REVIEW OF TRADE IN LIVE CORALS FROM INDONESIA

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Live coral collectors in Spermonde Archipelago (South Sulawesi Province, Indonesia, April 2001)

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INTRODUCTION

In the 1990s, with the development of air cargo and the increasing interest of the public for the "newly discovered underwater fantasy", international trade in live corals rapidly increased and expanded in response to the demand of the tropical marine aquarium industry.

Following an export prohibition adopted in the Philippines, Indonesia became the world largest exporter of live corals. In 1997, the CITES Management Authority of Indonesia decided to allocate export quotas for live corals. First they were set per genus, but since 1998 export quotas for live specimens have been established per species of coral that most appear in international trade.

The Wildlife Trade Regulation (EC) No 338/97 was adopted by the European Council of Ministers of the 15 Member States of the European Union (EU) in 1997. In order to facilitate the implementation and enforcement of this new European legislation, the European Commission prepared a "Reference Guide" in the 11 languages used in the EU that is accessible on internet (http://www.europe.eu.int/comm/environment/cites/legislation_en.html)

In 1998, based on an overview of available literature and on their field observations in Indonesia, the members of scientific authorities of European Union Member States, raised concern regarding the level of export quotas allocated by the Indonesian authorities for specific taxa.
The issue was first brought to the attention of the Scientific Review Group (SRG) at its 9th meeting, and the case evolved as follows,

- SRG 9 (June 1998) (SRG9/5/2): a negative opinion was given concerning the level of export quotas set for *Catalaphyllia jardinei*. This opinion was maintained and a suspension of imports in the European Union (EU) was adopted by the Committee in September 1998 (suspension published in the Official Journal of the European Communities).
- SRG 10 (November 1998) (SRG10/5/7) and SRG 13 (June 1999) (SRG13/4/7): additional research was done regarding export quotas set for other taxa and a negative opinion was given for additional species:
  - *Blastomussa merleti*,
  - *Cynarina lacrymalis*,
  - *Euphyllia divisa*,
  - *E. glabrescens*,
  - *Plerogrya simplex* and
  - *Trachyphyllia geoffroyi* (including its synonym *Wellsophyllia radiata*).
- SRG 14 (September 1999): the response provided by the Indonesian authorities (SRG14/4/2.1, SRG14/4/2 and SRG14/4/3) was not considered satisfactory, the negative opinion was maintained and EU Member States stopped issuing import permits for 7 or 8 (incl. synonym) species in total (16 September 1999).
- SRG 17 (July 2000) (SRG17/4/6): the negative opinion was extended to additional species (11 July 2000),
  - the whole genus of *Euphyllia* spp. (8 or 9 species – ref. Veron 2000 or Cairns 1999 respectively),
  - *Hydnophora exesa*,
  - *H. microconos* and
  - the whole genus of *Plerogyra* spp. (3 or 4 species – ref. Veron 2000 or Cairns *et al.* 1999 (full reference not available)) respectively (including *Nemenzophyllia turbida* considered synonym of *P. discus* or *P. turbida*) (Anon. 1999 to 2001).

  Including *Blastomussa wellsi* that was considered not to occur in Indonesia, therefore import permits would not be issued for this species if declared to originate from Indonesia.
- SRG 18 (November 2000): a report was received from Indonesian (SRG18/3/3), but the negative opinion is maintained and the Commission decides to fund a project to assist Indonesia in responding to the SRG questions regarding management measures in effect in Indonesia and particularly:
  1) distribution,

2) abundance,
3) growth rate and
4) recruitment rate of the taxa of concern.

- SRG 19 (26 March 2001) (SRG19/4/6): the level of trade in certain species supplied by other range States, e.g. Solomon Islands and Tonga, started to attract the attention of certain members of scientific authorities of the EU Member States. No negative opinion was adopted, but it was decided to keep investigating exports of other genera and from other range States.

The total number of species and genera for which the trade between Indonesia and the EU has been suspended varies pending the sources of information used, regarding the distribution and the taxonomy of the species,

a. 18 species (8 genera) based on Veron 2000, including *Blastomussa wellsi* and excluding both synonyms: *Nemenzophyllia turbida* and *Wellsophyllia radiata*,
b. 20 species (10 genera), including the two synonyms or
c. 22 species (10 genera), if Cairns 1999 is used as taxonomic reference for *Euphyllia* and *Plerogyra*.

FINDINGS OF DATA ANALYSIS, LITERATURE RESEARCH AND FIELD SURVEYS

With regard to synonyms, neither *Nemenzophyllia turbida* nor *Wellsophyllia radiata* were reported in international trade from 1997 to 1999. It will therefore be considered that these species (if they are separate taxa) are usually traded under the name of the synonym species, i.e. *Plerogyra discus* (or *P. turbida*) and *Trachyphyllia geoffroyi*, respectively.

Trade in live specimens of coral genera of concern

From 1997 to 1999, five of the 18 species for which EU imports have been suspended did not appear to be exported from Indonesia, including *Blastomussa wellsi*, *Hydnophora rigida* and *Plerogyra turbida* (or *P. discus*).

The genera of concern made up to 50.6% of Indonesian exports of specimens described as "LIV" (live) of "COR" (coral, raw or unworked) and reported in number of pieces in 1998. While for other exporting nations in Southeast Asia and the Pacific on which no the trade suspension has been imposed, the proportion was 4.8% of Fijian exports, the world second largest supplier of corals, 17.2% of Solomon Islands' exports, 5.4% of Vietnam's and 9% of Vanuatu's (consisting of *Euphyllia* spp. only)(Andy Bruckner, International Workshop on the Trade in Stony Corals (Jakarta), 9 April 2000).

Indonesian export quotas established for these genera represented 45% of the total quota allocated to live coral pieces in 1997 (765,000 pc.), 45% in 1998 (810,000 pc), 42% in 1999 (825,890 pc), and 35% in 2000 (858,960 pc) and 2001 (891,000 pc).

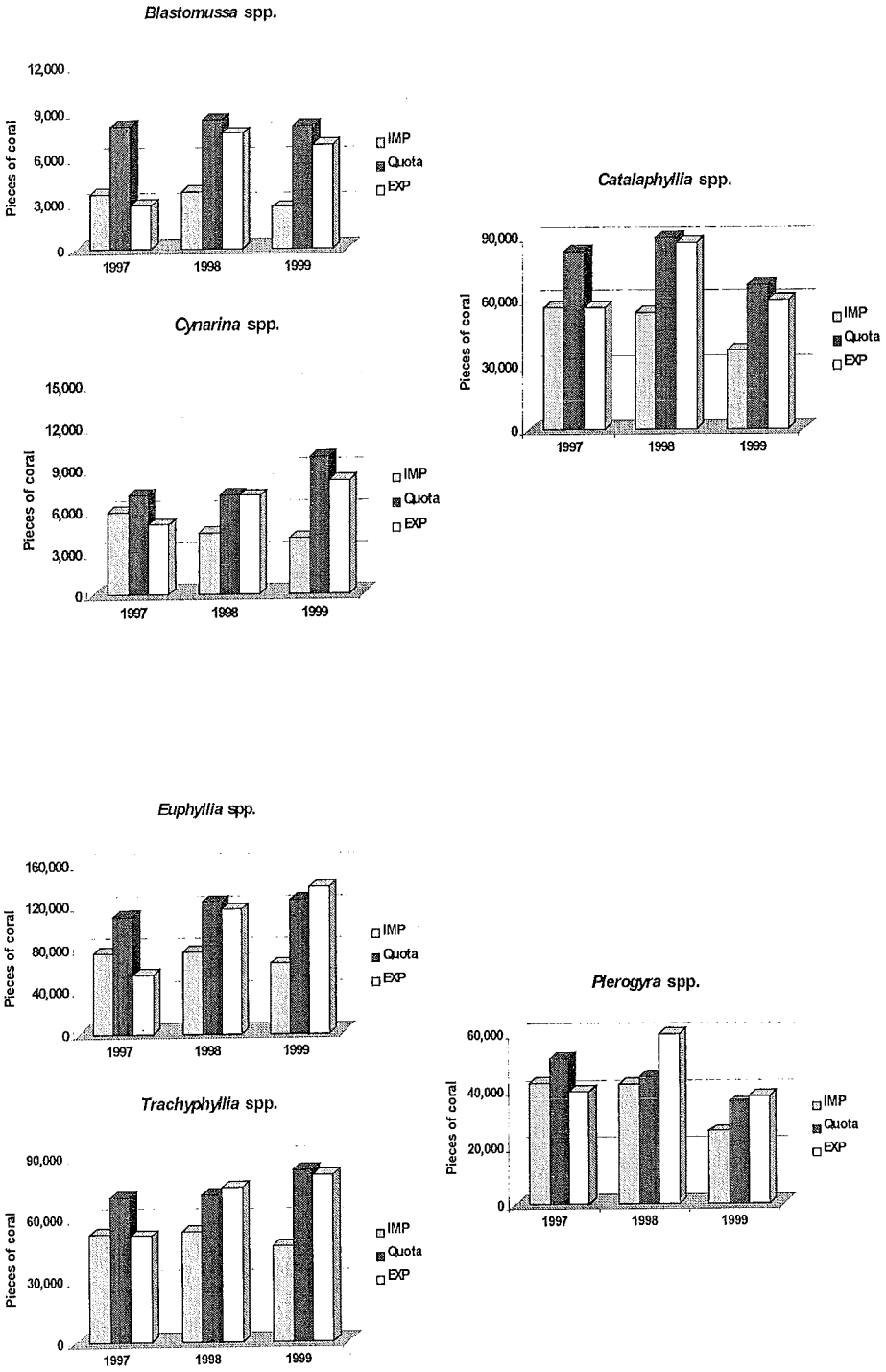
Data analyses reveal discrepancies between reports from exporting and importing Parties (Figure 1, a to f). In 1999, for instance for the relevant genera, EU Member States reported a total import of about 33,600 pieces of live coral from Indonesia while the country of origin reported a total export of 50,235 pieces (Table1). This is almost certainly due to the fact that the majority of exporting countries base their Annual Report on export permits issued. They thereby disregarding the fact that in most cases the amount stated on the permit will probably not be reached, partly for safety reasons, i.e. the supplier wants to prevent excess that would be exposed to seizure.

Table 1. 1999 Trade in live corals of eight genera of concern (Number of pieces of live coral reported "LIV", "COR" and "CAR")

	ID-EU		% ID to EU		ID-World		ID Export	% World from ID		non ID-World		Total	
	Importers	Exporters	Imp.	Exp.	Importers	Exporters	Quota	Imp.	Exp.	Importers	Exporters	Importers	Exporters
B. merleti	203	573	**45**	**8**	453	6,775	8,100	**100**	**100**	0	0	453	6,775
B. wellsi	0	0			0	0	(* 7,200)	**0**	**0**	50	50	50	50
Blastomussa spp.	601	0	**25**	**0**	2,365	13		**100**	**100**	2	0	2,367	13
Catalaphyllia jardinei	1,094	5,648	**37**	**9**	2,938	60,152	67,500	**98**	**100**	50	0	2,988	60,152
Catalaphyllia spp.	2,386	0	**7**	**0**	34,308	247		**99**	**95**	397	12	34,705	259
Cynarina lacrymalis	521	1,484	**81**	**18**	647	8,202	9,900	**93**	**100**	50	0	697	8,202
Cynarina spp.	334	0	**10**	**0**	3,486	16		**86**	**67**	584	8	4,070	24
E. ancora	0	0	**0**	**0**	200	8,202	(* 36,000)	**100**	**41**	1	12,011	201	20,213
E. cristata	0	0		**0**	0	7	no quota		**100**	0	0	0	7
E. divisa	2,108	8,702	**56**	**13**	3,785	66,769	72,000	**100**	**100**	0	0	3,785	66,769
E. glabrescens	2,418	6,743	**61**	**14**	3,980	49,459	54,000	**99**	**100**	50	0	4,030	49,459
Euphyllia spp.	6,616	17	**11**	**3**	58,195	526		**83**	**58**	12,003	385	70,198	911
Hydnophora exesa	1,766	4,712	**94**	**50**	1,879	9,378	10,890	**100**	**100**	0	0	1,879	9,378
Hydnophora microconos	501	1,474	**96**	**46**	523	3,195	4,050	**100**	**100**	0	0	523	3,195
Hydnophora rigida	390	2,160	**86**	**54**	453	3,991	4,500	**75**	**100**	150	0	603	3,991
Hydnophora spp.	1,580	6	**34**	**30**	4,705	20		**65**	**14**	2,574	121	7,279	141
Plerogyra simplex	1,612	5,425	**66**	**17**	2,440	31,557	36,000	**100**	**100**	0	0	2,440	31,557
Plerogyra sinuosa	15	0	**33**	**0**	45	1	(* 31,500)	**47**	**33**	50	2	95	3
Plerogyra spp.	4,330	3,348	**18**	**53**	23,853	6,263		**100**	**100**	35	0	23,888	6,263
Scolymia lacera	0	0	**0**	**0**	65	0	no quota	**100**	**0**	0	4	65	4
Scolymia vitiensis	193	501	**59**	**15**	327	3,349	no quota	**87**	**100**	50	0	377	3,349
Scolymia spp.	203	0	**9**	**0**	2,280	9		**70**	**33**	962	18	3,242	27
Trachyphyllia geoffroyi	2,246	9,440	**54**	**12**	4,124	81,287	83,700	**98**	**100**	87	0	4,211	81,287
Trachyphyllia spp.	4,509	2	**10**	**1**	43,260	238		**99**	**94**	656	15	43,916	254
Grand totals	33,626	50,235	**17**	**15**	194,311	339,657	350,640	**92**	**96**	17,816	12,626	212,127	352,279

Source: **WCMC, 2001; CITES Notification to the Parties 1999/47**

Figure 1. Three Genera of Corals from Indonesia: Export Quotas compared with reported Imports and Exports of pieces of live corals (CITES Annual Reports, including "LIV", "COR" and "CAR" specimens)



Source:
CITES Annual Reports and Notification to the Parties, 980, 1998/07, 1999/47, 2000/053-061 and 2001/019

The importance of supplies from Indonesia, trends from 1997 – 1999

In 1999, Indonesia supplied about 95% of the world trade in these genera, 350,640 from Indonesia of a total of 363,270 pieces (based on exports reported by CITES Parties) (Table 1). For *Blastomussa merleti*, *Catalaphyllia jardinei*, *Cynarina lacrymalis*, *Euphyllia ancora*, *E. cristata*, *E. divisa*, *E. glabrescens*, *Hydnophora exesa*, *H. microconos* and *Trachyphyllia geoffroyi*, Indonesia was the only country from where exports were reported at species level. These species are probably also traded by other range States under the name of the genus. However, only for two genera *Euphyllia* spp. (11,952 pc.) and *Hydnophora* spp. (2,574 pc.), exports of more than 1000 pc. have been reported.

The role of the EU in 1999 and the effectiveness of the trade suspension for Catalaphyllia jardinei

According to AKKII exports data for 2000 (ANNEX I, Table 2), the USA imported about 64% of Indonesian coral exports, EU Member States about 18% (two largest importers: France and Germany) and Japan 11%. In 1999, imports in the EU represented more than 50% of the trade in live corals from Indonesia for seven of the 13 species of concern that were recorded in trade, based on Indonesian exports report. The highest share concerned *Cynarina lacrymalis*, 81% were shipped to the EU, and for the two species of *Hydnophora*, 95% (Table 1, WCMC 2001).

Although the EU import suspension for *Catalaphyllia jardinei* from Indonesia was adopted in September 1998, in 1999 EU Member States still reported imports of this genera for a total of 3480 pc of live coral, of which 1094 pc. of *C. jardinei* specifically (Table 1). However, import permits are valid for six months, these hipments may therefore have been allowed before the suspension was adopted. 2000 trade data of will show without doubt if the trade has been implemented efficiently by European Member States.

Trends and Compliance with Indonesian export quotas set from 1997 – 1999

The total export quota for the seven genera most involved in Indonesia live coral trade has increased from 1997 to 1999, decreased by 16% in 2000 and raised again to 307,250 pc. for 2001 (Table 2). From 1998 to 1999, reports by importing Parties indicate a decrease of 17% of imports of these genera from Indonesia. However, trends from 1997 to 1999 described on a genus by genus basis indicates that, reported exports of *Blastomussa* spp. doubled (3,650 pc. to 6788 pc.), for *Trachyphyllia* spp. they increased by 37% and for *Cynarina* spp. they were multiplied by six (from 1,345 pc. to 8,217 pc.).

Drastic changes in Indonesian export quotas are noticeable from one year to the next, mainly the shift of the total quota from one species to another. For example, 36,000 pc. was set as export quota for *P. simplex* in 1999, while no quota was set for *P. simuosa* , but in 2000 and 2001, quotas were set at 31,500 pc. to 36,000 pc. for the latter and no quota set for the first.

In 1998, Indonesian reported exports of live specimens exceeded the export quotas for three of the seven genera of concern: by 1% for *Hydnophora* spp. (15,414 compared to 15,300 pc. allocated), by 34% for *Plerogyra* spp. (60,426 instead of 45,000 pc. set as quota) and by 4% for *Trachyphyllia* spp. (75,225 instead of the 72,000 pc.).

