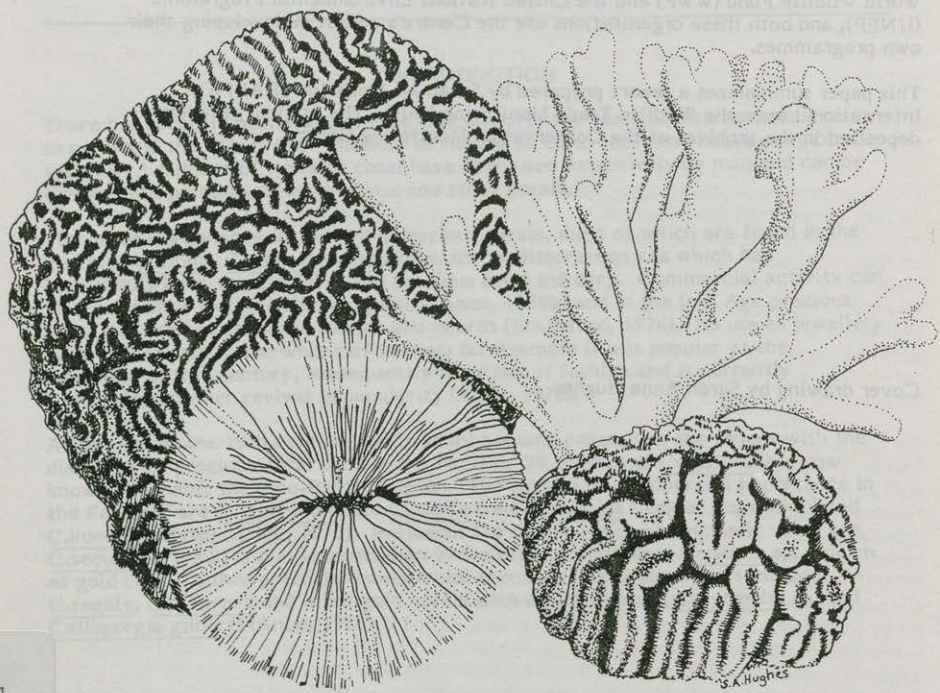
INTERNATIONAL UNION FOR CONSERVATION OF NATURE AND NATURAL RESOURCES

International Trade in Corals

by Susan M. Wells



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INTERNATIONAL TRADE IN CORALS

SUSAN M. WELLS

ABSTRACT

Analysis of foreign trade statistics reveals that there has recently been a considerable increase in the volume of coral involved in world trade. Stony corals for the curio trade are exported in large quantities from south east Asia, particularly the Philippines, to Europe and the US and imports into the latter increased dramatically during the 1970s. Taiwan and Japan are currently the centre of the precious coral industry, their boats ranging far into the Indo-Pacific since local coral beds have been successively depleted. Black or semi-precious coral has recently become popular for jewellery in the developed world and is being increasingly collected. Local depletions have been reported in the Caribbean. Exporting countries are beginning to attempt to control the coral trade but enforcement is difficult and consumer countries have made little attempt to curtail the retail end of the trade. A coral fishery management plan has been drawn up for the Western Pacific Region, based on research carried out on commercially valuable species in Hawaii. It is suggested that further research be initiated to determine optimum sustainable yields for commercially valuable species in other regions.

INTRODUCTION

There has recently been considerable concern over the scale of international trade in coral and the effect that this may be having on coral reefs and heavily exploited species. A number of types of coral have been used extensively by man and can be divided into precious, semi-precious and stony corals.

The order Gorgonacea includes the precious corals, most of which are found in the genus Corallium. C.rubrum comes from the Mediterranean sea which has historically been the centre of the precious coral industry. Commercial activity can be traced back to the Neolithic period (Anon, 1980a) and in the Iron Age precious coral was used to decorate shields and swords (Brailsford, 1976). Its use as jewellery has been subject to the whims of fashion; for example it was popular at the beginning of this century, subsequently went out of fashion and is currently undergoing another revival in popularity (Anon, 1978).

At the end of the 19th century the industry became centred on the Orient with the discovery of precious coral beds in the Pacific. 24 species of Corallium are now known to inhabit the Indo-Pacific region. The species of commercial importance in the Far East are C.japonicum and C.nobile (red), C.elatius (pink or angel-skin) and C.konojoi (white) (Grigg, 1970). In Hawaii the main species of economic value are C.secundum (pink) and a hexacorallian in the order Zoanthidea, Gerardia sp., known as gold coral. Other potential commercial species in Hawaiian waters include C.regale, C.laauense and other gold corals such as Narella sp., Calytropha sp. and Callogorgia gilberti (Anon, 1980).

Bamboo corals, also in the Gorgonacea, are increasingly being used for jewellery. In the Gulf of Mexico Acanella eburnea, Keratoisis flexibilis, K.ornata and Lepidisis caryophyllia are collected commercially in small quantities and the nodes of the branches are used for beads (Anon 1979a). In Hawaii Acanella sp. and L.olapa potentially have commercial value (Anon 1980a). Several gorgonacean corals have been used for medicinal purposes. The Romans took ground Corallium powder as an antidote to poison, and even up to the beginning of this century in Europe it was thought that coral necklaces would ward off ill-health in children (Ritchie, 1970). At least one species of coral is currently collected commercially for use in medicine: Plexaura homomalla contains prostaglandins and although these are now available synthetically, it is still collected off the coast of Mexico for the extraction of these important compounds (Ruggiere,1976; Bayer & Weinheimer, 1974).

