alone was importing 2,000 tons of pearl shell a year (Saul, 1974). Trade declined with the development of plastics, but recently it has been undergoing a revival and countries where labour is cheap, such as Japan, Taiwan and South Korea are taking the lead as centres of the carving industry. There is currently an annual demand for 6,000 tonnes of unprocessed *Trochus* shell (Bouchet & Bour, 1980). There is little evidence however that pearl shells are being collected in much greater numbers than in the past; for example in 1928 about 100 tons of *Trochus niloticus* were exported from the Philippines (Talavera, 1931); 50 years later 127 tonnes were exported.

Local depletion of mother-of-pearl species has been reported however and fishing is now controlled in a number of places. In Papua New Guinea catches of *Trochus niloticus* decreased progressively during the first half of this century until in 1956 regulations were introduced. A minimum size limit of 10 cm diameter was introduced and fishing zones were rotated (Barletta, 1976).

T. niloticus has been collected commercially in the Andaman and Nicobar islands since the turn of the century. With the introduction of diving techniques by the Japanese who were licensed to fish there in 1929, the areas down to 7 fathoms (14m) were rapidly depleted. In 1933 a diver could collect over 20 shells an hour but by 1935 only two or three were being found (Rao, 1937).

In New Caledonia Trochus niloticus populations have been periodically over-exploited but it is thought that an annual production of 1,000 tonnes can be maintained if current regulations are adhered to and if catches are evenly distributed throughout the main collecting localities. There is a minimum size limit of 8 cm diameter and fishing is only permitted under license. Some countries have regulations restricting Trochus capture to specimens between 6 and 12 cm in diameter, thus assuring reproduction will continue in the large individuals, since small specimens (between 6-10 cm in diameter) are most valued on the European market. However in New Caledonia, populations in the south have been heavily exploited in the past and the Trochus taken now tend to have a diameter of less than 9 cm. By retaining the 8 cm minimum size limit, some breeding individuals are safeguarded, since sexual maturity is reached at a size of 6.5-7 cm when the animal is two to three years old (Bouchet & Bour, 1980).

Although most countries have legislation for edible or other commercially valuable molluscs, relatively few have implemented any form of protection for species involved in the ornamental shell trade. The Netherlands controls trade in Harpa costata, Cypraea cribellum, and C. esontropius, three endemic species from Mauritian waters, and the collection of H. costata is prohibited in Mauritius (Abbott, 1980). Bermuda prohibits the collection of the queen and harbour conches (Strombus gigas and S. costatus), the Bermuda cone (Conus bermudensis), the Bermuda and calico scallops (Pecten ziczac and Acquiptecten gibbus), the Atlantic pearl oyster (Pinctada imbricata), the netted olive (Oliva reticularis) and all helmet and bonnet shells (Cassidae) (Anon, 1976). The Bahamas bans the export of edible conch (i.e. conch products containing more than 40 per cent edible material) and whole shells of Strombus gigas but allows exports of crushed shells or those with cut lips (Attrill, in litt 1981).

In Florida it has been illegal since 1971 to take more than ten Strombus gigas a day, to have more than twenty specimens in one's possession, or to sell conches for purposes other than for food. This prevents commercial exploitation and it has been reported that conch populations are now recovering (Abbott, 1980). Venezuela and Puerto Rico periodically introduce closed seasons on Strombus gigas collection (Brownell & Berg, 1978). In 1971 commercial collection of Cypraea thesities was banned in Australia as populations were becoming depleted. The giant triton (Charonia tritonis), the giant or horned helmet (Cassis cornuta) and the giant clam (Tridacna gigas) are also protected in Australian waters (Coleman, 1976). C. tritonis is protected in the Seychelles (Salm, 1978).

Few countries have attempted any overall control of imports or exports, although it has been reported that Japan and Australia have recently implemented controls (Abbott, 1980). In Kenya in the early 1970s a licensing system was introduced to control trade but this was poorly enforced and in 1979 a complete ban on the export of shells was introduced. In Kenya posters are being produced for hotels, with the aim of educating tourists about the possible damage that over-collection can cause (Anon, 1979b). In Papua New Guinea commercial shell collecting is organised by the government. Collectors are instructed as to which species are in demand, how they should be collected and packed to avoid wastage and damage, and are advised to change collecting areas at intervals (Anon, 1977b).

At present few species of mollusc are listed on the Appendices of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). A number of the North American freshwater mussels (Unionidae) are listed on Appendices I and II, as a result of concern about US exports to Japan of mussels for seeding pearl oysters. Unfortunately identification of different species in this group is extremely difficult and specimens may well pass unnoticed among exports of the more abundant species whose exploitation is still permitted. A number of terrestrial snails are listed, of which Papustyla pulcherrima (on Appendix II), the bright green Manus Island tree snail, is probably the best known and most common in trade. Trade in terrestrial shells is still a specialist market but there is evidence that its popularity is increasing. Mail order dealers in the US see a trend towards land species (Abbott, 1980) and the London specialist shell shop, Eaton's, has recently had a large number of terrestrial species on sale, including P. pulcherrima. As with marine species, most terrestrial molluscs are probably able to support a certain level of collecting and are unlikely to become endangered through collecting alone. Where the Florida tree snail, Liguus fasciatus, has been introduced into the Everglades National Park, it has become so well established that limited collection is now permitted (Abbott, 1980). However where collection is combined with habitat destruction a species could rapidly become endangered, especially if it has a restricted distribution and small population - as is the case with many terrestrial molluscs in South East Asia and the Pacific Islands. At present trade seems to be confined mainly to species from the Philippines (such as Helicostyla spp., and Chloraea spp.), Papua New Guinea (Papustyla spp., Papuina spp.) and from the Caribbean e.g. Haiti and Gulf of Mexico (Liguus spp.); these are all areas where deforestation is a major problem.

It is now generally recognised that 'conservation' must include the rational management of our living resources (Anon, 1980). The ornamental shell trade could contribute significantly to the income of many developing countries, as does the edible mollusc trade, but like the latter it must be controlled. Research should now be orientated towards determining sustainable yields for commercially valuable species, particularly in regions such as the Philippines and Mexico where exploitation is heavy. Collection methods should be examined to ensure that they do not involve habitat destruction or wastefulness. The possibility of making greater use of both edible and non-edible parts of the species involved in trade should be considered; Strombus gigas provides an example of a species where both shell and meat are commercially valuable.

CONCLUSION

Factors such as dredging, pollution, siltation and destruction of coral reefs by dynamiting for fish or mining for building materials are potentially as great or greater threats to marine molluscs than overcollecting, as is forest destruction to terrestrial species, and continuous efforts must be made to control such activities (Salvat, 1978). The creation of reserves, both marine and terrestrial, provides protection to the habitat as well as to breeding populations of commercially valuable species from which recolonisation of collecting areas can take place. In the meantime, the consumer countries of the Western world should make some attempt to regulate trade, particularly in species where overcollecting has been demonstrated. Education programmes should be established to inform the public of the damage that can ensue through excessive or careless collecting. It is striking that so far it is mainly exporting countries that have tried to curtail the trade. These tend to be countries where not only is enforcement a major problem through lack of funds and facilities, but ironically where the trade may be a vital addition, however small, to the local economy.

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