Proceedings of the CITES workshop on the conservation of sea cucumbers in the families Holothuriidae and Stichopodidae

1-3 March 2004
Kuala Lumpur
Malaysia

Edited by
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U.S. Department of Commerce
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Cover photos. Upper photo: *Bodaschia argus*, Sulawesi Indonesia (Andy Bruckner, NOAA Fisheries) ; lower photo: Sea cuucmbers drying on the beach, Papa New Guinea (Jeff Kinch, University of Papua New Guinea)

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Proceedings of the CITES workshop on the conservation of sea cucumbers in the families Holothuriidae and Stichopodidae

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The *Proceedings of the CITES Workshop on the Conservation of Sea Cucumbers* summarizes the outcome of an International CITES meeting on sea cucumbers held in Kuala Lumpur, Malaysia in March 2004. This was funded through the NOAA Coral Reef Conservation Program and NOAA Fisheries Office of Protected Species, with additional financial and logistical support from the CITES Secretariat, TRAFFIC Southeast Asia and the Department of Fisheries, Malaysia. The workshop was developed and conducted in response to a Decision adopted at the 12th Conference of Parties directing the CITES Secretariat to convene a technical workshop on sea cucumbers to review information on the biological and trade status and identify possible conservation actions. The workshop objectives and terms of reference for the working groups were developed by the Organizing Committee through consultations with the CITES Animals Committee working group on sea cucumbers, and sea cucumber experts invited to the workshop. This team set the vision for the sea cucumber workshop and worked together to develop these proceedings.

The workshop would not have been possible without the dedicated efforts of all the participants. In particular, we wish to acknowledge the Working Group Chairs, Warwick Nash, Kim Friedman, Chantall Conand, and Mohammad Pourkazemi, and their Rapporteurs, who presided over the deliberations during the workshop and provided draft reports that were used in preparing this document. The success of the workshop is also due to TRAFFIC Southeast Asia for their efforts in coordinating the logistics, including travel arrangements, lodging, meeting facilities, and meals. We would like to thank the people behind the scenes, especially Liz Burgess and James Compton, who were responsible for the audiovisual equipment, set-up, copying and distribution of the materials and organization of the reception. Alice Burke and Paula Henry from the CITES Secretariat need to be commended for all their hard work in compiling, formatting, printing and distributing the white papers and country reports, assistance with powerpoint presentations, and compilation and distribution of the working group reports and other materials to participants during and after the workshop. We would like to thank The Department of Fisheries Malaysia and National Parks Peninsula Malaysia for their assistance in logistical arrangements, their support for the reception, and their contributions through the opening address, keynote speeches and Malaysia Country Report. Special thanks go to Alassandra Lovatelli for his efforts to coordinate FAO efforts on sea cucumbers with CITES and this workshop, and his contributions from the ASCAM workshop.

The background information for the participants was provided in the form of four white papers and 16 country reports. A special thanks goes to each of the authors and speakers. Dr Chantal Conand presented a paper and talk on *Sea Cucumber Biology, Taxonomy, Distribution and Conservation Status* and on *Harvest and Trade in Sea Cucumbers*. This was followed by Dr. Andrew Bruckner, who discussed *Management and Conservation Strategies and Practices for Sea Cucumbers* and Mr. Glenn Sant, who presented a talk on *CITES and Sea Cucumbers*. Country Reports were presented by Lu Xiaoping (China), Irma Hernandez (Cuba), Veronica Toral-Granda (Ecuador), Asep Sugiharta (Indonesia), Karl Aiken (Jamaica),Shingo Fukui (Japan), Dinorah Perezrul (Mexico), Zaidnuddin Ilias (Malaysia), Ludivina Labe (Philippines), Andrew Bruckner (USA), and Philip Lambert (Canada).