The order Antipatharia contains the black or semi-precious corals which are largely deep water tropical species. These have been traditionally valued in Asia and Arabian countries as protection against sickness and evil and were commonly used to make amulets and beads (Douglas, 1947). In Indonesia black coral filaments are boiled in oil and when softened are bent and plaited to form arm bangles. Folk law maintains that a bangle worn on the right arm increases virility and one on the left arm cures rheumatism (M. Brendel, in litt. 1980). More recently black coral has become very popular as a material for jewellery manufacture, particularly in countries where tourism is a major industry. Small colonies are sold as curios. In Hawaii three species have been fished commercially since 1958. Antipathes dichotoma makes up 90 per cent of the catch and small quantities of A.grandis and A.ulex are also taken (Anon, 1980a). In the Caribbean A.pennacea and A.dichotoma are used for jewellery and occasionally Leiopathes glaberrima and Cirrhipathes lutkeni (Anon, 1979a).

The Scleractinia or stony corals (the main reef building species) are collected for a variety of purposes. In many parts of the world they are mined or collected live or dead for building, road construction and industrial uses such as lime production. Increasingly stony corals are being collected for the curio trade. They are dried and bleached in the sun and either sold locally to tourists or exported to countries where tourism is important but corals unavailable or already over-exploited, and to developed countries for sale in gift shops and department stores. Species from the genera Fungia, Acropora, Pocillopora and Porites are popular. The Indo-Pacific blue corals (Heliopora) and organ-pipe corals (Tubipora) are also collected for this purpose.

Very little information is available at present on the quantities of coral involved in trade. This report presents an analysis of foreign trade statistics which it is hoped will provide an indication of the trends in the trade and point to areas where further research is needed. Although foreign trade statistics are generally available for most countries, corals are unfortunately often recorded under the same tariff heading as shells. Unworked corals and shells are recorded under the tariff heading BTN (Brussels Tariff Nomenclature) 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). Figures for worked coral often include the weight and value of other materials used in the finished product such as wood or metal. Fortunately, some countries do separate coral from shells and these statistics can be used to estimate trade in other countries. No country separates precious from stony corals in their trade statistics, and information available from other studies has been used to interpret the figures.

INTERNATIONAL TRADE

Philippines

The Philippines was the main exporter of unworked coral between 1976 and 1978 (Table 1). About 60 per cent was destined for the US, the remainder going to several countries including Japan, Italy and other European countries. Philippine exports increased dramatically towards the end of the 1970s (Fig.1), reaching a peak of over 1,800 tonnes in 1976. In 1977 a presidential decree was issued banning coral exports from the Philippines and the 1976 peak may have been due to dealers getting rid of their stock in anticipation of the ban. Since then official export figures have dropped, but an analysis of imports for other countries shows that unofficial exports from the Philippines have continued; at least 962 tonnes were exported in 1978, (Table 2) and in 1980 the US imported over 236 tonnes from this country (Fig.4).

Philippine exports are mainly of stony corals. The principle collecting grounds are around Cebu, with most exports leaving through Zamboanga (Gomez, 1979). The species most actively exported include blue coral (Heliopora coerulea), organ-pipe coral (Tubipora musica), the hydrozoan fire corals (Millepora spp.) and a number of stony corals (McManus, 1979). Acropora millepora, A.arcuata, A.vaughani, Pocillopora verrucosa, P.danae, Fungia sp. and Parahalomitra philippensis, which are species from this region, were seen on sale in Florida in the 1970s (Anon, 1979a). Precious and black corals are found in Philippine waters but are not exploited very much by the local people who lack the necessary expertise to fish at great depths (Gomez, 1979).

Taiwan

Taiwan is the second main coral exporter (Table 1), about 60 per cent of its exports going to Japan, 20 per cent to Italy and the rest to the US and other countries. Exports probably include both precious and stony corals, and although subject to fluctuations have increased markedly since the early 1970s (Fig.2). In December 1980 it was reported that Taiwan's coral collecting fleet had just returned from its six month trip with a harvest expected to break all records; the 20 boat fleet took about 180 tonnes of gem quality coral, estimated to bring in nearly 20 million US dollars (Anon, 1980b). Taiwanese boats range far into the Pacific and down into Australian waters, and have been reported taking precious corals in Philippine waters (Gomez, 1979). Imports of unworked coral into Taiwan also increased in the early 1970s, from nil in 1972 to over 8 tonnes in 1976, most of which came from Japan and the Philippines (Table 2). By 1979 however, imports had dropped to only 530 kg of which most came from the Philippines. Taiwan is a major centre for the coral carving industry and is the main exporter of worked coral (Table 3). Over 67 tonnes were exported in 1979 to more than 50 countries including the US, Japan, Italy, France and Spain.

Japan

Japan is also a major centre for the precious coral industry. Exports are lower than those from Taiwan (Table 1), possibly because a higher proportion is kept for internal use. Japanese exports of unworked coral have declined from nearly 26 tonnes in 1970 to just under 3.5 tonnes in 1979 (Fig.3a). Over 75 per cent is destined for Italy; the rest goes to Taiwan, India and other European countries. As exports have declined, so imports of unworked coral have increased, from an average of 12 tonnes a year in the early 1970s to over 205 tonnes in 1979 (Fig.3b). In the first eleven months of 1980 however, imports barely reached 4 tonnes. The US and Philippines supply a small proportion but over 90 per cent comes from Taiwan (Table 2). Imports probably include stony as well as precious corals since ornamental shell and coral collecting is as popular in this country as in the western world.