Table 2. 1999 Indonesian quotas and exports of corals of eight genera of concern (Number of pieces of live coral)

	1997				1998				1999				2000	2001
	Quota	% Exported	CITES Trade Exporter	Importer	Quota	% Exported	CITES Trade Exporter	Importer	Quota	% Exported	CITES Trade Exporter	Importer	Quota	Quota
B. merleti									8,100	**84**	6,775	453		
B. wellsi											0	0	7,200	6,000
Blastomussa spp.	8,100	**45**	3,653	3,646	8,550	**90**	7,653	3,783			13	2,341		
Total *Blastomussa*										**84**	6,788	2,794		
Catalaphyllia jardinei				63				3	67,500	**89**	60,152	2,976	58,500	56,000
Catalaphyllia spp.	83,250	**59**	49,104	57,011	89,775	**98**	87,647	54,616			247	34,276		
Total *Catalaphyllia*										**89**	60,399	37,252		
Cynarina lacrymalis				60				29	9,900	**83**	8,202	647	9,000	10,000
Cynarina spp.	7,200	**19**	1,345	3,088	7,200	**99**	7,116	4,436			15	3,396		
Total *Cynarina*										**83**	8,217	4,043		
E. ancora				220							8,202	200	36,000	40,000
E. cristata				78			7	50	no quota		7	0		
E. divisa			3						72,000	**93**	66,769	3,622		
E. glabrescens				14					54,000	**92**	49,459	3,980	36,000	40,000
Euphyllia spp.	110,250		55,817	75,708	124,200	**93**	115,608	76,311			526	58,195		
Total *Euphyllia*									126,000	**93**	116,754	65,997		
Hydnophora exesa								16	10,890	**86**	9,378	1,879	11,250	11,250
Hydnophora microconos									4,050	**79**	3,195	523	4,500	4,500
Hydnophora rigida									4,500	**89**	3,991	442	4,500	4,500
Hydnophora spp.	15,750	**47**	7,430	8,613	15,300	**101**	15,414	7,284			18	4,691		
Total *Hydnophora*									19,440	**85**	16,582	7,535		
Plerogyra simplex									36,000	**6**	2,185	31,557		
Plerogyra sinuosa			2	20			3				45	0	31,500	36,000
Plerogyra turbida (*discus*)											0	0	16,200	15,000
Plerogyra spp.	51,300	**77**	39,512	42,830	45,000	**134**	60,426	42,247			23,853	6,263		
Total *Plerogyra*										**72**	26,083	37,820		
Scolymia lacera									no quota		3,349	327		
Scolymia vitiensis									no quota		10	2,280	3,600	4,000
Scolymia spp.								18			0	0		
T. geoffroyi			3	469				77	83,700	**97**	81,287	3,808	76,500	80,000
Trachyphyllia spp.	70,650	**73**	51,592	52,052	72,000	**104**	75,225	53,728			238	42,903		
Total *Trachyphyllia*										**97**	81,525	46,711		
Grand total	346,500	**60**	208,461	243,872	362,025	**102**	369,099	242,598	350,640	**90**	316,348	202,152	294,750	307,250

Source: **WCMC, 2001; CITES Notification to the Parties on Annual Export Quotas (Anon. 1997 to 2001).**

Table 3. CITES and traders reports on 1999 Indonesian coral exports for eight genera of concern (Number of pieces of live coral)

	1997					1998					1999					2000		
	Quota	% Exported	Exports CITES	% Exp.	AKKII	Quota	% Exported	Exports CITES	% Exp.	AKKII	Quota	% Exported	Exports CITES	% Exp.	AKKII	Quota	Exports % Exported	AKKII
B. merleti											8,100	**84**	6,775					
B. wellsi													0			7,200		
Blastomussa spp.	8,100	**45**	3,653	**30**	2,445	8,550	**90**	7,653	**38**	3,275			13	**62**	4,982		**64**	4,604
Total *Blastomussa*												**84**	6,788					
Catalaphyllia jardinei				**58**	47,880				**45**	40,263	67,500	**89**	60,152	**70**	47,033	58,500	**78**	45,689
Catalaphyllia spp.	83,250	**59**	49,104			89,775	**98**	87,647					247					
Total *Catalaphyllia*												**89**	60,399					
Cynarina lacrymalis				**60**	4,335				**44**	3,186	9,900	**83**	8,202	**59**	5,864	9,000	**81**	7,283
Cynarina spp.	7,200	**19**	1,345			7,200	**99**	7,116					15					
Total *Cynarina*												**83**	8,217					
E. ancora													8,202			36,000		
E. divisa			3								72,000	**93**	66,769					
E. glabrescens											54,000	**92**	49,459			36,000		
Euphyllia spp.	110,250		55,817	**58**	64,344	124,200	**93**	115,608	**51**	63,523	126,000		526	**72**	90,972	72,000	**75**	53,728
Total *Euphyllia*											252,000	**46**	116,754					
Hydnophora exesa											10,890	**86**	9,378			11,250		
Hydnophora microconos											4,050	**79**	3,195			4,500		
Hydnophora rigida											4,500	**89**	3,991			4,500		
Hydnophora spp.	15,750	**47**	7,430	**46**	7,231	15,300	**101**	15,414	**36**	5,531	19,440		18	**62**	11,968	20,250	**78**	15,822
Total *Hydnophora*											38,880	**43**	16,582					
Plerogyra simplex											36,000	**6**	2,185					
Plerogyra sinuosa			2										45			31,500		
Plerogyra turbida (*discus*)													0			16,200		
Plerogyra spp.	51,300	**77**	39,512	**56**	28,638	45,000	**134**	60,426	**54**	24,140		**66**	23,853	**66**	23,593	47,700	**13**	5,963
Total *Plerogyra*												**72**	26,083					
Scolymia vitiensis											no quota		10			3,600		?
T. geoffroyi			3	**56**	39,742					37,728	83,700	**97**	81,287	**70**	58,314	76,500	**80**	61,293
Trachyphyllia spp.	70,650	**73**	51,592			72,000	**104**	75,225					238					
Wellsophyllia radiata					6,676					3,856			0		3,430			3,452
Total *Trachyphyllia*				**66**	46,418				**58**	41,584		**97**	81,525	**35**	61,744	76,500	**85**	64,745
Grand totals	346,500	**53**	208,461	**54**	201,291	362,025	**103**	369,096	**47**	181,502	350,640	**90**	316,348	**62**	246,156	294,750	**69**	197,834

Source: **AKKII (Association of exporters) 2001; WCMC 2001; CITES Notification to the Parties on annual Export Quotas (Anon. 1997 to 2001).**

Comparison of trade data reported to CITES and recorded by AKKII

The difference between exports reported by the Indonesian CITES Management Authority and AKKII was particularly significant in 1998 and 1999. The official figures were 50% and 37% higher than the export figures recorded by the traders (Table 3). Based on the latter, only half of the export quotas set for 1998 were actually exported that year instead of the apparent excess suggested by data reported in the Indonesian Annual Report.

Literature search

No scientific work describing in-depth research on the biological characteristics of the species of concern was found in the literature. The current lack of scientific knowledge on the species identified has been confirmed by experts from Australia, the USA and most range States involved in live coral export in the Asia-Pacific region, i.e. Fiji, Solomon Islands, Tonga, Vanuatu and Vietnam, that have emerged as new exporters in recent years (ref. papers distributed at the International Workshop on Trade in Stony Corals (NOAA), Jakarta, 9-12 April 2001). Some scientists recognised that they dispose of personal observations made in the field while studying other species, but have not had the opportunity to develop specific work on the subject to set the bases for a publication (Hoeksema, pers. comm. to TRAFFIC Europe, June 2001). The main reason for the absence of scientific publications on the species subject to the EU import suspension is the depth at which they most commonly occur. In Australia, where the research on the Great Barrier Reef is considered to be among the world most comprehensive, the maximum allowable depth for diving is about 60 feet (20 m). This limit, set for security reasons, prevents scientists from surveying sites such as the largest patches of *Nemenzophyllia turbida* (*P. discus* or *P. turbida*) observed in the Spermonde Archipelago, located at 30 – 35 m depth.

In Indonesia, a great deal of information (published and unpublished, ANNEX I: References and Appendix A) has been accumulated by scientists and non-scientists (e.g. traders, collectors), but most of it is not available in English and no standardised protocole was used when collecting data.

Field surveys on coral reefs in Indonesia

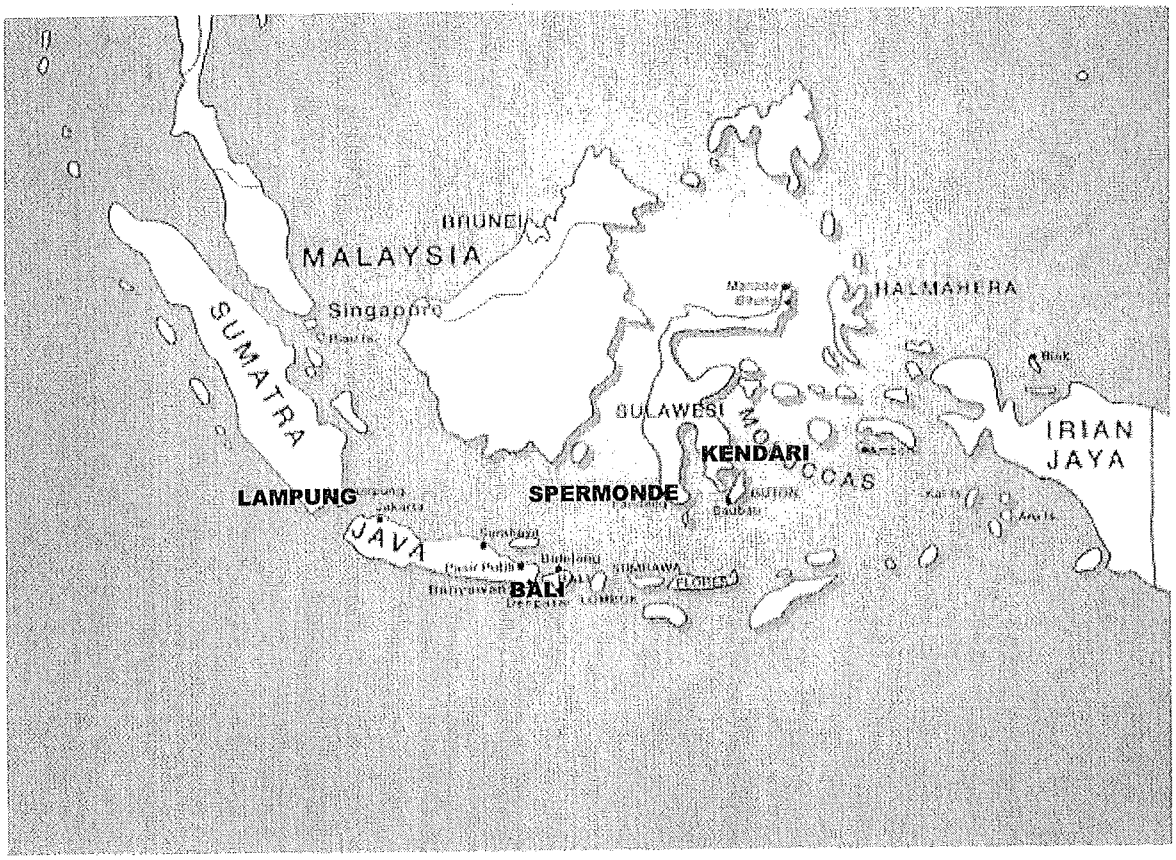
The diversity of corals on each field site is reported for each site (ANNEX I: Appendix D). Not all sites were surveyed under the current project, but additional information has been gathered from interviews with Indonesian scientists, traders and collectors. The extent of occurrence of each species of interest on collection sites contributes to a better knowledge of the distribution of the species in Indonesia.

List of field sites

Four sites were selected for the surveys to be carried out in the context of this project:
1. the Spermonde Archipelago, South Sulawesi (offshore Ujung Pandang)(ANNEX II)
2. Kendari, Southeast Sulawesi
3. Lampung, South Sumatra
4. Rembang, Central Java

These locations are coral collection sites from where most live specimens exported from Indonesia are harvested. In addition, information on species observed on other sites was compiled using interviews with traders and collectors (ANNEX I, Appendix A).

Figure 2. Map of Indonesia with survey areas



Methodology

At a international workshop on trade in stony corals (ANNEX II, page 4, Tables 4, 6 and 7), experts that were asked to develop a monitoring protocol to assess the status of a species in the wild in a vast country such as Indonesia came-up with the following tentative protocol:
- Select a representative collection site,
- Identify the different types of habitat, e.g. reef slopes, soft and sandy bottom, seagrass beds, and estimate the total area for each type,
- Measure the abundance of each species in each habitat, e.g. using line transects at different depth,
- Investigate the market needs, e.g. marketable size of specimens,

- Measure coral colonies to assess the availability of target specimens (size composition of the population and, at a later stage, the growth and recruitment rates of the species will also be assessed based on the data collected on colonies size),
- Extrapolate the population recorded during the underwater surveys, using the abundance of the species on the transects and taking into account the total surface covered by each type of habitat, to estimate the population of the species on the entire area of the site collection, e.g. the Spermonde Archipelago, and then to the province, e.g. South Sulawesi,
- Compare the estimated population to the collection quota set for the species in the province to assess if the level of harvest could put the wild population under pressure (ANNEX II: Table 7).

Literature on the distribution of the species throughout Indonesia is needed to project the estimated population of a species in one area of reefs to the reefs in the whole country (ANNEX I: Appendix A).

Observations made in the field

Biology of the relevant taxa

(see Table 4 hereunder, an overview of surveys findings and results of bibliographical research detailed in ANNEXES I (p. 19-23) and II (p. 12-15 + Table 4 and 7)).

Abundance:

Of the 18 species, the one that were least encountered were, in decreasing order of scarcity,

- *Cynarina lacrymalis*, could be considered extremely rare since only 8 individuals were observed during the 15 dives performed in the Spermonde Archipelago and 5 on all other three locations surveyed.
- On the Spermonde Archipelago, the density of *Euphyllia cristata* was estimated at 1 colony/100m^2 and it has not been recorded on other sites (probably due to lack of attention paid to the species).
- Observations on *Catalaphyllia jardinei* suggest that the species tends to occur in the same "patchy" distribution pattern describe below (178 colonies/100m^2: ANNEX I, p. 19 –surveys in Bolewang, Central Sulawesi, north of Kendari) as *Nemenzophyllia turbida* (ANNEX II, p. 13). This would explain why it was recorded in extremely low densities in the Spermonde Archipelago where no patch was found in spite of repeated exploration. However, the patch observed in Bolewang has never been exploited while Spermonde reefs have long been used as collection sites for live coral trade (member of AKKII pers. comm. April 2001).
- *Blastomussa wellsi* occurs in Indonesia (in contradiction with the statement of some experts) but in very low densities, 5 colonies/100m^2, while *Blastomussa merleti* was not observed in the wild and only in one holding facility.
- *Trachyphyllia geoffroyi* has very different morphological appearances of which only a couple interest the aquarium industry, the dark red and green morph (ANNEX I, p. 21 and ANNEX II, p. 13). While, the species is quite abundant on certain sites (e.g. 45 colonies/100m^2) the morph in demand was observed in low abundance at very few sites, mostly in deeper waters (30 m).
- On the reef slopes of the Spermonde Archipelago, *Hydnophora* spp. occurred at a density of 10 colonies/100m^2.

Recruitment:

No information could be found in the literature and the duration of the project (six months) did not allow to undertake experiment on this aspect. However, there is no information on the impact of selective collection practices, e.g. for certain species limited to specimens >5cm and <20cm, and the way they could influence the natural recruitment rate of targeted coral populations. Hydrology (marine currents) in the Java Sea and other seas should also be studied to understand the interaction between sites, areas and reefs.

Taxonomy:

Due to their unclear taxonomy, Indonesia export quotas for *Nemenzophyllia turbida* are usually put under *Plerogyra turbida* (or *discus*?) and for *Wellsophyllia radiata* under *Trachyphyllia geoffroyi*. However, during interviews collectors and traders (exporters and importers) confirmed that they can differentiate the four species without doubt.

Table 4. April-May 2001 survey findings and bibliographical sources: P3O-LIPI (ANNEX I (GL) text and App. A and D) and NOAA (ANNEX II (AB), Table 4 and 7)

Species	Ref. (**)	Province	Site	Water	Depth (m)	Market Size Ø (cm)	Wild Size Ø (cm)	Density colonies/100m^2	% Harvest (*)(**)	Remarks
Blastomussa spp.	in GL	South Sumatra	Lampung				10 - 20	20 colon./15 min.		Following a collector with a hookah
B. wellsi	in GL	South Sumatra	Lampung	Turbid	27					
B. wellsi	AB	South Sulawesi	Spermonde	Reef	15	4 - 6	2 - 5	5	31	One colony observed at 20 m
Catalaphyllia jardinei	in GL	Central Sulawesi	Bolewang	Soft	1 - 1.5		< 50 & > 50	178 & 132 respect.		Only 10 - 25 cm colonies are collected
	in GL	West Nusa Tenggara	Komodo & Rinca	bottom						
	in GL	South Sulawesi	Taka Bone Rate	& Turbid						Note: collected on each site
	AB	South Sulawesi	Spermonde			7 - 10.6				until no marketable
	in GL	Mollucas	Ambon							colonies can be found.
	in GL	West Nusa Tenggara	Lombok							
	AB	South Sulawesi	Spermonde	Turbid	3 - 6			5	96.2	
Cynarina lacrymalis	in GL	South Sumatra	Lampung	Sandy	12 - 25			Only 13 colonies		Similar to *Scolymia vitiensis*
	in GL	Southeast Sulawesi	Kendari	bottom				were observed		Reported by collectors
	in GL	West Java	Jakarta Bay					in total		in Lombok.
	in GL	Central Java	Rembang							
	AB	South Sulawesi	Spermonde	Sandy	15 & 30	4.7 - 6.7		0 - 10	2.2	
Euphyllia spp.	in GL	South Sulawesi	Spermonde	Reef slope			< 50 - > 50	90 - 20		
E. cristata	in GL	South Sulawesi	Spermonde	& Turbid				0 - 1		Widest range of collection:
E. ancora & *E. glabrescens*		West Java	Rembang		5		< 50	63		from Sibolga (North Sumatra,
	in GL						> 50	33		Indian Ocean)
E. ancora	AB	South Sulawesi	Spermonde			10.4 - 13.6		10 - 20	0.9	to Kupang (West Timor,
E. glabrescens	AB	South Sulawesi	Spermonde			7.7 - 8.6		3 - 9	0.9	Sawu Sea)
E. divisa	AB	South Sulawesi	Spermonde	Soft bottom (30 m)		7.4 - 8		0 - 17	?	
Hydnophora spp.	AB	South Sulawesi	Spermonde	Fringing reef	5 - 25	18		10	2.8	*Hydnophora exesa* & *H. microconos*
Nemenzophyllia turbida	AB	South Sulawesi	Spermonde	Soft bottom	30	15.6 - 21		220 - 790	0.4	Synonym = *Plerogyra turbida* or *P. discus*
Plerogyra spp.	in GL	South Sumatra	Lampung	Reef slope	12	5 - 10	< 50	33	4.2	Wide collection range
	AB	South Sulawesi	Spermonde		5 - 20	9.2 - 10		8 - 19		
Trachyphyllia geoffroyi	in GL	South Sumatra	Lampung	Sandy	18 - 20		< 50	45	1.9	Synonym =
	AB	South Sulawesi	Spermonde	bottom	30 - 40	6.1 - 6.7		10		*Wellsophyllia radiata*
	AB	South Sulawesi	Spermonde		1 - 4			28		

(* % of estimated coral population of the species in South Sulawesi that should be harvested in 2001 to reach the quota set for the province: based on Spermonde Isl. surveys)

(** Andy Bruckner, NOAA (National Oceanic and Athmospheric Administration, USA), *in litt.*, to TRAFFIC Europe, June 2001)

(Taxonomy: continued)
They are sold as separate "products" and are therefore mentioned independently in the list of species of traders' airway bills (invoice to the client).
Similar to the rarest species identified, *Cynarina lacrymalis*, is *Scolymia vitiensis* which seems to be as rare. During the period 1997 to 1999, *Scolymia vitiensis* first appeared in trade in 1999 (2280 pc. reported by importing Parties, but only 10 pc. reported by Indonesia) and the first quotas were established for 2000 (3,600 pc.) and 2001 (4000 pc.).