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EXECUTIVE SUMMARY

The *CITES Workshop on the Conservation of Sea Cucumbers in the Families Holothuriidae and Stichopodidae* (Kuala Lumpur, Malaysia, March 1-3, 2004) was convened to review biological, fishery and trade information for commercially important sea cucumber species, and identify possible national, regional and international conservation mechanisms to ensure that the harvest and trade in these species is sustainable. The workshop was attended by 56 representatives from governments of exporting and importing countries, universities, industry, and NGOs. On the first day, background information was presented on 1) the biology, taxonomy and distribution of commercially important sea cucumbers species; 2) the main species in trade and the origin, trade routes and utilization patterns; 3) current fishing practices and management options; 4) opportunities for sustainable wild harvest and trade controls; and 5) reports from 18 participating countries. Three concurrent working groups (WG) met to discuss (i) national fisheries management; (ii) priorities for international conservation and protection; and (iii) potential CITES implementation issues. All participants were requested to work together to formulate specific recommendations on conservation, fishery management approaches and trade measures needed to conserve and sustainably manage sea cucumber resources.

The primary threat to sea cucumber populations identified by the participants at this workshop was overexploitation to supply growing international markets for beche-de-mer and other products. Sea cucumbers are prone to overexploitation due to their life history (e.g., limited mobility as adults, late sexual maturity, density-dependent reproduction, and low rates of recruitment) and ease of collection (adults are large, often diurnal, easy to detect and collect, and do not require sophisticated fishing or processing techniques). Historical reports describe a 'boom-and-bust' cycle, where over-exploitation of traditional fishing grounds has prompted fishers to expand into deeper water, move to new locations, and target less valuable species. World sea cucumber capture fisheries increased approximately 500% between 1950 to 2000, with the largest growth since the 1980s. Increases are largely due to:1) larger numbers of producing countries; 2) greater numbers of species harvested; and 3) expansion of fishing activities into remote locations and deepwater habitats.

The two most urgent needs for sea cucumber conservation identified during this workshop were the development of national fishery management plans and harmonized trade reporting. Management plans should include specific regulations adopted through an adaptive management process, with emphasis on size limits, quotas, spatial closures, and other mechanisms as appropriate under particular situations. These plans should also address bycatch and habitat impacts associated with certain gear types, include development of aquaculture and restocking programs, and involve implementation of national monitoring programs that emphasize stock assessments and collection and analysis of fisheries data. While there was no specific endorsement for additional CITES listings, there was recognition that certain species qualify for listing. CITES listings could offer substantial benefits by preventing illegal trade and harvest, and ensuring that exports are sustainable. Additional CITES listings could help promote increased partnerships with importing countries, non-gopvernment organizations and sea cucumber experts, and provide a mechanism for comprehensive and standardized trade and quota reporting. Furthermore, future listings could contribute to enhanced opportunities for technical assistance and capacity building and the development of Regional Fishery Management Organizations for sea cucumbers. Implementation of additional CITES listings would also place additional burdens on exporting and importing countries, due to permitting requirements, paucity of information needed to make non-detriment findings, and enforcement problems dassociated with taxonomic discrepencies and difficulties in identifying sea cucumbers, especially in a processed state. Some of the critical information needs that could contribute to national management and facilitate successful implementation of possible CITES listings include 1) research on taxonomy, with emphasis on identification tools and marking schemes; 2) basic biological and ecological research; 3) improved collection, reporting and sharing of fishery-dependent data; 4) adoption of field monitoring programs; 4) improved education, training and dissemination of information and tools; and 5) improved enforcement capacity to address poaching and illegal trade.

National Fisheries Management

Working Group 1 (WG1) evaluated fishery management options for sea cucumber and commented on their feasibility, achievability, and relative ease in implementation. No one best management tool was identified that was applicable to all fisheries. The participants highlighted the points that management measures need to be practical, should be adopted to fit the particular circumstances of the fishery, should involve community participation in the development, and should be implemented through an adaptive management process. WG1 laid out the essential steps of an adaptive management process: 1) characterization of the fishery; 2) application of minimum size limit; 3) evaluation of impacts of size limits (monitoring); 4) implementation of small area closures (if catch/population data indicate the fishery is declining); 5) implementation of seasonal closures, rotational harvest and other measures as precautionary approaches (in absence of scientific data); 6) establishment of total allowable catch (as soon as sufficient data are available); 7) continued monitoring of the condition of stocks; and 8)reduction of TAC or implement total closures for affected species (if stocks continue to decline) to allow recovery of stocks.