TABLE 1

Importers and Exporters of Unworked coral (tonnes)
Figures in brackets are calculated from exports or imports of other countries.

	Exports			Imports		
	1976	1977	1978	1976	1977	1978
Philippines	1 828	170	(962)			
Taiwan	63	48	226	8	5	1
France	25	5	76	161	74	127
Indonesia	40					
Thailand	25			(1)		
Japan	15	8	6	3	11	148
Italy	(7)	(10)	(12)	(143)	(53)	(146)
Honduras			(15)			
Haiti			(12)			
Maldives		(10)				
India	1	8		2	12	(1)
Spain	3	2	7	59	121	293
South Africa		(2)	(1)			
United States	(3)		(1)	676	432	756
New Caledonia			(2)			
Tunisia	(1)					
Tanzania			(1)			
Kenya			(1)			
West Germany				(93)	(13)	(1)
Switzerland				(74)	(3)	
UK				(71)		
Netherlands				(62)		
Hong Kong				23	6	7
Yugoslavia				4	8	12
Greece				(16)		(1)
Australia				(13)	(5)	
Belgium				(9)	(1)	

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

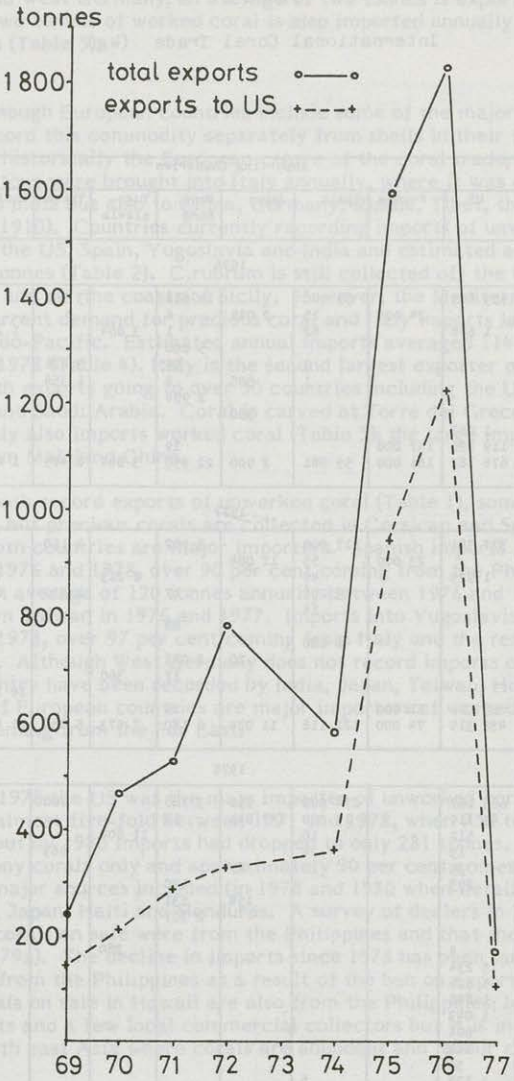

Fig.1 Weight of Philippine exports of unworked coral, 1969-1977. Figures from Gomez, 1979.

TABLE 2

International Coral Trade (kg)

Country of origin	Importing Countries: US	France	Spain	Japan	Hong Kong	Yugo-slavia	Taiwan	India	Thai-land	Estimated total exp.
	1976									
Philippines	553 805		59 000		14 878		3 500			631 183
Taiwan		24 000	15	2 045	6					26 066
Italy	1 888		62		1	3 804		1 290		7 045
Indonesia					5 000					5 000
Japan			3		55		3 621	522		4 201
US			1	505	2		1 354		909	2 771
Malaysia					2 994					2 994
Hong Kong				350						350
Tunisia	1 063									1 063
Other Countries	119 426	137 000			19					
Total	676 182	161 000	59 081	2 900	22 956	3 804	8 475	1 812	909	
	1977									
Philippines	377 381		117 000		3 992		4 150			502 523
Taiwan		23 000	55	11 004						34 059
Italy	1 923		49			7 213		705		9 890
Japan			3 000		17		1 330	831		5 178
Hong Kong			14							14
Mainland China					88				101	189
Portugal			1 000							1 000
South Africa				20	2 046					2 066
West Germany					17	360				377
Maldives								10 160		10 160
Other Countries	53 011	51 000			19					
Total	432 315	74 000	121 118	11 024	6 180	7 573	5 480	11 632	101	
	1978									
Philippines	683 167		274 000	850	3 788		200			962 005
Taiwan	40 119		19 000	147 041	11					206 171
Italy	512		10			11 800				12 322
Japan	13		24				963			1 000
Spain	35			69						104
South Africa	693				120					813
US				154	531					685
Singapore					2 727					2 727
Mainland China									100	100
West Germany	4					280				284
Honduras	15 234									15 234
Haiti	11 526									11 526
New Caledonia	1 846									1 846
Tanzania	1 043									1 043
Kenya	604									604
India	157									157
Tunisia	38									38
Other Countries	1 134		6							
Total	756 124		293 034	148 114	7 177	12 080	1 163		100	

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

Japanese worked coral exports are destined for about 30 countries, particularly the US, Switzerland and West Germany; an average of two tonnes is exported annually (Table 3). About two tonnes of worked coral is also imported annually from Taiwan and the Philippines (Table 5).