Collection practices

1. Selective collection: apparently the method used to extracted the specimens cause little damage to the neighbouring colonies or even to the colony from which the specimen is extracted, e.g. *Euphyllia* spp.) (see ANNEX I (page 16) and ANNEX II (page 9)).
2. Depletion of a specific range of the population: the market is, among other factors, size driven. The demanded size of the colony will therefore be rapidly depleted on collection sites. It seems that, for most species, the range of market sizes is rather small. If not properly monitored and managed, the collection could therefore impact the entire young (probably pre-adult; ANNEX II, page 19) generation and, in the long term, eventually affect the regeneration of the population.
3. Side activity: for a certain number of coral collectors, this activity is only a secondary one while diving for the principal target, sea cucumbers "teripang". Typically, in a remote area, destination of several day trip, when sea cucumber collectors encounter a good coral site, on the day of return (corals can not be kept alive for more than a day), they harvest as many specimens as they can to round-up their income. But the main purpose of their underwater fishing operation is "teripang" and not live coral collection. Prices speak from themselves: the value of one sea cucumber can reach IDR 250,000 (USD 25) while the highest price paid to the collector for a piece of live coral is IDR 50,000 (USD 5) (collector at CV Dinar holding facility (Barang Lompo Island, Spermonde, South Sulawesi) pers. comm. to TRAFFIC Europe, April 2001).
4. Mortality after collection and before export (see ANNEX I, page 14 and ANNEX II) is rather low along the chain of custody of the official traders, i.e. AKKII (Appendix B in ANNEX I). However, little is known about the collection happening outside the organised framework of the Association and preliminary investigation suggest that significant quantities of live corals maybe harvested by "side channels" that also supply AKKII members (see point 3 above).

Market characteristics

The demand is very specific, with clear preferences for certain morphs, shapes, colours and size (as mentioned above)(ANNNEX I, page 21). This very focussed demand may potentially lead to localised extinction of certain population that comply with the market criteria.
Domestic market: Existence of a domestic market that seems to be increasing for corals, but decreasing for ornamental fish. Visits undertaken in March 1998 and April 2001 suggest that the availability of ornamental reef fish has dramatically decreased and that the retailers are compensating with the promotion of sales in live stony corals.
Observations on the domestic market:
Barito market (Jakarta, 24 April 2001): a standard size aquarium (1.5 x 0.5 x 7.5 m) with coral and fish costs IDR 400,000 (less than USD 40); the monthly service to clean, feed and replace dead fish or corals is charged at IDR 200,000/month (less than USD 20). Example of prices for individual products: IDR 7500 (USD 0.75) for a clown fish and IDR 3000 (USD 0.30) for one colony of *Trachyphyllia* spp.

CONCLUSIONS AND RECOMMENDATIONS

The challenge of the study was the high number of taxa involved, 7 genera including 18 species in total (Veron 2000), and the current status of scientific knowledge on their biology, almost "nil". Given the restricted timeframe of the project (about six months), the number of sites visited and the time spent on each of them was limited. In addition, a wide range of experts confirmed the current lack of scientific knowledge on the species identified by the scientific authorities of the 15 EU Members States. The outcome of the project should therefore not be considered final, current results will need to be verified and conclusions and recommendations regularly revisited to progressively adjust them to new findings.

The consequence of the SRG negative opinion, i.e. EU suspension of imports of 18 species (Veron 2000 or Cairns 1999) of corals from Indonesia, had great effect in the region. It attracted significant attention of officials and of the private sector (AKKII) in Indonesia. It also raised the interest of other range States, such as Fiji, that do not currently establish export quotas for corals. An immediate positive spin-off is the fact that authorities of major exporting countries have received additional information to strengthen their awareness on the fact that all species of coral cannot be treated identically. Particularly the fact that, due to their biology, the level of collection to supply the international market for certain taxa may be detrimental to the species in the wild.

For the 18 species, exports represented 60%, 102% and 90% of the quotas set for 1997, 1998 and 1999 respectively. The sharpest increase in effective exports was reflected for *Cynarina lacrymalis*, for which exports only reached 19% of the export quota set for 1997, while they reached 99% and 83% in 1998 and 1999 respectively.

Based on the estimated abundance, the estimated distribution (availability of preferred habitat), the observed distribution pattern (e.g. patches), the level of Indonesian export quotas and annual volumes as well as trends of exports, the other 15 species have been categorised as follows,

1. Most threatened species due to
   a) their scarcity, i.e. estimated abundance < 20 colonies/100 m^2
   b) a high export quota , > 10% of the estimated population
      - *Blastomussa wellsi / B. merleti*,
      - *Catalaphyllia jardinei*,
      - *Cynarina lacrymalis*,
      - *Euphyllia cristata*,

For these five species, it is considered that export quotas are too high and that imports should not be permitted as long as the necessary scientific work has been done to assess the population status of these species in areas where they are collected and that a proper management is designed.

2. Threaten in a lesser extent with
   a) low estimated abundance 20–50 colonies/100 m^2
   b) high export quota, 1–10% of the estimated population
      - *Hydnophora exesa*,
      - *H. microconos*,
      - *Plerogyra* spp. (including *Nemenzophyllia turbida* synonym of *P. discus* or *P. turbida*)
      - *Trachyphyllia geoffroyi* (including its synonym *Wellsophyllia radiata*),

It is strongly advised that export quotas for these six species are significantly reduced until scientific evidence is collected indicating that the level of trade is not detrimental to species and measures are taken for adequate monitoring of the collection.

Based on the current knowledge *Euphyllia ancora* and *E. glabrescens*, seem to be exploited at level that are probably not detrimental to the species. Regarding *E. divisa*, not enough information could be collected to draw a clear conclusion.

The distribution pattern of certain species such as *Catalaphyllia jardinei*, *Nemenzophyllia turbida* and in some cases *Trachyphyllia geoffroyi*, was also taken into consideration as factor representing an increasing risk of possible overexploitation.

The criteria listed above (see 1. and 2.) are preliminary parameters that appeared critical to a sound management of the coral collection. The classification under 1. or 2. is based on the combination of these parameters (e.g. ranges of abundance chosen can not be dissociated from percentages of estimated population represented by the quota). These parameters are not final, they are proposed and should be revised and adjusted as more information and data analysis are provided by Indonesian scientific authorities (e.g. using data collected during the present project as well as under the country wide project on coral monitoring and mapping ("CORMAP") currently implemented in Indonesia) as well as other countries.

The trade suspension adopted for *Catalaphyllia jardinei* in September 1998 was not efficiently enforced since EU Member States reported a total of 3480 pc of live coral imports for the genera in 1999, including 1094 pc. of *C. jardinei*, which represents about 35% of 1997 imports (10,000 pc.). It is recommended that information is transferred to the relevant services and that all measures are taken to implement the suspension as efficiently as possible.

One of the main difficulties encountered to enforce trade control for corals, is the identification at species level by customs, particularly at the importing end. But the lack of clarity on the exact number of species and the name of each species referring to the various sources of literature has added to the problem. A clear list of species, including all taxonomic names of species of coral subjected to the EU trade suspension and their synonyms that are recognised by both Veron and Cairns, should be provided in order to limit room for interpretation that may be used to justify the import of taxa of concern.

Among coral species that have not been identified by the SRG, *Scolymia vitiensis*, a species that is not easy to distinguish from *Cynarina lacrymalis*, first appeared in trade in 1999 and could probably benefit of a closer look by SRG members on the first export quotas set in 2000 (3600 pc) and 2001 (4000 pc), such as a first assessment of their level compared to the biology of the species, using available scientific publications.

Scientists from various horizons recognised that scientific publications on the biology of those species most targeted by the trade in live corals are not available internationally and probably also not locally. It is necessary to undertake research projects and promote worldwide publication of their result. For instance additional surveys and experiments in vitro would lead to a better assessment of

a. The standing crop in the areas of collection,
b. The current distribution using the compilation of records of occurrence (prepared during the current study) and the knowledge on Indonesian marine habitats (existing atlas that was update in the mid 1990s),
c. The average size at first reproduction (most specimens collected are at probably pre-reproductive stage)
d. The recruitment rate of the various species, including a study on local hydrological factors (e.g. current that transport the coral larvae) responsible for the interactions between reefs, and
e. The growth rate of the various species.

Besides international trade control measures and scientific work, collection monitoring and control measures should be initiated to set-up a management of the resource on collection sites per species. For instance: "No take zones" (e.g. *Nemenzophyllia turbida* and *Catalaphyllia jardinei* patches that could be over-exploited). A plan of action for a better management of the collection of live corals, using legislation and structures that currently exist in Indonesia, is proposed in ANNEX I (page 27 to end) and complementary specific measures are described in ANNEX II (page 17 to end).

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A REVIEW OF INDONESIAN CORALS IN TRADE WITH REFERENCE TO THEIR TRADE, POPULATION STATUS, AND DISTRIBUTION IN INDONESIA

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A REVIEW OF INDONESIAN CORALS IN TRADE WITH REFERENCE TO THEIR TRADE, POPULATION STATUS, AND DISTRIBUTION IN INDONESIA

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A REVIEW OF INDONESIAN CORALS IN TRADE WITH REFERENCE TO THEIR TRADE, POPULATION STATUS, AND DISTRIBUTION IN INDONESIA

EXECUTIVE SUMMARY

Indonesia has become the major exporting country of live corals in the last 10 years. The trade itself started back in the 1960s, where there were only a handful of coral exporters in Indonesia. Nowadays the exporters have formed an Association called AKKII (Asosiasi Koral, Kerang dan Ikan hias Indonesia), the Association of coral, shell and ornamental fish exporters of Indonesia, with 16 members who export live corals. The coral trade in Indonesia involves a long chain of sellers and buyers. Live corals are collected by thousands of coastal villagers, and the trade provides them with a source of income. Middlemen and exporters are the people who gain most from this industry, while the collectors, who are lowest in the trade chain, receive the least benefit.

Since 1997, The Indonesian government has set up quotas at genus level for allowable catches every year. No other major live coral-exporting countries have yet established quotas for coral collection and export. Furthermore, also in 1997, a document on the pattern of coral reef utilization was developed (Anon, 1998). These steps can be considered as a laudable attempt by the government to somehow manage and control the trade. However, there has been very little implementation of the regulations, and questions were raised by CITES authorities and the Scientific Review Group (SRG) of the European Union (EU), because they were not satisfied with the basis on which the Indonesian quotas had been established.

More specifically, concerns were raised that the quotas for some coral species were too high, and that, when establishing the quotas, insufficient consideration was given to factors such as growth and recruitment rates, distribution, and abundance of the species concerned. The available field data were not sufficient to give reliable estimates of population densities. On what basis, then, were these quotas actually being established?

The EU suspension on imports of live corals from Indonesia first applied to *Catalaphyllia jardinei* only (Anon. 1999a). It came into effect in September 1999, but later in the year, it was also applied to six or seven other species coral (*Blastomussa merleti*, *Cynarina lacrymalis*, *Euphyllia divisa*, *E. glabrescens*, *Plerogrya simplex* and *Trachyphyllia geoffroyi* (including its synonym *Wellsophyllia radiata*)). In June 2000, the EU import suspension was extended to 11 or 13 additional species (the whole genus of *Euphyllia* spp., *Hydnophora exesa*, *H. microconos* and the whole genus of *Plerogyra* spp. (including *Nemenzophyllia turbida* considered synonym of *P. divisa* or *P. turbida*)(ref. Notification to the Parties of the CITES Secretariat since 1999). These trade restrictions have initiated this study on the international trade in corals from Indonesia. It includes field assessments of populations of the species concerned at the collection sites, open-ended interviews with the players involved along the trade chain, and the compilation of as much data and information related to trade as possible.

For the seven or nine genera concerned the negative opinion of the SRG of the 15 Member States of the EU was based on the high level of export quotas established for 1998 by Indonesian authorities. It was feared that these quotas could be detrimental to the species in the wild. Furthermore, there is a lack of biological and ecological information regarding these species. It is assumed that most of these species are uncommon, and have limited distribution in Indonesia (Anon, 1998; 1999).

As a result of surveys conducted by the Research and Development Centre of Oceanology of Indonesia (P3O-LIPI) and others, a body of information exists concerning the distribution of traded Indonesian corals from throughout the archipelago. However, for some reason, these data have never been properly analyzed, and this information has so far not been published. It is recommended that the publication of this information is facilitated and supported.

The information gathered in this study has made us aware of how very limited our knowledge of the biology and ecology of stony corals in Indonesia actually is. On the other hand, the coral collectors possess a detailed knowledge of the stony corals they collect, including their distribution, habitat specifications and preferences, and variations within species. For instance, the collectors have been collecting *Blastomussa wellsi* in

Lampung Bay (South Sumatera) for years, and yet scientists have stated that this species does not occur in Indonesian waters (Anon. 1999b).

Some of the species or genera concerned have quite specific habitat requirements. *Catalaphyllia jardinei* is found as the dominant species in extremely clear shallow water (1-1.5 m) in sea grass beds with a sandy substrate in Bolewang Reefs, Central Sulawesi. The population density of this species in these areas was estimated to be 310 specimens per 100 m².

In contrast, in Lampung Bay, the same species of *Catalaphyllia* was found near the mouths of rivers, in deeper and turbid water with a muddy substrate. Therefore, remarkably, this species was found in two specific, but very different habitats.
The findings can be summarized as follows (S=small, M=medium, L=large):

Table 1. List of species/genera suspended by the EU with some of the ecological aspects.

Taxa	Live Identification	Abundance	Depth *	Substrate
Catalaphyllia jardinei (S,M,L)	Easy	Total covered across the substrate (310 colonies per 100m²)	Deep and shallow water	Soft, muddy, in deep water, and coarse sand in seagrass beds
Trachyphyllia geoffroyi (S,M.L)	Easy	Dispersed across the substrate with approximately 30 – 50 cm between colonies (45 colonies per 100m²)	Deep water, turbid	Coarse sands
Blastomussa wellsi (S)	Easy	Dispersed (20 specimens counted in 15 minutes diving following collector)	Deep water, turbid	Dead corals
Euphyllia spp. (S,M,L)	Difficult	Dispersed, Clumped, and total cover in some areas (90 colonies per 100 m²)	Shallow to deep water	Varied, soft muddy, sandy, rubble
Plerogyra simplex (S,M)	Easy	Dispersed across the substrate with approximately 50 – 100 cm between colonies (33 colonies per 100 m²)	Deep water	Dead corals
Cynarina lacrymalis (S)	Easy	Widely dispersed	Deep water	Dead corals

* "Deep" = > 20 m (about 6 feet, 6 inches)

From the field observations, new information was gathered on the ecology and biology of the species concerned. The author is aware that his information might be interpreted to mean that some of these species are sufficiently abundant to justify a lifting of the trade restrictions. However, it is important to note that this study only covered a small fraction of the total collection areas, and that further long-term surveys are needed to confirm the validity of this initial data.

Furthermore, it is difficult to estimate population density per km², because some of the species concerned have a clumped distribution pattern in specific habitats, which may not extend to a very large area.

A list of collection areas, recording the species collected from each area, was also made available to the author by the exporters and collectors. Information on the collection areas, collecting methods and handling and packaging were also recorded. This information is valuable for providing a clearer picture of the live coral trade in Indonesia.

A set of recommendations for action are included as the outputs of the study, including:

1. Establishment of an Indonesian Scientific Review Body to overview the live coral trade in particular, and other marine reef organisms in general. This Body can set research priorities, and deal with socio-economic issues related to the live coral trade, in order to support management initiatives that lead to sustainable use of the coral resources. The Body should be financed independently to guard its independence from specific interests, particularly the commercial sources. Therefore, funding is needed to establish the Body, from independent funding sources and the government budget.

2. Establishment of a reporting mechanism to produce a set of records, including
   a) accurate numbers of specimens collected from the wild in each collection area,
   b) an historical record of collecting patterns in collection areas, and mortality rates.
   These will provide essential data and information for management initiatives.

3. Improvement of collecting methods, holding, and transportation practices for live corals, through the development of a training programme specifically designed for this purpose.

4. Regulation of all segments in the trade chain, including licensing of collectors, and the adoption of a certification programme. The process of certification will enable the tracing of each specimen, the precise location and method of collection, and the methods of holding, handling, and transportation. The Marine Aquarium Council (MAC) certification process has been introduced in Indonesia, and the ongoing activities have been started.