The group reviewed six possible management measures:

- Minimum size was recognized as a measure to protect pre-reproductive individuals from collection, but management and enforcement of this measure may be difficult due to extreme size/shape changes of sea cucumbers and shrinkage during processing. Through an adaptive management process, this was recommended as the first measure that needs to be implemented.
- **Areas closures** were recognized as a mechanism to protect a portion of a fished population, thereby enhancing stocks in surrounding fished areas. The effectiveness of this measure depends on the location relative to larval transport, condition and abundance of the spawning stock within the reserve, community support for the measure. This measure would need to be applied in areas where size limits do not appear to be adequate to protect and restore populations in fished areas.
- **Total allowable catch** (TAC) was identified as the most effective way to limit fishing, but limits need to be set for each species to avoid serial depletion. This measure requires extensive fishery dependent and independent data and a monitoring program to determine realistic quotas, and could only be applied once monitoring programs are in place.
- **Gear restrictions**: Bans on trawling were not supported, although efforts to minimize habitat damage by modifying gear and efforts to protect important sea cucumber habitats (e.g., nursery areas) were supported. Restrictions on the use of compressed air was recognized as one way to maintain deep water populations. A complete ban on the use of compressed air was not supported, although the group recommended depth restrictions and more education on safe diving practices.
- **Rotational Harvest** was identified as a measure that would allow individual sea cucumbers to achieve a larger size before being collected. The group noted that information is not currently available to determine appropriate rotation rates, and implementation may be difficult in some areas with traditional management or resource tenure (e.g., Fiji).
- **Seasonal Closures** could protect reproductive stocks of sea cucumbers. However, this measure would be difficult to implement because reproductive seasons may extend for many months and species exhibit asynchronous spawning periods. This would be especially problematic in the IndoPacific, where fisheries are multi-species.
- **Limited entry** provides a way to reduce fishing effort. However the group felt that this measure may work in developed countries, but it not feasible in countries where this measure is not socially or culturally acceptable.

Priorities for International Conservation and Protection

Working Group 2 (WG2) reviewed biological and trade status of sea cucumbers and identified biogeographical hotspots, taxa of concern, and possible conservation and management measures. A specific level of concern was identified for each commercially important sea cucumber (e.g., high concern throughout its range; concern in specific range countries; potential for future concern as harvest increases; no concern; and minor specific of little commercial value), based on their commercial value, vulnerability to harvest, distribution, historical and present status of different populations, life history, importance in world trade, and specific issues raised by range or importing countries.

Statement of Priority

There is a high demand for sea cucumber products on the international markets This has caused the over-exploitation of certain fisheries. Inadequate or non-existent appropriate management plans at both national and regional levels have allowed such exploitation to take place. It is highly recommended that relevant regional and international institutions be engaged in the preparation of management plans. Priority actions to be taken concern trade measures, fishery assessments and basic research studies, as well as public awareness.

WG 2 identified 41 commercial sea cucumber species in the families Holothuridae and Stichopodidae that were commercially harvested. This includes 31 species from the western Pacific and Indian Ocean, 4 Caribbean species, 1 tropical eastern Pacific species, and 5 temperate species. Tropical fisheries in the Indo-Pacific target multiple species, whereas temperate fisheries are largely monospecific. The highest value species from the tropical IndoPacific are *H. scabra, H. fuscogilva,* and *H. nobilis*; species of medium value include *A. echinites, A. miliaris* and *T. ananas*, and low value species include *B. marmorata, H. atra, H. fuscopunctata*, *S. chloronotus* and *S. variegatus*. In the Eastern Pacific, the most important sea cucumber fishery is in the Galápagos Islands and Mexico for *I. fuscus*. North American fisheries target *Cucumaria frondosa* (Atlantic) and *P. californicus* (Pacific northwest), both of which are high volume, low value species. The species with the longest record of exploitation, and the largest amount of recent investment in aquaculture and mariculture is *A. japonicus* (Family Stichopodidae).