Europe

Unfortunately, although European countries include some of the major consumers of coral, very few record this commodity separately from shells in their trade statistics. Italy is historically the European centre of the coral trade; In the 19th century about 160 tons were brought into Italy annually, where it was carved and exported largely to India but also to China, Germany, Russia, Tibet, the US and Europe (McIntosh, 1910). Countries currently recording imports of unworked coral from Italy include the US, Spain, Yugoslavia and India and estimated annual exports average about 10 tonnes (Table 2). C.rubrum is still collected off the west and north coasts of Sardinia, and off the coasts of Sicily. However, the Mediterranean can no longer meet the current demand for precious coral and Italy imports large quantities mainly from the Indo-Pacific. Estimated annual imports averaged 114 tonnes between 1976 and 1978 (Table 4). Italy is the second largest exporter of worked coral (Table 3), with exports going to over 50 countries including the US, West Germany, France and Saudi Arabia. Coral is carved at Torre del Greco near Naples (Ritchie 1970). Italy also imports worked coral (Table 5); the large imports in 1976 came primarily from Mainland China.

Spain and France both record exports of unworked coral (Table 1), some of which may be re-exports, but precious corals are collected in Corsican and Spanish waters (Hunnam 1980). Both countries are major importers. Spanish imports increased five-fold between 1976 and 1978, over 90 per cent coming from the Philippines. France imported an average of 120 tonnes annually between 1976 and 1978 of which one fifth came from Taiwan in 1976 and 1977. Imports into Yugoslavia increased between 1976 and 1978, over 97 per cent coming from Italy and the rest from West Germany (Table 2). Although West Germany does not record imports of coral, exports to this country have been recorded by India, Japan, Taiwan, Hong Kong and Spain. A number of European countries are major importers of worked coral (Table 5), most imports coming from the Far East.

US

Between 1976 and 1978 the US was the main importer of unworked coral (Table 2). Imports increased almost five-fold between 1971 and 1978, when 756 tonnes were imported (Fig. 4), but by 1980 imports had dropped to only 281 tonnes. US import figures refer to stony corals only and approximately 90 per cent comes from the Philippines; other major sources included (in 1978 and 1980 when details were available), Taiwan, Japan, Haiti and Honduras. A survey of dealers in Florida showed that most corals on sale were from the Philippines and that these were the cheapest (Anon, 1979a). The decline in imports since 1978 has been largely due to a decline in imports from the Philippines as a result of the ban on exports from that country. Most corals on sale in Hawaii are also from the Philippines; local corals are collected by tourists and a few local commercial collectors but it is in fact cheaper to import from south east Asia where corals are abundant and labour cheap (Johannes, 1978).

The US is also a major importer of cut precious coral, which is recorded under the same tariff heading as cameos. The value of annual imports of these two commodities increased dramatically between 1972 and 1976, mainly due to an increase in imports from Italy. Between 1976 and 1979 the value of imports from Italy has declined but imports from Taiwan have been increasing (Wells, 1981).

TABLE 3

Major exporters of worked coral (kg)

	1976	1977	1978
Taiwan	18 038	18 051	28 850
Italy	23 035	18 800	24 500
UK	3 120	3 151	14 789
Belgium	12 300	3 900	1 200
Netherlands		3 000	11 000
Spain	2 066	6 429	5
France	1 465	5 376	880
Japan	2 523	2 281	1 655
West Germany	473	423	1 488
Denmark	200		1 100
Norway		1 000	
Mexico	13		

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

TABLE 4

Estimated Italian Imports of Unworked Coral (kg)

xporting countries	1976	1977	1978
ilippines	116 109	31 185	
iiwan	6 901	9 377	76 494
rance	5 000	5 000	59 000
apan	11 626	5 794	4 241
pain	3 000	2 000	6 000
ugoslavia	108		
otal estimated imports	142 794	53 356	145 735

ata obtained from official government foreign trade tatistics, Department of Trade Library, Export House, London.

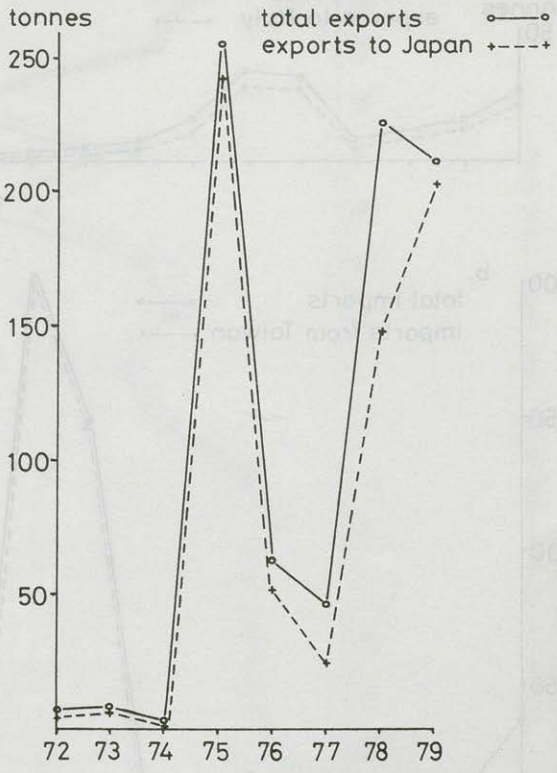

Fig.2 Weight of Taiwanese exports of unworked coral, 1972-1979. Data from foreign trade statistics.