5. Prior to the establishment of allowable quotas, conduct surveys on stock assessment, population studies of species in trade, and growth and recruitment trends in the collection areas. Stock assessment techniques have to be appropriate for use in the conditions where the species concerned live. Surveys of shallow water sites can be conducted using manta tow techniques to gather general information on coral abundance. Subsequently, transects can be used to gather more detailed information on population densities. Stock assessments for corals in deeper water can be recorded by measuring the amount of time needed to count the specimens, so that catch per unit effort can be calculated.

6. Promotion of marine conservation related to the marine aquarium trade to the general public, and produce awareness materials for various users such as hobbyists, exporters, middlemen, collectors, Government Agencies, and NGOs.

In view of the new information gained during this survey, which highlights our lack of knowledge about the actual distribution and population densities of these corals, it is questionable at this stage to say that we have sufficient evidence to make informed recommendations either way on whether we should retain or lift the import restrictions. On the other hand, the new information we do have might be considered a solid enough basis on which to allow limited trade, on the understanding that follow-up studies will be financed and carried out at the collection sites as soon as possible. In the opinion of the author, this latter course of action would be more constructive than continuing the trade ban. What is certain however is that if the ban is not lifted, the trade in these species will continue with export to other (non-EU) countries, but with no additional

management or monitoring. Allowing limited trade to the EU countries (on the condition that the trade is adequately monitored with regular independent reporting responsibilities built into the decision) would provide an opportunity for the development of best practices in the trade.

Whatever is decided, this suspension should act as an important lesson for all parties concerned. In the author's opinion, the trade has gone ahead for too long based on false assumptions, and has been fuelled more by short-term business interests than on hard, reliable data from the field. It is sincerely hoped that this study will contribute in some small way to a process that will eventually lead to a more rational, informed management of the live coral trade in Indonesia.

A REVIEW OF INDONESIAN CORALS IN TRADE WITH REFERENCE TO THEIR TRADE, POPULATION STATUS, AND DISTRIBUTION IN INDONESIA

INTRODUCTION

Indonesia has long been the major exporter country of live corals for trade. At time of writing, the total allowable annual harvest quota is 930,000 pieces of live corals. In the early 1970s, corals were collected by only a handful of exporters, within easy transport distance of Jakarta International Airport. These days, the industry employs thousands of coastal villagers as coral collectors throughout the archipelago..

The international markets are known to be the major targets for the Indonesian coral trade. The domestic market has never been considered as being significant, even though aquarium shops are found in almost every big city throughout Indonesia. Domestic buyers normally only wish to fill their marine aquaria with coral reef fishes, and only occasionally decorate their aquaria with live corals.

The trade of corals is regulated by the Convention on International Trade in Endangered Species (CITES), and in Indonesia, the Management control is administered under the Forestry Department and the Indonesian Institute of Sciences (LIPI).

Restrictions on the import of seven species of live corals from Indonesia to members of European Union (EU) countries came into effect in 1999. The EU's Scientific Review Group (EU-SRG) voiced concerns about the basis on which the quotas were established. The lack of information from the Indonesian Scientific Authority on population status, growth and recruitment rates, and the distribution of these seven species, was a further reason for these trade restrictions.

The sustainability of the harvest of these seven species (which were assumed to be rare, have restricted distribution, and unknown growth and recruitment rates) was questioned. Currently, trade quotas for these species are established using rates of coral reef accretion, coral growth rates, and total reef area. (Suharsono, unpublished report). The quotas given to these seven species from 1997 to 1998 were considered high compared to those of other species, and possible reasons for the high quotas were discussed. There is a concern that these species will disappear if trade continues at present rates.

This study aims to examine the current status of conservation management and trade of certain species of hard corals in Indonesia. Those species for which export quotas are believed to be too high, may become difficult to conserve in the future. This document includes recommendations for the future management and policies of trade in live corals in Indonesia.

GENERAL ISSUES CONCERNING CORAL REEFS IN INDONESIA

Indonesian coral reefs face serious threats throughout the archipelago. Human activities have directly or indirectly been the major cause of coral reef destruction. Coral blasting and coral mining cause the most widespread damage to the reefs, although other causes, such as destructive fishing practices and various coastal developments, also play a significant role in reef damage. One research study on reef degradation in Indonesia showed that land-based pollution causes the greatest threat to local coral species diversity (Edinger et al, 1999).

Another activity that may causes coral reef depletion is the collection of live coral specimens, although the extent to which collection damages the reef is insufficiently understood. The increased interest in marine aquaria, mostly in western countries, has generated a demand for the supply of live corals. The argument from the traders and hobbyists is that having reef organisms at home or visiting public marine aquaria will raise the profile of coral reef ecosystems, which in turn will help efforts to conserve these ecosystems.

An assessment study based on surveys of percentage of live coral cover from more than 40 coral reefs over a 10 - year period, showed that only 30 % of the total area of Indonesian coral reefs (85,707 km^2) remained in good condition (Suharsono, unpublished report). However, this figure has more recently been questioned, since most of the surveys were conducted a few years ago. Furthermore, coral reefs have been subjected to tremendous pressure in the last 10 years, and the 30% figure may no longer be valid.

A REVIEW OF INDONESIAN CORALS IN TRADE WITH REFERENCE
TO THEIR TRADE, POPULATION STATUS, AND DISTRIBUTION IN INDONESIA

Many summaries and data from the results of coral reef surveys have been accumulated over the last 10 years. These surveys were mainly conducted by P3O-LIPI, Jakarta, UNHAS, Makassar, and the National Museum of Natural History, Leiden (Moka and Yusuf, 1999; Manuputty, 1999; Manuputty and Budiyanto, 1999; Tuti and Budiyanto, 1999; Sutarna, 1989; P3O-LIPI, 1995; P3O-LIPI, 1995; Sutarna, 1987; Manuputty, 1998; Best *et al*, 1989; Moll, 1983; Suharsono, 1998). So far, around 400 species of stony corals (Scleractinia) from 74 genera have been recorded as from Indonesia. Distribution lists for species of special concern have also been published in several reports (Appendix A).

The Uses of Indonesian Corals for Various Purposes

Coral reefs have always been important marine resources for coastal communities in Indonesia. These communities depend on reef fishes as their sources of food and income. The magnificent structure, diversity and splendour of the coral reefs have attracted many marine industries to benefit from them. The value of coral reefs in areas with limited tourism activities has been estimated to be US$ 3,000/km^2, and for major tourism sites, the value is US$503,000/km^2 (Cesar, 1996).

Corals have been extracted in many places in Indonesia for many purposes over the years (Polunin, 1983). Massive coral boulders have been collected mainly for burning to produce lime, and to provide foundations for houses, or for use as construction materials. Major Government development projects, such as airport runways, harbors, and roads, have always used corals for their foundations. Small- to large-scale coral mining still continues throughout Indonesia. For coastal communities, corals are used as cheap building materials for their houses, breakwaters and dikes on eroding beaches, and for garden walls.

Coral Mining

Coral mining regulations are administered only at district level, and there are no national regulations that prohibit the mining of corals. The Government of Bali prohibited coral extraction in 1985. This was in response to the major extractions of corals from adjacent reefs surrounding Bali, which caused beach erosion along the coasts. In the early 1980s, there were at least two major sites for coral burning kilns in Bali, which chiefly served to produce materials for the development of tourism facilities and infrastructure, such as hotels and road construction (Putra, 1992).

Corals have been mined in Lombok since 1940 (Bachtiar, 1997). There are presently 146 coral kilns operating on the island of Lombok, east of Bali. A recent study estimated that 28,032 m^3 of corals were being used every year to produce lime from these kilns (P3O-LIPI and Univ. Mataram, 1998). In order to generate heat to break down the coral, the kilns need fuel wood, which is taken from secondary forests around the villages. According to the report, 56,064 m^3 of fuel wood was needed in order to supply 46 kilns every year. From coral reef surveys prior to 1998, Lombok's reefs were in excellent condition, but more recent surveys show that 22 out of 24 sites are now in poor condition (Hopley and Suharsono, 2000). In 1996, Fishermen from Lombok who had traveled in small boats as far away as Komodo National Park (some 300km) to find fish, stated that this was because their reefs in Lombok no longer provided adequate catches due to extensive reef destruction (R.P.H.Lilley pers.comm.2001)

Collection of Live Corals for Marine Aquaria

Corals have been collected and exported from Indonesia since the 1970s (Wells, 1981), with the number exported increasing significantly during the 1990s. Quotas were issued between 1992 and 1996 for a total of more than 5 million pieces of live corals, recent dead corals and base rocks (PHPA, 1992; 1993; 1994; 1995; 1996). Up to 1998, live and recent dead corals (live corals harvested and dried to get the white coral skeletons) were exported, but since then only live corals have beenallowed to export. The export of recent dead corals for marine curios was prohibited in 1997, which did not prevent directly that this continued to happen.

A REVIEW OF INDONESIAN CORALS IN TRADE WITH REFERENCE TO THEIR TRADE, POPULATION STATUS, AND DISTRIBUTION IN INDONESIA

OVERVIEW OF THE TRADE

Data and information for the purposes of this study were collected from various sources at each link in the trade chain, and from the published data from the Fisheries Statistics book. Fieldwork was also conducted in order to try to assess the population densities of the species concerned.

Indonesia is currently the world's largest coral exporter since the Philippines ceased being the leading exporting country from South East Asia in the late 1980s (Bruckner, 2001; Green and Shirley, 1999; Shoup, 1996). The USA, Japan, Europe and Asian countries were the major importing countries of Indonesian's corals in 2000 (table 1). The quantity of corals exported from Indonesia to the world market has increased significantly over the years. In the mid-1970s, black corals were extensively collected along the coast of Sulawesi, and sold locally as jewelry (Wells, 1981).

In the interests of supporting economic growth, some decision makers work on the assumption that the extraction of live corals is sustainable, provided that the "management of best practices" (as defined by their own government scientists) are followed. The validity of these "best practices" is being questioned by others from various organizations, including government agencies. In any case, the extent to which best practices are followed remains very limited. The argument that the harvest of live corals for trade is sustainable remains an open question, given the unavailability of information on the biological and ecological impacts of the trade, and the lack of studies on the characteristics of the trade itself.

Numbers of exporters

In 1990, AKKII was established. The mission of this Association has been to conduct a responsible trade in marine resources, and to maintain the trade by adopting sustainable management techniques and practices. The main function of AKKII is to administer the quotas, with the mandate given to them by the Management Authority. To date, there are 16 members who export live corals (Appendix B).

The exporters of live corals usually export other reef organisms such as coral reef fish and invertebrates. Some of them also export live freshwater fish. Only members of AKKII are legally allowed to export live corals, and because the value of the majority of live corals is higher than that for other reef organisms, there are a number of non-AKKII exporters who would also like to join the Association. At least six other exporters have applied to the Indonesian Management Authority to also export live corals. At the moment these six exporters are only exporting coral reef fish and invertebrates. The number of registered exporters for coral reef organisms for marine aquaria throughout Indonesia is 114. The major exporters are based in Jakarta and Bali, while others operate in other cities where international airports are situated.

Of the 35 countries that imported corals from Indonesia in 2000, the top ten coral importing countries were USA, Canada, Japan, European countries, and two Asian countries (AKKII, 2001)

Table 2. Importers of Indonesian Live Corals

No.	Country	Pieces	%	No.	Country	Pieces	%
1	USA	891,691	63.81	19	Poland	2,281	0.16
2	Japan	157,787	11.29	20	Rep Chech	2,126	0.15
3	France	95,092	6.81	21	Hungaria	1,684	0.12
4	Germany	62,903	4.5	22	Mexico	980	0.07
5	Netherland	48,949	3.5	23	Argentina	931	0.07
6	Canada	24,987	1.79	24	Austria	745	0.05
7	Hongkong	18,202	1.3	25	Norwegia	707	0.05
8	Italy	17,605	1.26	26	Russia	519	0.04
9	United Kingdom	16,115	1.15	27	Africa	451	0.03
10	Taiwan	11,878	0.85	28	China	292	0.02
11	Switzerland	7,907	0.57	29	Thailand	273	0.02
12	Korea	7,283	0.52	30	Portugal	268	0.02
13	Spain	7,270	0.52	31	Cyprus	183	0.01
14	Belgium	4,081	0.29	32	Greece	173	0.01
15	Israel	3,877	0.28	33	Slovenia	159	0.01
16	Brazil	3,583	0.26	34	Slovakia	110	0.01
17	Swedia	3,233	0.23	35	New Zealand	103	0.01
18	Denmark	2,878	0.21				

Besides the legal trade in live corals, there is also a thriving illegal trade. Because of the weak monitoring of the live coral trade, and lack of control over it, the illegal trade can be easily operated and hidden via the coral reef fish exporters. No special permits are needed to export coral reef fish for marine aquaria. The exporter has only to establish a formal business operation. The live corals are usually packed below the reef fish, so the corals are not seen if an inspection is conducted by the customs or quarantine agencies. There is no information or data available on the illegal trade. However, during this study, some aspects of the operation of illegal trade were recorded (pers. obs, 2001).

Another important factor in the trade is the number of traders who are now supplying the domestic market. There is a growing market for marine aquaria in the country. The corals supplied for this market are mainly specimens that have been rejected by the exporters due to coral size and health requirements for export.

Exports

Accurate data on the actual numbers of exported live corals were provided by the Association. In previous years, it was impossible to access accurate data. Many reports on the coral trade in Indonesia refer to data which were extracted from the export data on reef organisms, from books by the Central Bureau of Statistics on trade in fisheries commodities which are published annually (Bentley, 1998). However, the data in these books are not always complete, and the units of measurement are confusing. For example, kilograms are used instead of pieces, which present further difficulties when trying to interpret the data.

The Association has records of annual exports, which go back to 1997, and is the source of the most comprehensive information on the live coral trade in Indonesia. There was a significant increase in exports *Euphyllia* spp. and *Trachyphyllia geoffroyi* from 1998 to 1999 (Table 3). Over the period of 1997 to 1999, exports increased for some genera including the species concerned (Appendix C).

Table 3. Total exports of species/genera concerned 1997-2000 (number of pieces)

Taxa	1997	1998	1999	2000
Blastomussa spp	2,445	3,275	4,982	4,604
Catalaphyllia jardinei	47,880	40,263	47,033	45,689
Caulastrea spp.	7,890	7,281	13,960	16,652
Cynarina lacrymalis	4,335	3,186	**5,864**	**7,283**
Euphyllia spp.	64,344	63,523	90,972	53,728
Heliofungia actiniformis	21,821	22,276	40,735	46,747
Hydnophora spp.	7,231	5,531	11,968	15,822
Lobophyllia spp.	11,920	12,913	18,841	22,273
Physogyra lichtensteini	6,888	8,248	7,925	8,313
Plerogyra spp.	28,638	24,140	23,593	5,963
Trachyphyllia geoffroyi	39,742	37,728	**58,314**	**61,293**
Wellsophyllia radiata	6,676	3,856	3,430	3,452

Source: AKKII, unpublished report 2000.

The data in Table 2 show that exports of two species, *Cynarina lacrymalis* and *Trachyphyllia geoffroyi*, increased between 1999 and 2000. The major importing countries for these two species were the USA and Japan, where the total number imported to these two countries amounted to 6,773 pieces of *Cynarina lacrymalis* and 56,516 pieces of *Trachyphyllia geoffroyi*.

Since the export of some species to the E U countries was suspended, the export of these species has continued, mainly to the USA. 36,745 pieces of *Catalaphyllia jardinei* alone were exported to the USA in 2000. The other major importing countries were Japan, Canada, Hongkong, Korea and Switzerland, as well as other countries that imported corals in smaller quantities (Table 1).

In spite of import restrictions to the EU countries being in place, the exports did not significantly decreased. However, some exporters stated that the import restrictions for these seven species to EU countries have negatively affected their businesses. They said that the export of live corals to EU countries requires a smaller quantity of specimens, because the demand is lower, but the value of each specimen is much higher. The EU countries set higher quality standards for the whole trade process, compared to other importing countries such as the USA (coral exporter in Jakarta, pers.comm. 2001)

The total allowable catch (TAC) quota issued by Management Authority exceeded the numbers of corals being exported (Table 4). These discrepancies are true for the years 1997 to 1999. However, the actual coral harvest for 1997 to 1999 is not known.

Table 4. Collection quotas and number of live coral specimens exported from 1997-1999

Taxa	TAC Quota	Actual/ Export quota	%
Blastomussa spp	24,750	10,702	43
Catalaphyllia jardinei	240,525	135,176	56
Euphyllia spp.	360,450	217,839	60
Cynarina lacrymalis	24,300	13,385	55
Trachyphyllia geoffroyi	226,350	135,784	60
Wellsophyllia radiata	22,950	13,962	61
Plerogyra simplex	132,300	76,371	58
Caulastrea spp.	55,800	29,131	52
Heliofungia actiniformis	143,100	84,832	59
Hydnophora spp.	50,490	24,730	49
Lobophyllia spp.	76,050	43,674	57
Physogyra spp.	40,950	23,061	56

Source: AKKII, unpublished report 2001

Field assessment surveys at the coral collection sites

In order to gain a better understanding of the collection of corals for the aquarium trade, field surveys were conducted in four areas, including Lampung Bay (South Sumatera), Ujung Pandang (South Sulawesi), reefs in the Banda Sea near Kendari (Southeast Sulawesi) and reefs in Rembang, North Java Sea (Central Java). These sites are all collection areas where only stony corals are collected. Kendari has only been a collection site over the last two years, particularly for *Catalaphyllia jardinei*. Lampung has long been an area with many collection sites, from which corals have been collected over the last 20 years. Almost all coral species that are traded from Indonesia are found in Lampung, and all of the coral exporters based in Jakarta have been supplied from here.