Geographical hotspots with a high concern of overfishing were identified off east coast of Africa and the Red Sea, Western Pacific, Asia and Central and northwestern part of South America. These hotspots included 27 countries, or approximately half of all countries with existing sea cucumber fisheries. Overfishing was also identified as a medium or high level of concern in about half (15 species) of all commercially important species from the western Pacific and Indian Oceans, and also for the species collected off South America and the Galapagos. Populations of certain high value species *(e.g. H. scabra, H. nobilis H. fuscogilva, T. ananas* and *I fuscus)* were identified as the species of highest concern. These taxa are overfished throughout much of their range, and populations have collapsed in some locations.

Overall, the WG participants recognized that a number of sea cucumbers are overfished, but there was no scientific evidence that sea cucumber stocks presently under exploitation were at risk of extinction. It was noted that overexploited species reach a scarcity level that makes them uneconomic to fisheries long before critical levels of stock failure are reached. However, there was also recognition that depletion of one high value species from an area triggers more pressure on other medium and low value species; as long as fisheries continue to operate in that area, rare or depleted species will continue to be collected when found.

WG2 highlighted the need for the development of management strategies and harmonized trade reporting. They noted that the framework that would support sea cucumber management and reporting is in early stages of development in most locations. Furthermore, the establishment of management strategies is hampered by 1) a lack of basic biological and ecological information for most commercial species, 2) limited information on existing and historic sea cucumber fisheries, and 3) an absence of harmonized reporting codes. WG2 identified seven overarching measures that are needed, specific actions for each measure, implications of these measures from a conservation perspective, and possible organizations that could assist in the development and implementation of these measures. The key information needs include:

1) research on biology and ecology, with emphasis on taxonomy, population dynamics, restocking, habitat preferences, and role of sea cucumbers in healthy ecosystems;
2) fishery dependent and independent monitoring of specific fisheries and across regions;
3) better trade reporting;
4) development of management plans that are regionally harmonized;
5) aquaculture, mariculture and restocking efforts;
6) capacity building and training in fisheries management, reporting by fishers, training for enforcement and customs officers, and training in research and monitoring; and
7) communication and awareness.

Potential CITES Implementation Issues

Working Group 3 (WG 3) evaluated the benefits and drawbacks of a CITES Appendix II or III listing for one or more species of sea cucumbers. They outlined measures to assist in the management and conservation of sea cucumbers under a "no listing" and "listing "scenario and identified measures that range states should consider if sea cucumber species are included in Appendix II or III.

WG3 recognized the significant conservation benefits associated with a CITES listing. The WG felt that a listing would curtail illegal trade and harvest, and provide a mechanisms to ensure that exports are sustainable through the requirement of a non-detriment finding. A listing would result in comprehensive and standardized trade and quota reporting. A CITES listing was also recognized as an important mechanism to raise awareness, enhance opportunities for capacity building and technical assistance, and encourage development of new regional fishery management organizations (RFMO) for sea cucumbers.

WG3 identified major issues regarding implementation of additional CITES listings. They emphasized burdens associated with 1) permitting requirements; 2) costs for new management planning, monitoring, and enforcement; 3) training requirements and regulatory measures that are needed to comply with CITES provisions; 4) limited availability of data that could be applied towards non-detriment findings; 5) taxonomic issues and difficulties in identifying taxa of sea cucumbers in trade; and 6) socioeconomic impacts to local fishing communities.

The WG identified a series of priorities for sea cucumbers that need to be considered by CITES Parties under a listing and no listing scenario. If sea cucumbers are not proposed for listing, there is a need to:

1) Endorse and adopt the findings of the FAO ASCAM workshop.
2) Encourage national fisheries agencies to develop national fishery management plans with harvest regulations, efforts to minimize bycatch, monitoring programs, and aquaculture and restocking programs.
3) Support the formation of RFMOs for sea cucumbers.
4) Raise awareness of conservation concerns surrounding sea cucumbers in other International Fora and Conventions.
5) Develop standardized methodologies for monitoring populations, fisheries and trade.
6) Develop universal marking and labeling schemes.

Under a listing scenario, the WG recommended:

1) Appendix III listings for *I. fuscus* in additional range states;
2) Appendix III listings for additional species where needed to complement national management measures;
3) possible Appendix II listing of all or a limited number of commercially traded species of sea cucumbers.