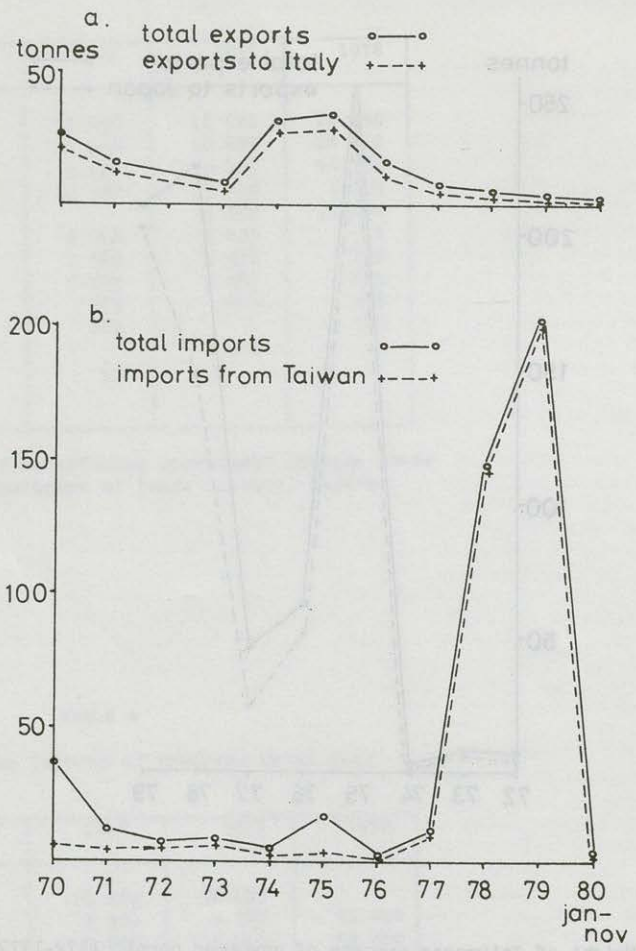

Fig.3 Weight of Japanese a) exports and b) imports of unworked coral, 1970-1980. Data from foreign trade statistics.

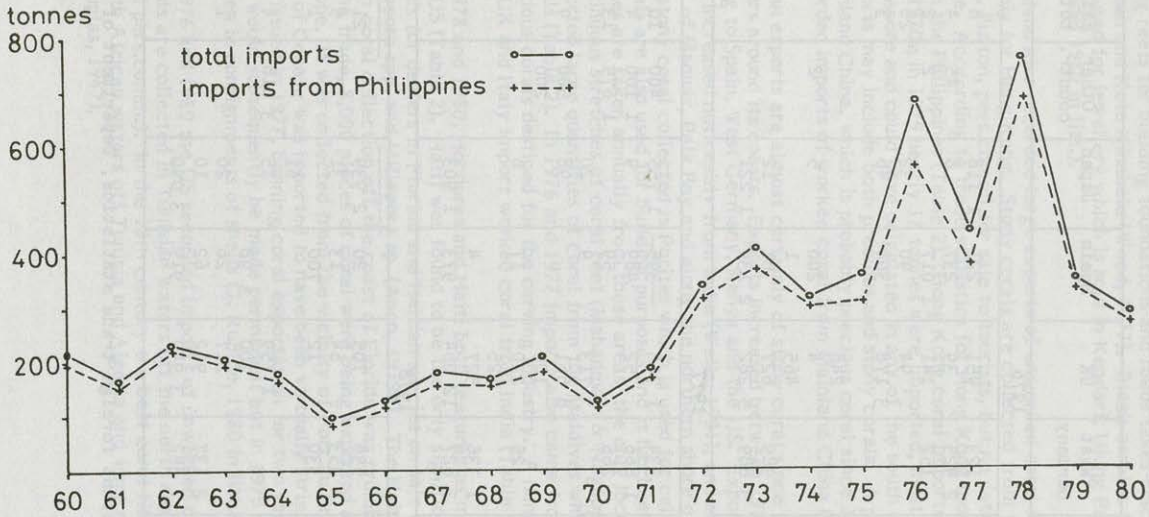

Fig.4 Weight of US imports of unworked coral, 1960-1980. Data from foreign trade statistics.