Methodology

Line transects were used for this study (English et al, 1994). 30m line transects with a width of 1m were laid across the reefs when conditions were favourable enough for doing underwater work. Some sites are far too deep and too turbid for laying transects. Individual specimens of the target species were counted and placed in one of the following three categories, namely; less than 50cm; greater than 50cm but less than 100cm; and greater than 100cm total cover per species. Some specimens were collected to provide samples for this study, and these are held in Centre for Research and Development of Oceanologi LIPI.

Interviews were also conducted with collectors and middlemen in order to find out more about each link or stage of the trade chain. The methods used to collect, handle, and transport the corals from collection areas to the exporters' holding facilities were also recorded. The results of the interviews provide much useful information, and compliment the ecological data of the corals in trade.

The trade chain

In the trade of live corals, there is a long chain between the collectors and the exporters. The time interval from when the corals are collected from the reefs, to their delivery at the exporters holding facility, varies from two days to two weeks. There are four major players involved within Indonesia: the collector, chief

collector, middleman or coordinator, and the exporter. It is considered that the longer the chain is, the more complicated the issues in the trade become.

The exporters explained that the middlemen play an important role in the trade chain. The middlemen who live near the collection areas usually have the facilities such as large seawater basins, boats and diving equipment. Middlemen provide the operational costs such as logistics, fuel, and plastic containers, for transporting and packaging the live corals. Even though their role is important, there is sometimes friction between the middlemen and the collectors. Because of their low salaries, the collectors often have to borrow money from the middlemen. In order to pay off their debts, the collectors will pay the middlemen with their coral harvest, for which the middlemen set an extremely low price for each specimen. The collectors are not given any choice, except to agree to the price decided by the middlemen. Thus, the collectors often end up working for nothing, or for very low wages, and enter into a downward debt spiral.

As a general principle, the shorter the chain, the higher the income of collectors for each coral species. In some places, the exporters have their own staff in collection areas, who deal directly with the collectors. The exporters pay directly to the collectors. However, in many collection areas, the exporters always rely on middlemen to organize the supply from the collectors to them.

Only a few exporters have their own collectors at their sites. Those that do, prefer to train their own collectors and do business with them, rather than just buy specimens from other collectors or from middlemen. According to the exporters, the collectors who are trained by them are more aware than other people of the correct methods of collecting and handling the corals. In most cases, the exporters have to invest considerable sums of money to get their collectors to find new collection sites (coral supplier in Lampung, pers.comm.2001)

The secrecy of site locations tends to help to restrict the amounts of corals collected overall. In addition, many of the collectors prefer not to collect quantities of corals over and above those that are demanded by the exporters and buyers at the time, in order to reduce waste. These two factors are important in the control of coral collection, and could be applied to all collectors as a collection management tool. However, given the growing demand in Indonesia by local buyers for corals, even if they are damaged, this might provide a new incentive for the collectors to collect as much as possible.

Collection sites

Corals are collected from many sites throughout the archipelago (Appendix D). Live coral specimens are collected from various reef types, from the shallow reef flats, to the deeper, submerged reefs. The sites at which live corals are harvested, are chosen very selectively by the collectors. Each site usually has only one target species, which has a high market value. Collectors know very well the varieties of coral species occurring at their collection sites (Tjallingi and Douven, in press). The collectors usually keep the position of their sites very secret. In this way, each group of collectors is able to maintain the sites for themselves, and avoid other collectors harvesting from these sites.

The report by Green (1999), stated that most coral collection sites are from reefs near major international airports, and it goes on to say that this factor therefore restricts and limits the areas of depletion for certain species. However, with the increasing efficiency and speed of boats and other means of transport, many more species are now being collected at sites very far from airports. Therefore, it is the locality of the species, rather than the convenience of transportation, which dictates the area of collection. The availability of air cargo flights and improved methods of handling now allow the collection and transportation of rare, more delicate species from remote sites. The high prices paid for these rare species also provide an incentive to risk collection from remoter sites.

In collection areas for stony corals, exporters usually invest in finding new sites when their old sites no longer contain marketable specimens. The initial information about a new site usually comes from fishermen

who use fishing lines, and who know the locations of deep-water submerged reefs. Places where these fishermen have caught good harvests of fish, are assumed to be locations where there are submerged reefs. The collectors will then dive there, to look for stony coral specimens. From their previous knowledge of collection sites for certain species, the collectors hope to find, for example, specimens of *Catalaphyllia jardinei* which live at depths of 10-25 m, on a soft sandy substrate. This particular species is one of the most expensive species in trade, and in Lampung, it was once the dominant species at several of the sites.

The other major sites for *Catalaphyllia jardinei* are in the Spermonde Islands, South Sulawesi, and in the waters off Kendari in South East Sulawesi. Kendari has only become an area for coral collection within the last 2 years, because the sites have only been discovered within this period. The predominant species collected there is *Catalaphyllia jardinei*. The collectors of this species are the Bajau communities who live on Pade Kecil island. This collection area is located in Central Sulawesi, approximately 3 hours by fast boat with a 40HP outboard engine.

The Bajau collectors collect reef organisms relatively near to their homes. They also build temporary stilt houses on the shallow reef flats, where the corals are collected. The Bajau community leader, who is also the head of the collectors at these collection areas, has the authority to decide who can become a collector. The community leader also decides who is allowed to harvest on certain reefs in the area. In this situation, the collection process is not ruled by Government regulations.

The Belitung Islands are also sites for *Catalaphyllia*. Some patch reefs in the north Java Sea are collection sites for several species of *Euphyllia*. Other collection sites are near Lampung in the Sunda Strait, and Banten bay is the collection area for *Acropora, Hydnophora* and *Galaxea* (Tjallingi and Douven, in press).

Collection practices

Collection of corals for the live trade involves many thousands of coral collectors who usually live in coastal villages. The sites of the harvest areas range from shallow reef flats to submerged reefs, often to below 30 m. The collectors commonly use tools such as chisels, hammers, and crowbars, in order to harvest live specimens from deeper water. Collectors use "hookahs", that supply air to them through a plastic pipe from a compressor in the boat above. Regard for safe diving practices and the use of appropriate equipment is not an issue for these collectors. Many cases of decompression sickness occur as a result of the dangerous methods used by them. However, accurate data on the number of divers affected is not available.

Coral collectors have to collect the specimens very carefully. Small amounts of damage to the coral skeletons will cause bacteria to enter the coral polyps, which will eventually cause death to the corals. Special care and attention has to be given when collecting species that have fleshy polyps, where a slight dent can cause damage to the whole specimen. Attached corals are collected by breaking the base using hammers and chisels. Free, solitary corals can be collected more easily by choosing the right size and colour, and then simply picking them up from the substrate.

Becoming a coral collector needs courage, and good physical health. New collectors usually were previously helpers in the boats. They observe the collectors collecting live corals, and then help to put the live corals into the holding areas. In some places, the holding sites are at the same depth as that from which the corals were taken. The work involved in putting the corals into the holding sites is time–consuming, and requires patience and skill. Live corals have to be carefully stood upright, and placed firmly on the substrate, until they are packaged and transported to the exporters holding facility.

Assessment of the Harvest

Numbers of corals collected

Records have never been kept of the actual harvests of live corals. There is no obligation whatsoever for the collectors or middlemen to report the number of pieces of corals being harvested. The only available data are

for the actual number of pieces being exported, and there is no information on the amounts which are damaged, and/or die, or which are rejected as being unsuitable for export. Because of this, the annual total allowable quota has very limited meaning, and is of little use when trying to control the trade

According to the collectors, they move from one reef to another within the range of the collection areas. Some of the collectors say they have been collecting corals for as long as they can remember, but add that they can never become rich through selling corals,

Efforts to monitor the actual quantity of corals harvested for the live trade throughout Indonesia will require an enormous effort; a task that is beyond the capacity of the existing human- and financial resources currently available in-country. Indonesia possesses about 14% of the world's coral reefs. The estimated total reef area is more than 85,707 km², spread over 76 barrier reefs, 55 atolls and 40 patch reefs (Tomascik *et al*, 1997). This figure does not include the many relatively small, submerged patch reefs, which occur in deeper water.

Coral diversity varies from one reef to another, and also over time (Hopley and Suharsono, 2000). Factors affecting diversity of reefs at any given moment in time include the geographical location of the reef, proximity of other sites from which new corals can be recruited after natural disasters or previous human damage, and the relative recruitment and growth rates of the various species.

Catch per unit effort

There has never been any information regarding catch per unit effort for coral collection. Observing the collectors harvesting the live corals in Lampung provided this study with a brief insight into this matter. In 30 minutes searching, one collector managed to bring 15 colonies of *Blastomussa wellsi* to the surface. (pers.obs.). *B. wellsi* attaches its colonies to hard substrates. A hammer and chisel are needed to collect this species.

One shipment was recorded during the fieldwork. A total of 400 pieces of *Catalaphyllia jardinei* was being transported from Kendari to an exporter in Jakarta. The estimated time needed to collect 400 pieces was 4 to 5 days, using five collectors. Since this species lives half-buried in sand, no special tools are needed for collecting The middleman who supplied the exporters corals from this area in the last two years, mentioned that in the first year, 30 % of his supply was rejected. The exporters never explained to him the reason why such a high percentage was being rejected.

Holding facilities and transportation methods

Collectors use various techniques for keeping/holding the corals before supplying them to the middlemen, or before the middlemen transport them to the exporter's holding facility. In Lampung, there are collectors who put their harvests in holding areas in the sea, at depths of 10-20 m. There are also collectors who bring their corals directly to the middlemen at land-based holding facilities.

In Lampung, reef organisms are collected from holding areas in the sea, and packed in boxes on site, in the boat, above or near the holding areas, and prepared for transportation to the exporters' holding facilities. The reef organisms are individually placed inside plastic bags filled with seawater and oxygen. Some specimens such *Catalaphyllia jardinei* and *Scolymia vitiensis,* which have thick/fleshy soft bodies, do not require plastic bags filled with seawater, and are only wrapped in damp paper and then placed in boxes. If the holding facilities are on land, then the specimens are packed there and then transported to the exporters holding facility by truck.

The transport from the collectors or middlemen's holding facilities to the exporter usually takes place during the night, to avoid transporting the corals during the heat of the day.

Handling and packaging at the exporters

Some of the exporters' holding facilities are situated close to International Airports. The facilities of the exporters are variable in quality and resources, depending on the size of the company. Big companies usually have their own vehicles, which collect seawater from the nearby coast. All of them operate water filtration systems in the holding areas.

The sorting of reef organisms at the exporters facility occurs immediately after the packages arrive from the middlemen. The reef organisms are then be held at the quarantine holding place at the exporter's facility. In this place, they are usually acclimatized and treated with antibiotics if necessary, before being placed into a holding area ready for export.

The packaging for international airfreight is designed to keep the reef organisms alive inside for up to 48 hours. Some exporters have facilities to provide a heating agent in sachets which are scattered inside the Styrofoam boxes. These sachets provide heat for shipments at times when it is winter in the receiving countries.

Some international airlines make visits to the exporters holding facility, to see the methods of packaging of the reef organisms for the marine aquarium trade, prior to agreeing to ship them.

Factors affecting coral harvests

Coral collection is affected by the seasons, both in-country, and overseas. The demand for live corals from importing countries increases during the winter months, when people in the northern hemisphere tend to stay indoors. The winter months in the northern hemisphere coincide with the west monsoon at some of the collection sites in western Indonesia. During the west monsoon, collecting times are reduced, because of the high seas and dangerous weather conditions. Therefore, the weather can become a limiting factor, affecting the amounts of corals collected (Anon, unpublished report).

There are several criteria by which corals are collected. These include:

Colour specification: Corals with bright red, blue, green, pink or purple colours are the main targets, due to the high prices paid for these particular colours. For some species, certain collection areas have a unique colour variety that is not found elsewhere in Indonesia. For example, the variety of elegance coral (*Catalaphyllia jardinei*) found in Lampung, has a green, metallic colour, which makes this coral highly prized and sought after by collectors.

Size specification: there are various sizes of corals that are marketable: these are : small, medium, large, and extra large. Genera for which size is used to determine their value include *Blastomussa, Catalaphyllia* and *Plerogyra.* Corals that are too small will not be accepted at the exporters, and likewise, pieces that are too big will also be rejected. Therefore it is not only damaged corals that may be rejected by buyers.

There are currently around 70 species that belong to 37 genera of Scleractinia being traded (Appendix E). Paradoxically, the most valuable species (and species that may have limited distribution) are presently given the highest quotas. The seven most sought –after species have each been traded with quotas of above 10,000 pieces each year. These species generally have large, fleshy polyps, and beautiful colours. The species with fleshy polyps cannot easily be cultivated by application of asexual reproduction.

Field assessment of populations of the species concerned

Several problems were encountered during this fieldwork, including time constraints that limited the amount of information gathered, and prevented more comprehensive surveys being carried out. Many collection sites are located on remote reefs, which necessitate long journeys by boat in seas that are often very rough, The

collectors' boats were used for the surveys, and none of them provided the survey team with any safety equipment or procedures. However, for the surveys to be successful, the survey team had to trust that the knowledge and skill of the collectors and local fishermen would make these journeys safe and worthwhile.

Surveys were conducted at sites in various collection areas, which included reefs in Lampung Bay (South Sumatera), Rembang Central Java, (North Java Sea), Spermonde (South Sulawesi), and Reefs of Amulewang/Bolewang (Central Sulawesi) (Appendix D).

Kendari was chosen as the survey site for *Catalaphyllia jardinei*. The east monsoon had just begun in the Kendari waters, and many collectors will not go collecting during this season, due to the strong winds and high waves. Lampung was chosen because some of the species concerned live in this area.

Monospecific genera do exist on many reefs, and include a large population of the usually rare *Nemenzophyllia* on a Spermonde patch reef (Suharsono, pers.comm. 2001) and *Heliofungia* on the reefs surrounding Komodo Island. On Amulewang Reef in the Banda Sea, *Catalaphyllia jardinei* was found as the dominant species on the shallow reef flats among the seagrass beds (*Enhalus spp.*.).

Coral Identification Issues for the Species in Trade

The Indonesian Scientific Authority produced a list of species for identification purposes, with comprehensive descriptions of the live corals, along with their abundance, growth rates, natural size and trade status (Suharsono, unpublished report). It was stated in the list that there are 14 species that can be easily identified (Table 5).

During this study, observations on the ability of collectors, middlemen and exporters to identify species in trade, showed that there was still much confusion and debate about their identification to species level. On many occasions, the Indonesian Scientific Authority (LIPI) has suggested that, in order to get accurate information and data on species in trade, only species that can be easily identified may then be traded at species level. According to LIPI, those genera which have more than 2 species in trade, and are difficult to identify to species level, should be identified only to genus level.

This problems of coral identification should be discussed further at the next CITES Animal Committee meeting, which should involve professional coral taxonomists.

Table 5. List of 14 species which are easy to identify, and their trade status

Taxa	Trade Status
Stylophora	Not in Trade
Heliofungia	Traded
Zoopilus	Not in Trade
Pseudosiderastrea	Traded
Archelia	Not in Trade
Blastomussa	Traded
Cynarina	Traded
Scolymia	Traded
Physogyra	Traded
Catalaphyllia	Traded
Trachyphyllia	Traded
Scapophyllia	Not in Trade
Wellsophyllia	Traded

Source: Suharsono, unpublished report

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NOTES ON THE FINDINGS ABOUT THE SPECIES CONCERNED

Blastomussa merleti and *B. wellsi*

These two species occur in Indonesian waters and are traded under the name of "pineapple eye coral". Specimens of *Blastomussa wellsi* are collected from Lampung Bay, where this species has been collected for at least the last 10 years. *B. wellsi* has larger corallites than *B merleti*. In Lampung, B. *wellsi* lives in turbid waters at a depth of 27 meters, near the Maitem Islands. The substrate to which this species settles is dead coral covered with turf algae.

20 specimens were counted in 15 minutes, following the collectors using hookah equipment who dived in a zigzag pattern to find the specimens. The sizes of colonies found around Maitem Island were between 10 cm to 20 cm across. The colours of the colonies are red or green.

The corallites of *Blastomussa wellsi* have conspicuous extra-tentacular budding, making corals of this specimen easy to identify underwater.

These species were also recorded from the Spermonde Reefs at a depth of 15 meters. Other collection areas for trade of these species are from the reefs of Pulau Seribu, Jakarta Bay, and reefs in Spermonde and Bangka Belitung. Therefore, the distribution of these species also includes western Indonesia. The fieldwork confirmed that *Blastomussa wellsi* does occur in Indonesia, and samples of the specimens were dried and taken for collection by the Indonesian Scientific Authority.

These species may be considered uncommon, but in places where they are found, they can be abundant.

Catalaphyllia jardinei

This species has always been a favourite in the trade. It can be considered a robust species, because it will survive if only transported in damp paper, or even if wrapped in plastic bags, without water. Corals of this species often live semi-buried in sand (Hoeksema, 1993).

On the Bolewang (Amulewang) Reefs in the Banda Sea, Central Sulawesi, this species occurs on the vast shallow reef flats at depths of 1 to 1.5 m. Colonies live in beds of seagrass (*Enhalus* spp.). It is a dominant species on these reefs. The population density of *C. jardinei* in these areas was estimated to be 178 colonies per 100 m^2 for specimens smaller than 50 cm across, and 132 per 100 m^2 for ones larger than 50 cm.

It was difficult to estimate the population densities of the stony coral species in this study, given that the study sites only covered a small area of the whole reef. The estimated total area of the Bolewang Reefs is 12 km^2. It is possible that his species is not distributed evenly over the whole reef. There are several physical factors influencing distribution that need to be considered, including current flow patterns, which may have a direct affect on the distribution of this species on the reef.

Therefore, it is recommended that a more thorough survey be conducted to cover the whole of the Bolewang Reefs. Manta Tow surveys can be used before individual corals are counted using transects. Reefs in this area are located in the open sea. Therefore, the surveys must be carried out during the right season, which is during the west monsoon

The size of the colonies varied from less that 50 cm to over 50 cm. Only colonies with sizes of 10 – 25 cm were being collected, while colonies that were smaller or larger than this were left untouched.