The group recognized that range states would need to consider existing laws that affect international trade; permit systems; knowledge of species in trade and forms in which they are traded; monitoring to determine quotas and ensure sustainable harvest and trade, and law enforcement training.

CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES
OF WILD FAUNA AND FLORA

CITES Technical workshop on the conservation of sea cucumbers
in the families Holothuriidae and Stichopodidae
Kuala Lumpur (Malaysia), 1-3 March 2004

AGENDA

Opening ceremony

1. Adoption of the agenda and working programme

Session 1: Background; biology and uses of sea cucumbers

2. Objectives of and background to the workshop

3. Sea cucumber biology

    - Taxonomy and distribution
    - Biology
    - Conservation status

4. Utilization of and trade in sea cucumbers

    - Utilization as food, in traditional East Asian Medicine and other uses
    - Sea cucumber fisheries
    - Legal trade
    - Illegal, unreported and unregulated trade
    - Bycatch
    - Socio-economic characteristics of the trade in sea cucumbers

Session 2: Fisheries management and conservation

5. Management and conservation strategies & practices

    - Fisheries management approaches of wild harvest (minimum size limits, closed seasons, closed areas, etc.)
    - Aquaculture and Restocking
    - Trade controls and enforcement, including identification of specimens in trade

6. CITES and sea cucumbers

   - CITES requirements and provisions
   - Compliance with Article IV, making of non-detriment findings and 'legal acquisition' issues
   - Experience with the inclusion of *Isostichopus fuscus* in CITES Appendix III

Session 3: Country status reports

6.1. China
6.2. China (Hong Kong)
6.3. Cuba
6.4. Ecuador
6.5. Fiji
6.6. Indonesia
6.7. Jamaica
6.8. Japan
6.9. Malaysia
6.10. Mexico
6.11. Philippines
6.12. Solomon Islands
6.13. United States of America
6.14. Northern Territories (Australia)
6.15. Canada
6.16. Egypt

Session 4: Working Groups

7. Major findings and recommendations from the Workshop on *Advances in Sea Cucumber Aquaculture and Management* (ASCAM), 14-18 October 2003, Dalian, China.

8. Establishment of working groups: tasks, composition and reporting

9. Working group sessions (addressing conservation strategies;` fisheries management; `national and international measures; and potential CITES implementation issues)

Session 5: Working group reports; findings and recommendations

10. Working group reports

11. Identification of priorities and actions to secure the conservation status of sea cucumbers in the families Holothuridae and Stichopodidae

12. Implementation of Decision 12.60 by the Animals Committee: communication and reporting to the Conference of the Parties

13. Closure of the workshop

INTRODUCTION

At the 12th meeting (Santiago, 2002), the Conference of the Parties adopted Decisions 12.60 and 12.61 related to sea cucumbers within the families Holothuriidae and Stichopodidae. The CITES Secretariat was mandated through Decision 12.61 to convene a technical workshop on the conservation of sea cucumbers in cooperation with relevant bodies with the outcomes to be reviewed by the Animals Committee. The *technical workshop on the conservation of sea cucumbers in the families Holothuriidae and Stichopodidae* was held from 1-3 March 2004 in Kuala Lumpur, Malaysia.

The objectives of the three-day workshop were as follows:

a) to review information on the status, catches and bycatches of and trade in specimens of sea cucumbers within the families Holothuridae and Stichopodidae; and on domestic measures for their conservation, including considerations of the adequacy of these measures;

b) to establish conservation priorities and actions to secure the conservation status of sea cucumbers within the families Holothuridae and Stichopodidae, addressing *inter alia* trade monitoring and controls, national legislation and regulations, fisheries management options, conservation management and research, enforcement and capacity building; and

c) to consider and review biological and trade information, and to assist in establishing conservation priorities and actions to secure their conservation status. The workshop will deal with species that are currently not listed under CITES, but for which CITES offers an important forum to address their conservation, management and regulatory needs.

The workshop was conducted in English and was attended by 56 participants, bringing together representatives of the fisheries sector, exporting and importing countries, intergovernmental organizations such as FAO, knowledgeable non-governmental organizations, and other stakeholders and experts.