TABLE 5
Imports of Worked coral (kg)

Country of origin	Importing countries: Italy	France	West Germany	UK	Spain	Japan	Other countr.	Estimated total exp.
1976								
Taiwan	668	5 370	123	951	221	1 118		8 451
Italy		1 754	2 425	39	237	8	45	4 508
Japan	889	66	152	141	1 017		2	2 267
Mainland China	28 073			94	90	32		28 289
Philippines	66			3 178	308	46		3 598
Australia	900							900
India	81			248				329
West Germany	5			4	200	5	2	216
South Korea				465	1			466
Other countries	150	2 476	989	627	61	12		
Total	30 832	9 666	3 689	5 282	2 134	1 221		
1977								
Taiwan	500	5 292	334	1 766	395	1 755	400	10 442
Italy		950	1 866	52	489	9	1 100	4 466
Japan	200	11 156	266		59		1 679	13 360
Mainland China				713	9	20		742
Philippines				8 661		98	500	9 857
India				105			200	305
Hong Kong			25	220	17	6		268
South Korea				125				125
Other countries	1 100	12 749	1 336	527	4			
Total	1 800	30 147	3 827	12 064	973	1 903		
1978								
Taiwan	1 300	17 472	536	705	20	2 939		21 972
Italy		985	4 353	64	13	31		5 446
Japan	600		330	12	700			1 642
Mainland China	200					61		261
Philippines				1 759		15	3 018	4 792
India				200	98			298
Hong Kong		841		217	26	20		1 104
Other countries	5 700	25 089	2 137	992	62	10		
Total	7 800	44 387	7 342	3 949	919	3 090		

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

Other countries

Indonesia recorded a high volume of exports of unworked coral in 1976 (Table 1), most of which was destined for Japan and the US. Although little information is available on exploitation for the curio trade, large scale removal of coral from living reefs for building foundations and roads takes place in Sabah, especially near Labuan and Kota Kinabalu (Wood, 1977). Black coral is fished off the Sulawesi coast and used for jewellery which is sold in Kendari, Ujung Pandang and Jakarta (M. Brendel 1980 in litt.).

Thailand also recorded large exports of unworked coral in 1976 (Table 1), destined mainly for Hong Kong. Stony corals are collected from the coast around Phuket (J.A. Burton, pers.comm) for sale to tourists, but no data is available on the export trade. Acccording to trade statistics for Hong Kong most imports of coral come from the Philippines (Table 2). Hong Kong coral imports have fluctuated throughout the 1970s; in 1979 nearly 18 tonnes were imported, most of which came from Singapore and could have originated in any of the south east Asian countries. Imports may include both precious and stony corals. A proportion is re-exported to Mainland China, which is probably precious coral since Japan, Italy and the UK all recorded imports of worked coral from Mainland China (Table 5).

Indian exports are almost certainly of stony coral since very little precious coral occurs around its coasts. Exports increased between 1976 and 1977 (Table 1), most going to Spain, West Germany, Kenya and the US. Exports of ornamental shells have also increased noticeably from India (Wells, 1981), and come from the same area: the Gulf of Mannar, Palk Bay and along the northern shore of Rameswaram I. Much of the stony coral collected is Porites which is used for calcium carbide production. Corals are also used for building purposes and it has been estimated that 25,000 tonnes are taken annually from these areas, the only localities in India with continuous stretches of coral reef (Mahadevan & Nagappan, 1972). In 1977 India imported large quantities of coral from the Maldives which were probably stony corals (Table 2). In 1976 and 1977 imports also came from Italy and Japan, probably precious corals destined for the carving industry. A number of countries including the UK and Italy import worked coral from India (Table 5).

In 1978 and 1980, Honduras and Haiti both featured as major suppliers of corals to the US (Table 2). Haiti was found to be the only significant source of Atlantic corals for dealers in Florida and Haitian species on sale included brain corals, Acropora spp. and Millepora sp. (Anon, 1979a). The Haitian coral trade flourished when coral collection off the coast of Florida was prohibited in 1976. At the height of the trade, 8,000 pieces of coral were being exported a month to the US and Europe. It was collected from the vicinity of Port au Prince and Leogane, and the Bay of Gonave was reported to have been virtually stripped bare. A communique was issued in 1977, banning coral exportation for two years, and it was thought that this would subsequently be made permanent but in 1979 coral was being exported hidden in consignments of shells (J. Rudloe, 1980 in litt.).

In 1976 and 1980 the US recorded imports of unworked coral from Tunisia. Precious corals are collected in Tunisian waters off the north coast near Tabarka (Boulhel, 1980 pers.comm.). In the 18th century the best coral fisheries were reputedly in North African waters off Tunisia and Algeria and were managed by the French (Douglas, 1947).

DISCUSSION

Although trade data on corals is very limited these statistics suggest that in several areas coral exploitation is increasing to supply a heavy demand. The market for stony corals for the curio trade has probably expanded most noticeably and is represented by the big increase in exports from the Philippines during the 1970s and the increase in imports into the US over the same period. The increase in international trade may also be due to the fact that local corals became unavailable over this period as a result of collecting bans; for example in 1976 the collection of corals in state waters was banned in Florida which resulted in many local dealers increasing their foreign imports (Anon, 1979a). The heavy demand for corals is further illustrated by the fact that where exporting countries have implemented bans, as in Haiti in 1976 (Anon, 1979a) and the Philippines in 1977 (Gomez, 1979) exports have continued illegally as evidenced by trade statistics for importing countries, notably the US.

There were considerable problems over the enforcement of the ban in the Philippines. Goods which had been declared part of the inventory at the time of the ban were allowed to be exported and and many Philippine dealers and US coral wholesalers stockpiled before its introduction (Gomez, 1979; Anon, 1979a) consequently trade escalated in the early 1970s.

A new presidential decree was finally issued which made the possession of stony corals illegal (Gomez, 1980 in litt.) and it is hoped that the trade will now decline. The close connection between the shell and coral trades creates further problems since dealers tend to mix coral with shells and declare the consignment as shells only (Gomez, 1979).