At Lampung, *Catalaphyllia* lives in turbid waters with soft sandy substrates. There were collection sites near the mouths of big rivers, according to collectors. Specimens of *Catalaphyllia* from Lampung have the most

striking green metallic colours, and they therefore fetch the highest prices, compared to specimens from other collection areas in Indonesia.

C. jardinei is also recorded as being found around the islands of Komodo and Rinca (E. Nusa Tenggara), Taka Bonerate, the Spermonde Reefs (South Sulawesi), Ambon, and Lombok (W. Nusa Tenggara). This species may be considered as a rare species with a limited distribution. However, it is the nature of the trade to harvest the sites until the marketable specimens are no longer available, leaving those which are either too small or too big, and which have no particularly striking colours. Once the sites reach this condition, traders move away to look for new sites.

Specimens of this species are easy to identify when alive.

Cynarina lacrymalis

This species was found at several of the survey sites, at a depth of 12 to 25 m, and in turbid waters. Corals of this species live half-buried in sand (Hoeksema, 1993). The number of specimens recorded in Lampung, Kendari and Rembang was low. However, we were informed that the collection areas for this species are reefs surrounding Lombok (Nusa Tenggara) and the Spermonde Reefs (South Sulawesi). In these collection areas, *Cynarina lacrymalis* is abundant. This statement from the exporters has yet to be proved.

Only 5 specimens were recorded during the whole survey.

C. lacrymalis has been recorded in the islands of Komodo and Rinca, Pulau Pari (Jakarta Bay). It is common at the Spermonde Archipelago (South Sulawesi), where it is also used in the trade.

This species is similar in appearance to *Scolymia vitiensis*, which is also uncommon to rare, and the two species can therefore be easily confused.

Trachyphyllia geoffroyi

This free-living monospecific genus is found on coarse sandy substrates in Lampung Bay, at a depth of 18 to 20 m. Corals of this species live semi-buried in sand (Hoeksema, 1993). The estimated population density of this species is 45 colonies per 100 m^2 for sizes smaller than 50 cm. *Trachyphyllia geoffroyi* has been collected for at least 15 years in these areas.

The species varies in colour, with the most common colour being light brown. The most sought –after specimens are the red-coloured *Trachyphyllia*, which have a higher price than *Trachyphyllia* of other colours.

This species is also recorded from Komodo and Rinca Islands, Pulau Pari (Jakarta bay), the Inner bay of Ambon (Mollucas), Lombok and Sumbawa Islands (Nusa Tenggara), and Spermonde reef (South Sulawesi).

Trachyphyllia geoffroyi is considered a synonym of *Welsophyllia radiata* (Best & Hoeksema, 1987) The colonies of *T. geoffroyi* are flabellomeandroid, while *Wellsophyllia* colonies have adjacent valleys that are fused. These two species synonyms are considered to represent two separate species by the traders.

Specimens of this species are easy to identify when alive.

***Euphyllia* spp.**

The estimated population density of *Euphyllia ancora* and *E. glaberencens* with sizes smaller than 50 cm in Rembang is 63 colonies per 100 m^2, and 33 colonies per 100 m^2 for sizes greater than 50 cm. This genus lives at a depth of 5 m, on the reefs situated right in front of Tanjung Sari River. The colour of the seawater is

brown due to the sedimentation from the river. Another genus, *Goniopora*, is also abundant at the same sites, and has an estimated population density of 160 colonies per 100 m².

In Bone Lola and Balang Lompo Patch Reefs (Spermonde Reefs, South Sulawesi), the estimated population density of *Euphyllia* spp. is 90 colonies per 100 m² for colonies smaller than 50 cm, and 20 colonies per 100 m² for colonies bigger than 50 cm.

Four out of the 8 (Veron, 2000) or 9 (Cairns, 1999), *Euphyllia* species are recorded in Indonesia (Suharsono, unpublished report) which is an underestimation of the real number of species at Indonesia (Hoeksema, pers. comm., 2001).

Because of the widespread distribution of this genus, collectors have no specific sites for collecting. Exporters informed the author that supplies of this genus come from many areas, with the most sought-after specimens of *Euphyllia* having certain colour specifications, such as green.

Supplies of *Euphyllia spp.* come from collection areas on Reefs in Sibolga (North Sumatera), Belitung (Malacca Strait), Labuhan (West Java, Sunda Strait), Binuangeun (West Java), Cilamaya (West Java, North Java Sea), Cilacap (West Java, South Java Sea), Banyuwangi (East Java), Madura Islands, Gilimanuk (West Bali), and Kupang (Nusa Tenggara). Reefs (South Sulawesi), Lampung bay and the Rembang Reefs (North Java Sea).

Historically, some of these areas have been collection sites for at least the last 15 years.

Other reefs where this genus has been recorded are Komodo and Rinca Islands, Karimunjawa Reefs (Central Java, North Java Sea), Thousand Islands (Jakarta Bay), Outer Reefs of Ambon, Lucipara (Mollucas), Tukang Besi (Southeast Sulawesi), Sumba Island, Sumbawa Island, Taka Bonerate (South Sulawesi), Selayar (South Sulawesi), and Lombok (Nusa Tenggara).

Euphyllia lives in a variety of water conditions and depths. The corals can live in very turbid waters such as on the reefs of West Java and Central Java, and also near the mouths of rivers.

***Plerogyra* spp.**

This species was found in turbid waters at several of the survey sites. This genus occurs in Lampung Bay at a depth of 12 m. Colonies are attached to the substrate, and are relatively small, with colonies between 5-20 cm across. These bubble corals are widely distributed throughout the archipelago. They have been recorded from Komodo and Rinca Islands, Karimunjawa Reefs (Central Java, North Java Sea), Pulau Pari (Jakarta Bay), Inner and Outer Ambon bay (Mollucas), Lombok and Sumbawa Islands (Nusa Tenggara), Spermonde Reefs, Selayar and Taka Bonerate (South Sulawesi).

The estimated population density of this genus in the collection areas was 33 colonies per 100 m² for colonies smaller than 50 cm. This genus may be considered to be common in Lampung bay.

Two species of *Plerogyra* (*P. simplex* and *P. sinuosa*) occur in Indonesia. Corals of this genus are easy to identify when alive.

***Hydnophora* spp.**

There are at least three species of *Hydnophora* recorded in Indonesia. The genus is widely distributed and common throughout Indonesia. These corals live at various depths and are the dominant species in some areas.

This genus was recorded from Komodo and Rinca Islands, Karimunjawa Reefs (Central Java, North Java Sea), Pulau Pari (Jakarta Bay), Inner and Outer Ambon bay (Mollucas), Tukang Besi (Southeast Sulawesi), Lombok, Sumba and Sumbawa Islands (Nusa Tenggara), Spermonde Reefs, Selayar and Taka Bonerate (South Sulawesi).

***Tubastrea* spp.**

Three species of this genus occur in Indonesia. The colonies form dendroid growths. The species concerned, *Tubastrea aurea,* has a bright orange colour, and the size of the colonies is generally small. This species is the most sought-after species for trade. The collection sites are in Indramanyu. Colonies attach themselves to the poles of offshore oil platforms. The colonies are abundant and are found at depths of up to 40 m.

This genus is widely distributed in Indonesia.

Notes on Growth, Recruitment and Reproduction

From the field observations, the species concerned were grouped into 3 size categories. (smaller than 50 cm; larger than 50 cm and smaller than 100 cm; and larger than 100 cm). Sizes are derived by measuring horizontally across the widest points of the colony.

Growth rates for each species concerned could obviously not be measured during this short period of study. However, long-term monitoring of growth rates can and should be conducted, in order to gain this information.

Corals reproduce sexually and asexually (Veron, 1995). In sexual reproduction, corals are brooders or spawners. This reproductive strategy is an important aspect of coral biology. Unfortunately, the coral species that are most popular in coral trade do not reproduce asexually very well and therefore cannot easily be cultivated (Hoeksema, pers. comm, 2001).

From the field observations, *Blastomussa wellsi, Trachyphyllia geoffroyi, and Plerogyra spp.* were found dispersed across the substrate with intervals of approximately 30-50 cm between colonies. Small colonies of *Euphyllia spp.* were found dispersed across the substrate, or found in clumps, with 3 to 5 colonies grouped together. They were also found totally covering the substrate in other areas. *Catalaphyllia jardinei* were found totally covering the substrate. All species mentioned here may have a brooder strategy of reproduction. Where fertilization occurs internally, the planulae (free swimming larvae) will settle near the mother colonies. However, further field observations are needed in order to gain a more thorough understanding of the reproduction strategies of these species.

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MANAGEMENT OF THE CORAL TRADE

Existing Regulations

The existing government regulations which aim to control and monitor the wildlife trade, (including the live coral trade) (Samedi and Liman, 2001), include the following: the Government Regulation No. 8/1999, which covers the utilization of plants and wildlife; the Presidential Decree No. 43/1978, concerning the participation of Indonesia as a signatory country to CITES; The Ministry of Forestry Decree No. 62/Kpts-II/1998, that regulates the establishment of a business for wildlife trade, and The Ministry of Forestry Decree No. 104/Kpts-II/2000, concerning the collection and catching of plants and wildlife.

The transportation of wildlife within the country also requires a transport permit, which is issued by the district level office of the conservation agency (KSDA).

Trade in live corals is regarded as wildlife trade, and all species of hard corals (Scleractinia, *Millepora* spp., *Stylaster* spp, *Distichopora* spp., *Tubipora* and *Heliopora*) are listed under Appendix II of CITES (Hoeksema, 1997), where all licensing requirements have to be fulfilled by the traders. The administration of this trade takes up most of the time and human resources of the PHKA, in the Ministry of Forestry, and there is no effort made to monitor the trade of wildlife in the field.

A review of the coral utilization guidelines: theory and practice.

A set of guidelines for the sustainable harvest of live corals was produced in 1997 (Anon, 1998). The process of the development of these guidelines involved the stakeholders of the coral trade, including LIPI as the Scientific Authority, PHPA as the Management Authority, the Ministry of Trade and Industry, the Association for corals, shells and marine fish exporters (AKKII), and WWF Indonesia, who acted as the facilitator in this process. The exporters were included in this process because they know the characteristics of the trade better that any of the other stakeholders, including the government agencies responsible for managing the trade.

However, these guidelines have so far not been fully implemented. Efforts by the government to ensure adherence to the guidelines, and by exporters to fully comply with them, are still limited. The guidelines include locations of harvest sites, methods of collection and removal, quota establishment, monitoring, and licensing. From this set of guidelines, some exporters are, to a limited extent, implementing those principles governing the locations of harvest sites and licensing, and the size of the trade specimens.

The major constraint in managing coral reef resources in Indonesia in general, and the live coral trade in particular, is that there is as yet no single agency responsible for making sure that the guidelines are followed. These guidelines also rely on the involvement and active participation of various agencies, in order to be implemented. However, each agency has its own set of policies, and there is to date still no coordination between these agencies (Suharsono, 1998).

The establishment of annual export quotas for corals

One of the management tools to monitor and control the trade was the establishment of harvest quotas for corals, which was started in 1992. However, the implementation of the quota system was never managed properly.

The quota for corals actually refers to numbers of allowable catch, and is not the number allowed for export. However, the actual harvest of corals from the reefs has never been reported. The number being reported is only the number of corals being exported. This is one of the major problems faced by the agencies responsible for managing and monitoring the trade, because the actual quantities of corals harvested are still unknown.

The quota system, based on 40 genera of stony corals, was issued for 1997 and 1998. In the following year, quotas were issued to species level. This practice created confusion among the traders, agencies and coral importing countries, due to the ongoing dispute among coral scientists over the nomenclature of Scleractinian corals. However, this dispute is not at species but at genus level, and should not be used as an excuse. Professional coral taxonomists should be asked for help in this matter.

The Centre for Development and Research of Oceanology (P3O-LIPI) is the Indonesian CITES Scientific Authority for corals, and has the responsibility and authority to recommend the annual quotas to the Management Authority.

The Criteria for setting up annual coral collection quotas include:

Reef accretion rates: it was estimated that the reef accretion rates for Indonesia are 1- 1.5 cm/year, based on studies in the Seribu Islands and the Banda Sea (Suharsono, unpublished report).

Growth rates: growth rates of coral, which vary from 2.5 – 30 cm/year (Suharsono, unpublished report).

Total reef areas in Indonesia: the estimated total reef area is 85,707 km² (Tomascik *et al*, 1997)

These criteria have been questioned by the EU-SRG. To determine the sustainable trade quotas for coral species which might have limited distribution and are uncommon or rare, the criteria need to be revised. The measurement of the reef accretion rates alone is not enough to ensure that the impact of coral collection is non-detrimental.

It should be made clear that the figure of 30 % of coral reefs being in good condition, as stated in Suharsono SRG14/4/3, was calculated from the percentage cover of living corals (Suharsono, 1998) The methodology used for the survey was line intercept transects, where measuring tapes were laid over coral reefs, and the presence of each individual living coral, or other organism, was recorded to the nearest centimeter. Therefore, this figure could still be used now, with a note that the condition of good reefs may have become reduced in recent years. Bearing in mind that this 30 % figure was the result of a study that was started almost 10 years ago, 10 % is probably now a more realistic figure, but it is vital that the actual figure is established if percentage cover of reefs is still going to be used as a measure to help establish collection quotas in the future. On the other hand, these figures concern transects on shallow reef zones and not necessarily the reef zones where the most popular traded corals are found (Hoeksema, pers. comm, 2001).

Quota Management

The Coral, Fish and Shells Association (AKKII) has been given the responsibility by the Management Authority to split the quota among its members. The basis for the distribution of the quota among members of AKKII is the previous year's performance (= exports) of each member. This approach of splitting the quota has been criticized by various agencies, including members of the Association. The reason is that there is a potential for monopoly, which enables the bigger companies to take the lion's share of the business.

It is apparent that the Management Authority would prefer to leave the issues of quota management in the hands of the Association. It should however be stressed that, to properly and successfully control and monitor the trade, the involvement of the Management Authority is crucial.

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Conservation concerns of the live coral trade

Sustainability of the collection

It is not yet possible to say with any degree of certainty how sustainable the collection of live corals in Indonesia is, and to what extent the effects of harvesting the reefs has been detrimental to their ecology for the future. The reefs are very widely spread out, and the collection sites have mostly been in areas other than those where scientific surveys were carried out. There has also always been a serious lack of communication and cooperation between the coral scientists and the industry.

Establishing an Association, and then proposing the setting up of allowable harvest quotas, was the first step made by the industry to try to address this difficult and delicate issue.

Concerns about conservation threats to some of the species in trade, which had higher quotas than others, have led to the suspension of imports of these species to European Union Countries. This appears to have been based, at least in part, on assumptions made by some of the parties involved in pressing for a suspension. These assumptions were in turn based on incomplete knowledge and data about the coral species in the field.

Nevertheless this suspension can be a great lesson for all parties concerned, and provides an opportunity for all to learn more about the actual nature of the trade, It will hopefully also open the minds of many coral scientists, and encourage them to be more thorough in their research and methods, so that in future, assessments of the status of the corals concerned will be based less on assumptions, and more on hard evidence from a greater number of reliable sources. A serious question for many of us is the extent to which corals should be viewed only as fragile creatures, or also as highly adaptable organisms that are capable of surviving many catastrophes over millions of years. For example, there are species that can live in very turbid waters that are low in salinity.

The suspension of trade of certain species does not, on its own, help towards finding a long-term solution, and will not guarantee that these species will be saved from extinction. Other solutions and possibilities need to be considered. For example, the efforts of Indonesian scientists in conducting coral reef research have never been mentioned, and are felt to be undervalued. This is in part because of the limited number of published reports by them. In spite of their limitations, including a lack of human resources, and limited amount of funding, their coral work continues, and this should be remembered. In the opinion of the author, it would be a far more positive and constructive (and cost-effective) to provide funding for these people to continue their research, and then encourage them to publish their work, with input from the global coral research community. Given the relative wealth of coral species in this area, the further development of a solid local coral research community is imperative if we are to have any chance of addressing the problems identified in this report.

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PROPOSED MANAGEMENT ACTIONS

Research priorities

A more integrated, participatory approach has to be developed, in order to provide scientific data and information to support the management of the live coral trade. The vastness of the seas in which the collection areas are located, and the limited availability of facilities and human resources with which to conduct coral research, have in the past been, and still are, major constraints when attempting to collect data and information concerning the trade.

This study has identified many further opportunities for research and monitoring, and will hopefully provide an initial basis for a further planned research programme. Preliminary data including biology, estimates of population densities in given areas, recruitment and conservation issues of species of special concern, were collected during the fieldwork of this survey. However, the main message is that there must be a better understanding and cooperation between the coral scientists and the industries, if rational conservation and trade strategies are to be realized.

Experience has shown that the coral trade industry, and especially the live coral collectors, have the most extensive knowledge of these resources. The industry can help coral scientists much more in gathering the detailed scientific data and information needed for management initiatives. Steps must be taken in order to enhance this cooperation.

Since there are more than 70 genera in trade, and collection areas are not concentrated in one location, species collection needs to be prioritized. Highly targeted species, and species that are assumed to have limited distribution and are considered uncommon, should be given priority in the list. Among the priority species are *Cynarina lacrymalis*, and *Blastomussa merletti*. Research should start at the existing collection areas. Furthermore, new sites have to be assessed for comprehensive data collection before collection starts. This management measure has also to be addressed by the industry and be part of "best practices".

Re-visiting the "pattern of sustainable utilization".

Even though the management recommendations of this important document (Anon, 1998) have hardly been implemented, the time and effort invested in producing this document will not have been wasted if the Management Authority begins to seriously implement the management measures proposed by it.

However, some of the management measures first need to be reviewed, including:

Licensing

The licensing is at present only applied to the exporter. Because the trade chain involves collectors and middlemen, licensing should also apply to them. At present, anybody can be a collector or middleman. If licensing is also applied to collectors, it will help to regulate and limit collecting efforts.