The workshop began (Session 1) with a review by Chantal Conand, Emeritus Professor, University of La Réunion of the biology, taxonomy and distribution of sea cucumbers in the families Holothuridae and Stichopodidae; a short description of the main species in trade; a summary of the conservation status of sea cucumbers and the main threatsaffecting these families; and a report on the knowledge gaps and research priorities for biology, taxonomy and conservation.

Professor Conand then followed with a presentation on the levels of harvest and trade in sea cucumbers, with indications of recent trends in harvest and trade, main fisheries, main exporting and importing countries, sources of sea cucumbers (i.e. wild or aquaculture), origins, bycatch, trade routes, and principal species in trade; a description of sea cucumbers used as food, in Traditional East Asian Medicines, live aquarium trade, and other uses, and the socio-economic aspects of the sea cucumber fishery, including relative economic importance, a description of the chain of custody, values and prices, and market trends.

In Session 2, Dr Andrew Bruckner, NOAA Fisheries, U.S. Department of Commerce presented a summary of current sea cucumber fishery practices and management options, with discussion on opportunities for sustainable wild harvest, aquaculture, efforts to enhance wild populations and trade controls. Mr Glenn Sant, TRAFFIC Oceania, provided a general background on the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES); the different implementation requireements for species of sea cucumbers that may belisted in either Appendix II or Appendix III; and non-CITES related institutional measures. Ms Verónica Toral-Granda, Charles Darwin Foundation Ecuador, ended the session with a discussion of the inclusion of *Isostichopus fuscus* in Appendix III by Ecuador.

In Session 3, 16 country delegates presented country status reports. Delegates reported on the status, fisheries and trade in sea cucumbers in the families *Holothuriidae* and *Stichopodidae* in their country, addressing national policies on management, conservation and protection.

In Session 4, the major findings and recommendations from the Workshop on *Advances in Sea Cucumber Aquaculture and Management (ASCAM)* held in China on 14-18 October 2003 were presented by Mr Alessandro Lovatelli, FAO Fishery Resources Division, Italy. Three working groups were established and tasks were assigned under the Terms of Reference at the conclusion of the session.

In Session 5, working groups conferred and then reported their findings on:

(1) National fisheries management;

(2) Priorities for international conservation and protection; and

(3) Potential CITES implementation issues.

In the last session the implementation of Decision 12.60 by the Animals Committee and the communications and reporting to the Conference of the Parties were discussed. As defined by the objectives of the workshop, comments were made on the preparation of a discussion paper on the biological and trade status of these sea cucumbers to provide scientific guidance on the actions needed to secure their conservation status for consideration at the 13th meeting of the Conference of the Parties (October 2004).

TERMS OF REFERENCE OF WORKING GROUPS

Working group 1: National fisheries management

Task:

1. Identify and review existing and potential national fisheries measures for conservation and management of sea cucumbers in the families Holothuriidae and Stichopodidae.

2. Identify and prioritise elements of workable management plans, including adaptive management measures, fishery-dependent and fishery-independent monitoring activities, and reporting.

3. Evaluate the pros and cons of the proposed fishery management measures from a biological, socio-economic and enforceability standpoint.

4. Provide suggestions to which audiences and actors these fisheries management actions should be directed, and to what taxa and geographical regions they could apply.

5. Formulate and prioritise recommendations and actions to ensure adequate fisheries management of sea cucumbers in the families Holothuriidae and Stichopodidae.

Take into consideration:

- Recommendations from the FAO workshop.
- Trade characteristics: single species/multiple species; international/national and local; food/medicinal/live; captive bred/aquaculture/wild collected; artisenal/targeted/bycatch removal;
- Management options: quotas; size limits; certification and labelling; aquaculture; restocking; gear restrictions; licensing; MPAs and habitat protection; and
- Challenges: knowledge, costs, time, resource needs, socio-economic implications.

Outputs:

A prioritised list of fisheries management options, that should lead to better conservation and management of sea cucumbers in the families Holothuriidae and Stichopodidae. Identify for each the pros and cons, actors and audiences, cost and benefits, regional and taxonomic scope, and feasibility.