Demand for stony corals also remains high because of its limited useful life; once on display it soon becomes dirty and is difficult to clean. Every piece reaching the consumer represents many others broken in transit or damaged during collection. Since it has been shown that it may take a single piece of coral up to twenty years to reach commercial size (McManus, 1979), it can be seen that overexploitation could occur given the current rate of collection. In Hawaii it was found that there was a danger of small colonies becoming depleted since these were the size preferred by the trade (Grigg, 1976).

Precious coral fisheries have long been prone to fluctuations in productivity. Corallium species tend to occur in large beds with a patchy distribution; once discovered they are often to be exploited to commercial extinction, after which productivity declines until the discovery of new beds. Since precious corals are characterised by great longevity, slow growth and relatively low rates of mortality and recruitment, depleted beds may take a very long time to recover (Anon, 1980a). Exploitation in the Mediterranean has tended to take this form since the beginning of commercial activity. The export trade to India was so intense at the beginning of the Christian era that Pliny wrote that coral was rarely seen even in areas where it was collected. The French controlled the trade in the 18th century and attempted to introduce conservation measures, advising the Algerians to fish their coral beds only once every five years. (McIntosh, 1910; Douglas, 1947; Anon, 1980a).

However coral fishing in the Mediterranean is now an opportunistic business and ordinary fishing boats are converted for coral when new sites are found. Large specimens of C.rubrum are said to be scarce in diveable sites although there are probably a few isolated places which have never been exploited (Hunnam, 1980). The beds off Sardinia which are being used at present are becoming depleted and it has been suggested that some should be set aside as a reserve (Cassola & Tassi, 1973).

The Pacific catch has similarly fluctuated since the end of the last century when commercial exploitation began. The annual Japanese catch has varied from about two tonnes to twenty tonnes, and although occassional attempts were made to impose restrictions, landings were never monitored and traders tended to stockpile. By 1970 when the beds in the Orient were exhausted the nature of the industry had changed from a local operation based on many small boats to one in which most of the coral is collected by fewer larger boats capable of remaining at sea for up to six months (Grigg, 1970). Since then Japanese and Taiwanese boats have been exploiting the East China Sea, the Philippines, Australia and beds off Hawaii.

The US Western Pacific Regional Fishery Management Council has recently prepared a management plan for the domestic and foreign precious coral fishery of the Western Pacific Region. This extends from American Samoa, Guam and Hawaii seaward to the central and western Pacific (Anon, 1980a). The plan is largely based on a detailed study of optimal sustainable yields for the precious coral beds currently exploited off Hawaii (Grigg, 1976). Maui Divers of Hawaii Ltd. collect about 1,200 kg annually to supply coral for the local jewellery trade.

Quotas and minimum size limits have been calculated for each bed (for example, a pink coral colony must attain a minimum height of 10" (25cm)for collection to be permissible) and areas have been set aside where harvesting will not be allowed, to serve as study areas and possible reproductive reserves. Until the distribution of precious coral is better understood it is suggested that each bed should be managed as a unit on the basis of its particular biological requirements and production potential.

Although black coral is now being fished commercially in a number of regions, such as the Caribbean, Hawaii, Indonesia, and the Philippines, the quantities taken are too small for statistics to be useful in analysing trade. Depletion of local populations has been reported in St.Lucia (Butler, 1980 in litt.), Barbados (Goldberg, 1981, in litt.; Sheppard 1980 in litt.), Netherlands Antilles (Goldberg 1981 in litt.), Bahamas (Attrill, 1978), and the British Virgin Islands (Anon, 1979b) and is usually attributable to over collection.

Legislation curtailing or prohibiting collection and trade exists in Antigua, Belize, Trinidad and Tobago, the Bahamas, the Netherlands Antilles and the US and British Virgin Islands. In March 1981 black corals (order Antipatharia) were added to Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). As a result, trade in black coral and its readily recognisable parts and derivatives between countries which are party to CITES (69 parties as at April 1981) will only be allowed if an export permit has been issued by the country of origin. Besides helping to control the trade this will also provide a means whereby it can be monitored. In Hawaii optimal sustainable yields have been calculated for the black corals of commercial value and a minimum size limit of 1.2m in height and/or 2.5cm in basal trunk diameter has been enforced. The Western Pacific Regional Fishery Management Council includes semi-precious corals in its management plan, but there is clearly need for further research into optimal yields and distribution.

It is unlikely that any one species of coral could be exploited to the point of biological extinction and there are many other threats to coral reefs such as pollution (Salvat, 1978). The distribution of species in trade is still not fully known, as evidenced by the continuing discovery of new beds of precious coral. Furthermore localities which have been depleted can, given enough time, be recolonised via planktonic larvae. Of much greater concern is the considerable habitat damage that tends to occur as a result of coral exploitation. Coral reefs are a vital link in fisheries productivity and their aesthetic aspects have made them a unique source of income from tourism (McManus, 1979). In the Philippines both tourism and the fisheries are threatened by the mass removal of stony corals which is taking place in some areas. Coral reefs also play an important role in protecting the coastline from erosion, and in a number of places such as the Maldives, beach erosion is now becoming a serious problem as a result of the destruction of the reefs (Salm 1979). Methods of collection of precious and semi-precious corals could also be improved in many areas. Dredges and tangle nets are frequently used which tend to destroy other reef or bottom-living organisms in their paths. Collection by individual divers or submersibles is often preferable since colonies can be chosen according to size and quality. Remotely controlled vehicles for precious coral harvesting are currently being developed in Hawaii and Taiwan (Anon, 1980a).