Quota establishment

Measures that need to be taken prior to establishing quotas include biological assessment, data on population dynamics, recruitment and distribution, as already stipulated in the document. However, the persons or parties responsible for conducting the field assessments need to be identified and listed.

Also the quota establishment should be both for export quotas and allowable harvest quotas.

Rotation system

In practice, some collectors appear to have implemented this measure. Once the marketable sizes are no longer found in a given area, the collectors move to other collection areas, giving a chance for the first area to recover. However, monitoring and controls still need to be conducted, to ensure that sufficient time is allowed for recovery of the site.

Collecting, Handling and transporting: improving techniques.

The novice collectors and middlemen have to be trained in order to improve their skills in collecting and transportation. This can be done through training programmes, or by training given by the licensed collectors and middlemen, who have more experience and use better methods than the novices.

Reviewing socio-economic issues by improving the social welfare of collectors

This delicate issue was also raised in the original document. It recognized that the collectors are the least advantaged group in the trade chain. The longer the chain is, the less the benefit gained by the collectors. The variety of prices of live corals set among the middlemen and exporters does not help the situation. There are no incentive mechanisms in place to reward collectors for their work. In general, the collectors tend to supply whatever amount they can collect, to anyone who will buy their stock, although some exporters have tried to pay their collectors higher prices under the understanding that the collectors only supply to them. The problem of trying to stop the collectors each selling to many buyers is a serious one, and needs to be resolved. This might be achieved partly by regulating the amounts collected by the collectors, through obliging them to keep a log which registers all their collections. The discrepancy between the amounts of money received by collectors and the exporters is far too great. If, for example, the price received by the collector is significantly raised, there is a hope that the amounts of corals collected will be more limited.

There should be mechanisms or a set of understandings developed within the Association concerning pricing and incentives, which can lead to greater sustainability of this trade by benefiting the collectors more.

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CONCLUSIONS AND RECOMMENDATIONS

Coral reef destruction caused by explosive fishing techniques, coral mining, sedimentation, and land-based pollution, continues be the major threat to reefs in Indonesia. As well as these threats, the capture and removal of reef organisms for the marine aquarium trade should also be viewed as a potentially significant threat. The existing techniques used to harvest coral reef fish for the aquarium trade have shown to be very damaging to extensive areas of coral colonies. In addition, it is reasonable to anticipate species depletion in some collection areas, if harvests of live corals are not managed more intensively. Although evidence of species depletion has not yet actually been recorded, anecdotal information from the live coral collectors suggests that some species in certain sites no longer occur at a marketable size, indicating that it is possible to strip a site of marketable specimens of a particular species. This leads us back to the question of how long it takes for a site to recover, so that smaller specimens are given a chance to reach marketable size.

In view of the many arguments and counter-arguments raging over the extraction of live corals for trade in Indonesia, due mainly to a lack of communication and information about the coral trade between the various stakeholders, a precautionary approach has to be taken to ensure that this type of exploitation can be sustained. The extraction has to show no detrimental effect towards the population of the targeted species, and the extraction must not cause the destruction of the coral reef habitat. It must be borne in mind that while these disputes are going on, a significant amount of coral destruction and illegal trade continues to take place every day. Coral collectors and others in the chain who have bought into the "legal" option of accountability and responsible harvesting, have to stand by and patiently wait while academic arguments half a world away decide their fate. Meanwhile, their illegal counterparts continue to make a good living, being totally outside this participatory process which has sustainability as its goal.

In a country where the political situation is creating increasing social turmoil day by day, and where the economy is in an accelerating downward spiral, the management of natural resources becomes even more problematical. Wholesale over-exploitation and destruction are still being justified on the premise that, at a time of economic hardship, it becomes even more important that natural resources are exploited, in order to feed the millions of needy people. Also, the lack of hard data has contributed to a general perception which seriously overestimates the amounts of natural resources (including corals) left. Simply put, these resources are still perceived as being almost infinite by most people (including the decision makers), and the total depletion and extinction of any given natural resource is unimaginable to them. Obviously, unsustainable practices should be stopped because of the potential long-term costs – but achieving this remains a major challenge for those who see the reality and seriousness of the situation.

The other potential backlash is the new regulation No. 22/2000, concerning the transfer of power from central government to the Provinces, giving them much greater authority to control their natural resources. The need for each Province to start financing its self has increased the pressure on local government to support the exploitation of natural resources, and this is now accelerating at an alarming pace. Naturally, this is also having a marked impact on the rate and methods by which marine resources are being exploited.

The following are the recommended strategic actions that need to be considered:

1. Establish an Indonesian Scientific Review Body to overview the live coral trade, where the main responsibility is to provide input to the Management Authorities, who in turn are responsible for ensuring that the management measures are implemented, and that the trade has no detrimental effect. Members of the Management Body should include reputable coral scientists (national and international), representatives from the coral trade, the national Scientific authority, and the Management Authority. The Body has regular meetings at least 2 times in a year.

2. Conduct stock assessments before allowable quotas are recommended, and monitor the levels of harvests regularly. Before an allowable quota is recommended, a minimum set of data needs to be established which includes information on population density, biological information and

recruitment trends of targeted species in collection areas. Stock assessment techniques have to be appropriate and relevant to the prevailing conditions at the sites where the species concerned live. Surveys of areas in shallow water can be conducted using manta tow techniques to get a general overview of coral abundance. More detailed transects can later be used to estimate population densities more precisely. Stock assessments for corals in deeper water can be recorded by measuring the amount of time needed to count the specimens. In addition, by measuring the time needed, catch per unit effort can be calculated.

3. Improve collecting methods for collectors, and minimum standards for holding and packaging methods have to be implemented, in order to reduce mortality and produce higher quality specimens. The possibility of providing training programmes for collectors and middlemen also has to be explored.

4. Regulate the live coral trade at each link in the trade chain more intensively. Applied licensing for collectors and middlemen is part of a licensing programme that needs to be introduced. This licensing will limit and regulate the collection effort, and only licensed collectors and middlemen will be able to trade live corals.

5. The idea of a certification programme of reef products which offers best practices for collectors, middlemen and exporters, needs to be exercised and discussed at all levels of the trade.

6. To establish reporting mechanisms which serve to produce a set of records that are comprehensive enough to support the management of the trade. The best approach has to be discussed with all players in the trade. A simple recording system, which will not burden the collectors, has to be introduced. Records of species and numbers collected in each given area, together with historical records of collecting, and rates of mortality on arrival at the holding facilities of the middlemen and exporters, are the types of data that are needed to support the management initiatives. A responsible authority or organization has to be appointed in order to compile this information. However, the association (AKKII) and the Indonesian Review Body already exist, and these could be proposed to become the responsible agency.

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Distribution of corals species in trade **APPENDIX A**

Taxa	Distribution	References
Acropora formosa	1, 2, 3, 4, 6, 8, 9,10, 11, 12, 13, 14	a, b, c, e, f, h
Acropora humilis	1, 2, 3, 4, 5, 6, 8, 10, 11, 12, 13, 14	a, b, c, d, e, f, h
Acropora hyacinthus	1, 2, 3, 4, 8, 9, 10, 13, 14	a, b, c, f, g, h
Acropora spp	1, 2, 4	a, c
Blastomussa merletti	12	f
Blastomussa wellsi		
Catalaphyllia jardinei	1, 2, 11, 13, 14	a, f, h
Caulastrea echinulata	9, 11, 13, 14	f, h
Caulastrea tumida	1, 2, 3, 10, 11, 12, 13	a, b, f
Cynarina lacrimalis	1, 2, 4, 13	a, c, f
Dendrophyllia cistula		
Diploastrea heliopora	1, 2, 3, 4, 5, 6, 8, 9, 10, 13, 14	a, b, c, d, e, f, g, h
Distichopora spp		
Euphyllia ancora	1, 2, 3, 4, 10, 13, 14	a, b, c, f, h
Euphyllia cristata	1, 2, 10, 14	a, f, h
Euphyllia divisa	1, 2, 3, 4, 12, 13, 14	a, b, c, f, h
Euphyllia glaberescens	1, 2, 6, 7, 8, 9, 10, 11, 12, 13, 14	a, e, f, g, h
Favia pallida	1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14	a, c, d, e, f, h
Favia spp	4	C
Favites abdita	1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14	a, b, c, d, e, f, h
Favites spp	4,	C
Fungia fungites	1, 2, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14	a, c, d, e, f, h
Fungia moluccensis	1, 2, 4, 10, 11, 12, 13, 14	a, c, f, h
Fungia paumotensis	1, 2, 4, 5, 8, 10, 11, 12, 13, 14	a, c, d, f, h
Fungia spp	4	c
Galaxea astreata	1, 2, 3, 4, 6, 7, 9, 10, 11, 12, 13, 14	a, b, c, e, f, h
Galaxea fascicularis	1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14	a, b, c, d, e, f, h
Goniastrea pectinata	1, 2, 3, 4, 6, 8, 9, 10, 11, 12, 13, 14	a, b, c, e, f, h
Goniastrea retiformis	1, 2, 3, 4, 6, 8, 9, 10, 11, 12, 13, 14	a, b, c, e, f, h
Goniopora lobata	1, 2, 5, 6, 8, 9, 10, 11, 12, 13, 14	a, d, e, f, h
Goniopora minor	8, 9, 10, 11, 12, 14	f, h
Goniopora stokesi	1, 2, 3, 9, 10, 13	a, b, f
Heliofungia actiniformis	1, 2, 4, 7, 10, 11, 12, 13, 14	a, c, f, h
Heliopora coerulea	3, 4	b, c
Herpolitha limax	1, 2, 5, 6, 8, 9, 10, 11, 12, 13, 14	a, d, e, f, h
Hydnophora exesa	1, 2, 3, 4, 5, 6, 8, 9, 11, 12, 13, 14	a, b, c, e, f, h
Hydnophora microconos	1, 2, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14	a, c, d, e, f, h
Hydnophora rigida	1, 2, 3, 4, 6, 8, 9, 10, 11, 12, 13, 14	a, b, c, e, f, h
Lobophyllia corymbosa	1, 2, 4, 6, 10 , 11, 12, 13, 14	a, c, e, f, h
Lobophyllia hemprichii	1, 2, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14	a, c, d, e, f, h

Taxa	Distribution	References
Merulina ampliata	1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14	a, b, c, d, e, f, h
Millepora spp	1, 2, 3, 4, 6	a, b, c, e
Montastrea annuligera	1, 2, 8, 10, 11, 12, 13	a, f
Montastrea spp	3, 4	b, c
Montastrea valenciennesi	1, 2, 7, 8, 9, 10, 11, 12, 13, 14	a, f, h
Montipora foliosa	1, 2, 3, 10, 11, 12, 13, 14	a, b, f, h
Montipora spp		
Montipora verrucosa	1, 2, 3, 11, 12, 13	a, b, f
Nemenzophyllia turbida	1, 2	f
Pectinia lactuca	1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14	a, b, c, d, e, f, h
Physogyra lichtensteini	1, 2, 4, 5, 8, 10, 11, 12, 13, 14	a, c, f, h
Plerogyra simplex	1, 2, 12, 13	a, f
Plerogyra sinuosa	1, 2, 3, 4, 5, 6, 10, 11, 12, 13, 14	a, b, c, d, e, f, h
Pocillopora damicornis	1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14	a, b, c, f, h
Pocillopora verrocosa	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14	a, b, c, d, e, f, h
Polyphyllia talpina	1, 2, 3, 4, 9, 10, 11, 12, 13, 14	a, b, c, f, h
Porites cylindrica	1, 2, 3, 4, 6, 9, 10, 11, 14	a, b, c, e, f, h
Porites lichen	1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 14	a, b, c, d, f, h
Porites lobata	1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14	a, b, c, f, h
Porites lutea	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14	a, b, c, d, e, f, h
Porites nigrescens	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14	a, b, c, e, f, h
Scolymia vitiensis	1, 2, 3, 10, 12, 13	a, b, f
Seriatopora hystrix	1, 2, 3, 5, 6, 8, 9, 10, 11, 12, 13, 14	a, b, d, e, f. h
Stylophora pistillata	1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14	a, b, e, f, h
Symphyllia agaricia	1, 2, 3, 8, 10, 13, 14	a, b, f, h
Symphyllia spp	1, 2, 3, 4, 10	a, b, c, f
Trachyphyllia geoffroyi	1, 2, 4, 5, 10, 13, 14	a, c, d, f, h
Tubipora musica	1, 2, 4, 5	a, d
Turbinaria mesenterina	1, 2, 8, 13	a, f
Turbinaria peltata	1, 2, 8, 9, 10, 11, 13, 14	a, f, h
Wellsophyllia radiata	1, 2, 5, 13	a, f

1. & 2. Komodo and Rinca
3. Karimunjawa
4. Pulau Pari (Kepulauan Seribu)
5. Ambon Inner Bay
6. Ambon Outer Bay
7. Lucipara
8. Tukang Besi
9. Sumba
10. Sumbawa
11. Taka Bone Rate
12. Selayar
13. Spermonde
14. Lombok

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***Association of Coral, Shell and Ornamental Fish Exporters of Indonesia**

Indonesian Live Coral Exports from 1997-1999 (number of pieces of coral)

APPENDIX C

	1997	1998	1999
Acropora spp	16,198	13,131	24,359
Blastomussa spp	2,445	3,275	4,982
Catalaphyllia jardinei	47,880	40,263	47,033
Caulastrea spp	7,890	7,281	13,960
Cynarina lacrymalis	4,335	3,186	5,864
Cyphastrea serailia	36	16	153
Diploastrea heliopora	56	14	197
Euphyllia spp	64,344	63,523	90,972
Favia spp	3,611	3,797	4,886
Favites spp	4,284	4,107	5,290
Fungia spp	3,882	3,870	4,774
Galaxea spp	6,164	6,403	15,847
Goniastrea spp	147	99	506
Goniopora spp	60,368	50,018	92,720
Heliofungia actiniformis	21,821	22,276	40,735
Heliopora coeruela			806
Herpolitha limax	204	107	899
Hydnophora spp	7,231	5,531	11,968
Lobophyllia spp	11,920	12,913	18,841
Merulina spp	440	524	1,527

	1997	1998	1999
Millepora spp	306	159	174
Montastrea spp	1,837	2,068	3,343
Montipora spp	395	294	1,323
Nemenzophyllia turbida	7,220	7,176	3,454
Pavona spp	123	135	678
Pectinia spp	214	146	561
Physogyra lichtensteini	6,888	8,248	7,925
Plerogyra spp	28,638	24,140	23,593
Pocillopora spp	968	964	3,180
Polyphyllia talpina	2,210	2,474	3,818
Porites spp	9,247	8,836	20,418
Scolymia vitiensis	1,030	1,975	2,729
Seriatopora spp	26	25	446
Stylophora pistillata	233	118	586
Symphyllia spp	438	726	1,235
Trachyphyllia geoffroyi	39,742	37,728	58,314
Tubastrea spp	15,287	13,861	
Tubipora musica	9,116	7,841	7,167
Turbinaria spp	11,974	13,711	22,522
Wellsophyllia radiata	6,676	3,856	3,430

Source: AKKII (Association of Coral, Shell and Ornamental Fish Exporters of Indonesia) unpublished report, 2001

Coral collection sites surveyed

APPENDIX D

Location	Taxa	Common name	Local name
East Java	*Catalaphyllia*	Elegant Coral	Kolang Kaling kembang
(Bali Strait)	*Trachyphyllia*	Brain Coral	Karang Otak
Banyuwangi	*Plerogyra*	Bubble Coral	Kolang Kaling Biasa
	Physogyra	Pearl Coral	Karang Muatiara
	Nemenzophyllia	Fox Coral	Karang Melati
	Lobophyllia	Meat Coral	Karang Daging
	Heliopora	Blue Coral	Karang Biru
	Heliofungia	Plate Anemone	Anemone Piring
	Goniopora	Flower pot	Batu Yo
	Fungia	Plate Coral	Karang Piring
	Euphyllia	Hammer Coral	Karang Kuku
	Distichopora	Distichopora	Karang Ungu
	Diploastrea	Diploastrea	Karang Diploastrea
	Cyphastrea	Cyphastrea	Karang Cyphastrea
	Caulastrea	Candycane Coral	Caulastrea
	Acropora	Acropora	Karang Tonjol
	Wellsophyllia	Wellsophyllia	Wellsophyllia
	Turbinaria	Pagoda Stone	Pagoda
	Tubipora	Red Pipe Organ	P Cengkeh Batu Merah
	Tubastrea	Sunflower	Polip Matahari
	Cynaryna	Modern Coral	Karang Modern
Belitung Isl.	*Heliofungia*	Plate Anemone	Anemone Piring
(Sum.-Kali. Strait)	*Polyphyllia*	Tongue Coral	Karang Lidah
South Sumatra	*Plerogyra*	Bubble Coral	Kolang Kaling Biasa
	Heliopora	Blue Coral	Karang Biru
	Lobophyllia	Meat Coral	Karang Daging
	Goniopora	Flower Pot	Batu Yo
	Fungia	Plate Coral	Karang Piring
	Euphyllia	Hammer Coral	Karang Modern
	Cynaryna	Modern Coral	Karang Modern
	Caulastrea	Candycane Coral	Caulastrea
	Nemenzophyllia	Fox Coral	Karang Melati
	Physogyra	Pearl Coral	Karang Mutiara
	Acropora	Acropora	Karang Tonjol
	Scolymia	Scolymia	Scolymia
	Symphyllia	Smphyllia	Karang Daging Kulon
	Trachypjyllia	Brain Coral	Karang Otak
	Turbinaria	Pagona Stone	Pagoda
	Catalaphyllia	Elegant Coral	Kolang Kaling Kembang