Further research is urgently required to determine the feasibility and advisability of commercial exploitation of coral in different parts of the world. Studies on the coral resources of the Philippines have begun (Gomez, 1979) and a fishery management plan for the Gulf of Mexico has been produced which recommends research to determine coral yields in that region (Anon 1979a). The management plan produced for the Western Pacific Region is an example of the way in which coral resources could be utilised (Anon, 1980a).

Until such management plans can been developed for the regions, the international coral trade should be controlled. Coral protection is largely limited to marine parks where collection of marine organisms in general is usually banned, and to the attempts of exporting countries to curtail or ban collection and export. Fortunately an increasing number of marine reserve are being created (IUCN, 1976), but it is surely time that consumer countries in the developed world took some action. The US may shortly list corals under the Lacey Act which will prevent imports into the US of corals illegally obtained in or exported from their country of origin; this would have a major impact on the Philippine trade. The economic importance of coral resources to developing countries, both as an exportable commodity and as an essential component of their coastal ecosystem, should be a major incentive for their conservation and rational utilisation.

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REFERENCES

Anon (1978). Coral returns to Fashion. The Australian Gemmologist May 1978, 169-171.

Anon (1979a). Fishery Management Plan for Coral and Coral Reef Resources. Report to the Gulf of Mexico and South Atlantic Fishery Management Councils. Center for Natural Areas, Washington D.C.

Anon (1979b). Endangered Animals and Plants (Protection of Black Coral) Order, 1979. News Release 14/9 Government Information Service, Ministry of Natural Resources and Public Health, Tortola, British Virgin Islands.

Anon (1980a). Fishery Management Plan and Proposed Regulations for the Precious corals Fishery of the Western Pacific Region. Western Pacific Regional Fishery Management Council, Honolulu, Hawaii.

Anon (1980b). Coral record. Fishing News International December 1980, 23.

Attrill, R. (1978). Diver Conservation Caribbean Conservation News 1(14), 8-12.

Bayer, F.M. and Weinheimer, J.J. (Eds) (1974). Prostaglandins from Plexaura homomalla: ecology, utilization and conservation of a major medical marine resource: a symposium. Studies in Tropical Oceanography 12, Univ. of Miami Press, Coral Gables, Florida.

Brailsford, J. (1975). Early Celtic Masterpieces from Britain. British Museum Publications Ltd.

Cassola, F. & Tassi, F. (1973). Proposta per un sistema di Parchi e Riserve Naturali in Sardegna. Boll.Soc.Sarda Sci.Nat. B,5-83.

Douglas, T.S. (1947). The Wealth of the Sea John Gifford Ltd., London.

Gomez, E. (1979). Philippine Corals: Issues on Conservation and Management. Journal of the Natural Resources Management Forum 1(9), 10-14.

Grigg, R.W. (1970). Status of the Precious Coral Industry in Japan, Taiwan and Okinawa. Sea Grant Technical Report, UNIHI-SEAGRANT-AR-71-02, University of Hawaii.

Grigg, R.W. (1976). Fishery Management of Precious and Stony Corals in Hawaii . Sea Grant Technical Report UNIHI-SEAGRANT-TR-77-03, University of Hawaii.

Hunnam, P. (1980). Mediterranean species in possible need of protection. Report to IUCN, Aquatic Biological Consultancy Services Ltd., Chelmsford, UK.

IUCN (1976). Papers and Proceedings of an International Conference on Marine Parks and Reserves. IUCN Publications N.S. 37.

Johannes, R.E. (1978). Stony Coral Harvesting in Oahu. Unpub. report.

Mahadevan, S. & Nagappan, N.K. (1972). Distribution of Coral Reefs in the Gulf of Mannar and Palk Bay and their Exploitation and Utilization.
In Proceedings of the Symposium on Corals and Coral Reefs ed. by C. Mukundan & C.S. Gopinada Pillai, Marine Biological Association of India, Cochin.

McIntosh, W.C. (1910). A brief sketch of the red or precious coral Zoologist 14: 1-22.

McManus, J.W. (1979). Philippine Coral Exports: the Coral Drain. International Center for Living Aquatic Resources Management Newsletter, January 1979, 18-20.

Noome, C. & Kristensen, I. (1976). Necessity of conservation of slow growing organisms like Black Coral. (abstract) C.C.A. Ecology Conference, Bonaire Sept. 1975, STINAPA, 11, 76-77.

Ritchie, C.I.A. (1970). Carving Shells and Cameos Arthur Baker Ltd., London.

Ruggiere, G.D. (1976). Drugs from the sea. Science 194, 491-497.

Salm, R.V. (1979). Sunken Treasures. Animal Kingdom 82(5), 13-18.

Salvat, B. (1978). Trouble in Paradise Part 1: Assault on Coral Reefs and Lagoons. Parks 3(2), 1-4.

Wells, S.M. (1981). The International Trade in Ornamental Shells. Conservation Monitoring Centre, Cambridge.

Wood, E.M. (1977). Coral reefs in Sabah: present damage and potential dangers. The Malayan Nature Journal 31(1), 49-57.