Location	Taxa	Common name	Local name
Binuangeun West Java	*Lobophyllia*	Meat Coral	Karang daging
	Physogyra	Pearl Coral	Karang Mutiara
	Nemenzophyllia	Fox Coral	Karang Melati
	Galaxea	Durian Coral	Karang Koreng
	Polyphyllia	Tongue Coral	Karang Lidah
	Goniopora	Flower Pot	Batu Yo
	Plerogyra	Bubble Coral	Kolang Kaling Biasa
	Fungia	Plate Coral	Karang Piring
	Trachyphyllia	Brain Coral	Karang Otak
	Turbinaria	Pagoda Stone	Pagoda
	Favia	Favia Coral	Favia
	Euphyllia	Hammer Coral	Karang Kuku
	Catalaphyllia	Elegant Coral	Kolang Kaling kembang
	Acropora	Acropora	Acropora
	Heliofungia	Plate Anemone	Anemone Piring
	Tubastrea	Sunflower	Polip Matahari
	Favites	Favites Coral	Favites
Cilacap Central Java (Indian Ocean)	*Goniopora*	Flower Pot	Batu Yo
	Tubastrea	Sunflower	Polip Matahari
	Catalaphyllia	Elegant Coral	Kolang Kaling Kembang
	Porites	Multi Colour	Panca Warna
	Euphyllia	Hammer Coral	Karang Kuku
Cilamaya West Java (Java Sea)	*Heliofungia*	Plate Anemone	Anemone Piring
	Catalaphyllia	Elegant Coral	Kolang Kaling Kembang
	Caulastrea	Candycane Coral	Caulastrea
	Euphyllia	Hammer Coral	Karang Kuku
	Favia	Favia Coral	Favia
	Fungia	Plate Coral	Karang Piring
	Turbinaria	Pagoda Stone	Pagoda
	Heliopora spp	Blue Coral	Karang Biru
	Leptoseris	Leptoseris	Karang Leptoseris
	Lobophyllia	Meat Coral	Karang Daging
	Merulina	Merulina	Karang Merulina
	Montipora	Montipora	Karang Montipora
	Pavona	Pavona	Karang Pavona
	Physogyra	Pearl Coral	Karang Mutiara
	Plerogyra	Bubble Coral	Kolang Kaling Biasa
	Porites	Multi Colour	Panca Warna
	Symphyllia	Symphyllia	Karang Daging Kulon
	Tubipora	Red Pipe Organ	P Cengkeh Batu Merah
	Acanthastrea	Acanthastrea	Karang Acanthastrea
	Favites	Favites Coral	Favites
	Tubastrea	]Sunflower	Polip Matahari
	Goniopora	Flower Pot	Batu Yo
	Acropora	Acropora	Karang Tonjol

Coral collection sites surveyed APPENDIX D

Location	Taxa	Common name	Local name
Gilimanuk West Bali (Bali Strait)	*Porites*	Multi Colour	Panca Warna
	Fungia	Plate Coral	Karang Piring
	Goniopora	Flower Pot	Batu Yo
	Heliofungia	Plate Anemone	Anemone Piring
	Heliopora	Blue Coral	Karang Biru
	Lobophyllia	Meat Coral	Karang Daging
	Merulina	Merulina	Karang Merulina
	Nemenzophyllia	Foz Coral	Karang Melati
	Favites	Favites Coral	Favites
	Plerogyra	Bubble Coral	Kolang Kaling Biasa
	Pavona	Pavona	Karang Pavona
	Scolymia	Scolymia	Scolymia
	Seriatopora	Seriatopora	Seriatopora
	Trachyphyllia	Brain Coral	Karang Otak
	Turbinaria	Pagoda Stone	Pagoda
	Wellsophyllia	Wellsophyllia	Karang Otak Surabaya
	Pectinia	Pectinia	Karang Pectinia
	Euphyllia	Hammer Coral	Karang Kuku
	Cynaryna	Modern Coral	Karang Modern
	Caulastrea	Candycane Coral	caulastrea
	Blastomussa	Blastomussa	Blastomussa
	Acanthastrea	Acanthastrea	Karang Acanthastrea
	Acropora	Acropora	Karang Tonjol
	Physogyra	Pearl Coral	Karang Mutiara
	Favia	Favia Coral	Favia
Jepara Central Java (Java Sea)	*Scolymia*	Scolymia	Scolymia
	Wellsophyllia	Wellsophyllia	Karang Otak Surabaya
	Turbinaria	Pagoda Stone	Pagoda
	Trachyphyllia	Brain Coral	Karang Otak
	Porites	Multi Colour	Panca Warna
	Plerogyra	Bubble Coral	Kolang Kaling Biasa
	Euphyllia	Hammer Coral	Karang Kuku
	Heliofungia	Plate anemone	Anemone Piring
	Tubipora	Red Pipe Organ	P Cengkeh Batu Merah
	Heliopora	Blue Coral	Karang Biru
	Fungia	Plate Coral	Karang Piring
	Goniopora	Flower Pot	Batu Yo
	Physogyra	Pearl Coral	Karang Mutiara
Kendari South-East Sulawesi (Sawu Sea)	*Catalaphyllia*	Elegant Coral	Kolang Kaling Kembang/Batu

Coral collection sites surveyed

APPENDIX D

Location	Taxa	Common name	Local name
Kupang West Timor (Sawu Sea)	*Pocillopora*	Pocillopora	Karang Pocillopora
	Merulina	Merulina	Karang Merulina
	Montipora	Montipora	Karang Montipora
	Nemenzophyllia	Fox Coral	Karang Melati
	Turbinaria	Pagoda Stone	Pagoda
	Wellsophyllia	Wellsophyllia	Karang Otak Surabaya
	Pavona	Pavona	Karang Pavona
	Pectinia	Pectinia	Karang Pectinia
	Scolymia	Scolymia	Scolymia
	Plerogyra	Bubble Coral	Kolang Kaling Biasa
	Lobophyllia	Meat Coral	Karang Daging
	Seriatopora	Seariatopora	Karang Seriatopora
	Tubipora	Red Pipe Organ	P Cengkeh Batu Merah
	Tubastrea	Sunflower	Polip Matahari
	Trachyphyllia	Brain Coral	Karang Otak
	Symphyllia	Symphyllia	Karang Daging Kulon
	Favites	Favites Coral	Favites
	Physogyra	Pearl Coral	Karang Mutiara
	Catalaphyllia	Elegant Coral	Kolang Kaling Kembang
	Goniopora	Flower Pot	Batu Yo
	Hydnophora	Staghorn Coral	Hydnophora
	Acanthastrea	Acanthastrea	Karang acanthastrea
	Caulastrea	Candycane Coral	Caulastrea
	Cynaryna	Modern Coral	Karang Modern
	Euphyllia	Hammer Coral	Karang Kuku
	Heliopora	Blue Coral	Karang Biru
	Fungia	Plate Coral	Karang Piring
	Galaxea	Durian Coral	Karang Koreng
	Heliofungia	Plate Anemone	Anemone Piring
	Favia	Favia Coral	Favia
	Acropora	Acropora	Karang Tonjol

Coral collection sites surveyed APPENDIX D

Location	Taxa	Common name	Local name
Labuhan West Java (Sunda Strait)	*Fungia*	Plate Coral	Karang Piring
	Blastomussa	Blastomussa	Blastomussa
	Catalaphyllia	Elegant Coral	Kolang Kaling Kembang
	Cynaryna	Modern Coral	Karang Modern
	Euphyllia	Hammer Coral	Karang Kuku
	Favites	Favites Coral	Favites
	Goniopora	Flower Pot	Batu Yo
	Tubastrea	Sun Flower	Polip Matahari
	Heliofungia	Plate Anemone	Anemone Piring
	Favia	Favia Coral	Favia
	Nemenzophyllia	Fox Coral	Karang Melati
	Physogyra	Pearl Coral	Karang Mutiara
	Plerogyra	Bubble Coral	Kolang Kaling Biasa
	Polyphyllia	Tongue Coral	Karang Lidah
	Lobophyllia	Meat Coral	Karang Daging
	Trachyphyllia	Brain Coral	Karang Otak
Lampung South Sumatra (Sunda Strait)	*Physogyra*	Pearl Coral	Karang Mutiara
	Heliofungia	Plate Coral	Anemone Piring
	Lobophyllia	Meat Coral	Karang Daging
	Wellsophyllia	Wellsophyllia	Karang Otak Surabaya
	Symphyllia	Symphyllia	Karang Daging Kulon
	Plerogyra	Bubble Coral	Kolang Kaling Biasa
	Fungia	Plate Coral	Karang Piring
	Favia	Favia	Karang Nanas
	Favites	Favites	Favites
	Polyphyllia	Tounge Coral	Karang Lidah
	Goniopora	Flower Pot	Batu Yo
	Euphyllia	Hammer Coral	Karang kuku
	Trachyphyllia	Brain Coral	Karang Otak
	Catalaphyllia	Elegant Coral	Kolang Kaling kembang
	Blastomussa	Blastomussa	Karang Nanas Mata
	Cynarina	Modern Coral	Karang Modern
	Hydnophora	Staghorn Coral	Hydnophora

Coral collection sites surveyed

APPENDIX D

Location	Taxa	Common name	Local name
Madura (Isl.) East Java (Java Sea)	*Diploastrea*	Diploastrea	Karang Diploastrea
	Seriatopora	Seriatopora	Karang Seriatopora
	Pavona	Pavona	Karang pavona
	Pectinia	Pectinia	Karang Pectinia
	Physogyra	Pearl Coral	Karang Mutiara
	Plerogyra	Bubble Coral	Kolang Kaling Biasa
	Pocillopora	Pocillopora	Karang Pocillopora
	Polyphyllia	Tongue Coral	karang Lidah
	Cynaryna	Modern Coral	Karang Modern
	Scolymia	Scolymia	Scolymia
	Merulina	Merulina	Karang Merulina
	Symphyllia	Symphyllia	Karang Daging Kulon
	Trachypjyllia	Brain Coral	Karang Otak
	Tubastrea	Sunflower	Polip Matahari
	Tubipora	Red Pipe Organ	P Cengkeh Batu Merah
	Turbinaria	Pagoda Stone	Pagoda
	Wellsophyllia	Wellsophyllia	Karang Otak Surabaya
	Porites	Multi Colour	Panca Warna
	Fungia	Plate Coral	Karang Piring
	Acanthastrea	Acanthastrea	Karang Acanthastrea
	Blastomussa	Blastomussa	Blastomussa
	Catalaphyllia	Elegant Coral	Kolang Kaling kembang
	Caulastrea	Candycane Coral	Caulastrea
	Cyphastrea	Cyphastrea	Karang Cyphastrea
	Euphyllia	Hammer Coral	Karang Kuku
	Nemenzophyllia	Fox Coral	Karang Melati
	Favites	Favites Coral	Favites
	Montipora	Montipora	Karang Montipora
	Goniopora	Flower Pot	Batu Yo
	Galaxea	Durian Coral	Karang Koreng
	Heliofungia	Plate Anemone	Anemone Piring
	Heliopora	Blue Coral	Karang Biru
	Hydnophora	Staghorn Coral	Hydnophora
	Lobophyllia	Meat Coral	Karang Daging
	Acropora	Acropora	Karang Tonjol
	Favia	Favia Coral	Favia
Pemalang Central Java (Java Sea)	*Euphyllia*	Hammer Coral	Karang Kuku
	Tubastrea	Sunflower	Polip Matahari
	Goniopora	Flower Pot	Batu Yo

Coral collection sites surveyed

APPENDIX D

Location	Taxa	Common name	Local name
Pulau Untung Jawa (Island) Central Java (Java Sea)	*Trachyphyllia*	Brain Coral	Karang Otak
	Merulina	Merulina	Karang Merulina
	Montipora	Montipora	Karang Montipora
	Nemenzophyllia	Fox Coral	Karang Melati
	Physogyra	Pearl Coral	Karang Mutiara
	Plerogyra	Bubble Coral	Kolang Kaling Biasa
	Lobophyllia	Meat Coral	Karang Daging
	Porites	Multi Colour	Panca Warna
	Tubastrea	Sunflower	Polip Matahari
	Tubipora	Red Pipe Organ	P Cengkeh Batu Merah
	Turbinaria	Pagoda Stone	Pagoda
	Acropora	Acropora	Karang Tonjol
	Polyphyllia	Tongue Coral	Karang Lidah
	Cynaryna	Modern Coral	Karang Modern
	Hydnophora	Staghorn Coral	Hydnophora
	Catalaphyllia	Elegant Coral	Kolang Kaling Kembang
	Caulastrea	Cabdycane Coral	Caulastrea
	Blastomussa	Blastomussa	Blastomussa
	Cyphastrea	Cyphastrea	Karang Cyphastrea
	Diploastrea	Diploastrea	Karang Diploastrea
	Distichopora	Distichopora	Karang Ungu
	Galaxea	Durian Coral	Karang Koreng
	Favia	Favia Coral	Favia
	Favites	Favites Coral	Favites
	Fungia	Plate Coral	Karang Piring
	Goniopora	Flower pot	Batu Yo
	Euphyllia	Hammer Coral	Karang Kuku
	Heliofungia	Plate Anemone	Anemone Piring
Rembang Central Java (Java Sea)	*Euphyllia*	Hammer Coral	Karang Kuku
	Goniopora	Flower Pot	Batu Yo
Sibolga North Sumatra (Indian Ocean)	*Merulina*	Merulina	Karang Amrulina
	Turbinaria	Pagoda Stone	Pagoda
	Trachyphyllia	Brain Coral	Karang Otak
	Symphyllia	Symphyllia	Karang Daging Kulon
	Scolymia	Scolymia	Scolymia
	Plerogyra	Bubble Coral	Kolang Kaling Biasa
	Polyphyllia	Tongue Coral	Karang Lidah
	Pocillopora	Pocillipora	Karang Pocillopora
	Physogyra	Pearl Coral	Karang Mutiara
	Porites	Multi Colour	Panca Warna
	Lobophyllia	Meat Coral	Karang Daging
	Hydnophora	Staghorn Coral	Hydnophora
	Heliofungia	Plate Anemone	Anemone Piring
	Goniopora	Flower Pot	Batu Yo
	Fungia	Plate Coral	Karang Piring

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Coral collection sites surveyed APPENDIX D

Location	Taxa	Common name	Local name
... Sibolga North Sumatra (Indian Ocean)	*Favites*	Favites Coral	Favites
	Acropora	Acropora	Karang tonjol
	Euphyllia	Hammer Coral	Karang Kuku
	Cynaryna	Modern Coral	Karang Modern
	Catalaphyllia	Elegant Coral	Kolang Kaling Kembang
	Blastomussa	Blastomussa	Blastomussa
	Nemenzophyllia	Fox Coral	Karang Melati
	Favia	Favia Coral	Favia
UjungPandang South Sulawesi (Makassar Strait)	*Cynaryna*	Modern Coral	Karang Modern
	Turbinaria	Pagoda Stone	Pagoda
	Trachyphyllia	Brain Coral	Karang Otak
	Scolymia	Scolymia	Scolymia
	Plerogyra	Bubble Coral	Kolang Kaling Biasa
	Physogyra	Pearl Coral	Karang melati
	Nemenzophyllia	Fox Coral	Karang melati
	Merulina	Merulina	Karang Merulina
	Heliofungia	Plate Anemone	Anemone Piring
	Euphyllia	Hammer Coral	Karang Kuku
	Catalaphyllia	Elegant Coral	Kolang Kaling Kembang
	Blastomussa	Blastomussa	Blastomussa
	Acropora	Acropora	Karang Tonjol
	Goniopora	Flower Pot	batu Yo

Indonesian species/genera present in international trade in the 1990s **APPENDIX E**

Number	Taxa	Number	Taxa	Number	Taxa
1	*Acropora formosa*	25	*Galaxea fascicularis*	49	*Pavona spp*
2	*Acropora humilis*	26	*Goniastrea pectinata*	50	*Pectinia lactuca*
3	*Acropora hyacinthus*	27	*Goniastrea retiformis*	51	*Physogyra lichtensteini*
4	*Acropora spp*	28	*Goniopora lobata*	52	*Plerogyra simplex*
5	*Blastomussa merletti*	29	*Goniopora minor*	53	*Plerogyra sinuosa*
6	*Blastomussa wells*	30	*Goniopora stokesi*	54	*Pocillopora damicornis*
7	*Catalaphyllia jardinei*	31	*Heliofungia actiniformis*	55	*Pocillopora verrucosa*
8	*Caulastrea echinulata*	32	*Heliopora coeruela*	56	*Polyphyllia talpina*
9	*Caulastrea tumida*	33	*Heliopora coeruela*	57	*Porites cylindrica*
10	*Cynarina lacrymalis*	34	*Herpolitha limax*	58	*Porites lichen*
11	*Cyphastrea serailia*	35	*Hydnophora exesa*	59	*Porites lobata*
12	*Diploastrea heliopora*	36	*Hydnophora microconos*	60	*Porites lutea*
13	*Euphyllia ancora*	37	*Hydnophora rigida*	61	*Porites nigrescens*
14	*Euphyllia cristata*	38	*Lobophyllia corymbosa*	62	*Scolymia vitiensis*
15	*Euphyllia divisa*	39	*Lobophyllia hemprichii*	63	*Seriatopora hystrix*
16	*Euphyllia glaberescens*	40	*Merulina ampliata*	64	*Stylophora pistillata*
17	*Favia pallida*	41	*Millepora spp*	65	*Symphyllia agaricia*
18	*Favia spp*	42	*Montastrea annuligera*	66	*Symphyllia spp*
19	*Favites abdita*	43	*Montastrea spp*	67	*Trachyphyllia geoffroyi*
20	*Favites spp*	44	*Montastrea valenciennesi*	68	*Tubastrea aurea*
21	*Fungia fungites*	45	*Montipora foliosa*	69	*Tubipora musica*
22	*Fungia moluccensis*	46	*Montipora spp*	70	*Turbinaria mesenterina*
23	*Fungia paumotensis*	47	*Montipora verrucosa*	71	*Turbinaria peltata*
24	*Galaxea astreata*	48	*Nemenzophyllia turbida*	72	*Wellsophyllia radiata*

Source: AKKII (Association of Coral, Shell and Ornamental Fish Exporters of Indonesia) 2001.