Working group 2: Priorities for international conservation and protection

1. Review the biological and trade status of sea cucumbers within the families Holothuriidae and Stichopodidae and identify and prioritise the threats to their long-term survival.

2. Indicate the bio geographical hotspots for sea cucumbers in the families Holothuriidae and Stichopodidae, and the taxa that are most under threat and/or require most urgently conservation attention.

3. Review approaches to regionally and internationally manage and conserve sea cucumbers in the families Holothuriidae and Stichopodidae, taking into consideration voluntary measures, guidelines and certification, and regional or international regulatory measures (incl. CITES). Prioritise these policies.

4. Assess biological, social and economic requirements and implications of the different policies, and recommend actions by relevant stakeholders.

5. Provide suggestions to what taxa and geographical regions these measures should apply, and to which audiences and stakeholders they should be directed.

Take into consideration:

- Biological and trade information on sea cucumbers in the families Holothuriidae and Stichopodidae.
- Research needs.
- The costs and benefits of different international measures and policy options in terms of implementation, enforcement and control, social and economic impacts, resource requirements, conservation, future utilization of the resource.
- Recommendations from the FAO workshop.

Outputs:

- A list of bio geographical 'hot spots' for sea cucumbers in the families Holothuriidae and Stichopodidae
- A list of taxa of conservation concern, with justifications and an indication of measures to be taken to ensure their long-term management and conservation.
- A table listing types of measure identified (voluntary; regulatory; regional and international) with proposed actions, and identifying for each the implications for the stakeholders, and the impact on conservation and management of sea cucumbers in the families Holothuriidae and Stichopodidae.

Working group 3: Potential CITES implementation issues

Task:

1. Discuss the appropriateness and feasibility (costs and benefits) of CITES as a tool to assist in the management and conservation of sea cucumbers in the families Holothuriidae and Stichopodidae.

2. Identify the scientific and management requirements concerning the inclusion of species of sea cucumbers in the families Holothuriidae and Stichopodidae in the Appendices of CITES, and assess the needs to and possibilities of range States in meeting these requirements.

3. Address options on how to handle the problem of illegal, unrecorded and unregulated trade, considering CITES and other mechanisms.

4. Address options for enforcement, includingidentification problems for specimens of sea cucumbers in the families Holothuriidae and Stichopodidae in trade, and how to control international trade in parts, derivatives, and finished products.

Take into consideration:

- CITES provisions concerning trade in species included in Appendix II and III.
- Article IV of the Convention (the making of Non-detriment Findings; legal acquisition).
- Species and specimens in international trade (whole live and dried; parts and derivatives; processed products; origins of specimens in trade) and their taxonomy.
- Identification issues, including recognition of specimens in international trade to the species level, labelling and marking.
- Taxa and range States of particular concern.
- Controls of international trade in CITES-listed species, and CITES reporting and data gathering requirements.
- Recommendations from the FAO workshop.

Outputs:

- An evaluation of the pros and cons of including species of sea cucumbers in the families Holothuridae and Stichopodidae in the Appendices of CITES.
- If appropriate suggestions for further CITES activities concerning the management and conservation of sea cucumbers in the families Holothuriidae and Stichopodidae, including geographical and species priorities.
- A list of measures that range States should consider in case species of sea cucumbers in the families Holothuriidae and Stichopodidae are included in Appendix III or II, indicating their feasibility, implications for stakeholders, practical recommendations for their implementation, and an evaluation of their costs and benefits.

Report from WORKING GROUP 1

National fisheries management

Participants: *Warwick Nash (Chairman), Jun Akamine, Irma Alfonso, Ahmad Ali, Manfred Altamirano, Mark Baine, Andy Bruckner, Liz Burgess (Rapporteur), Chow Wing-kuen, Ridzwan Hashim, Dinorah Herrero, Ramli Khamis, Ludivinia Labe, Grant Leeworthy, Stephen Sly, Alvin Wong, Suhaila Mohd. Omar, Rozeta Zaharan.*

General Recommendations

1. National Management Programs

- A number of management tools have been recommended or are in use in countries with sea cucumber fisheries, such as minimum size, gear restrictions, spatial and seasonal closures, rotational harvest, limited entry have biological and economic benefits. Adoption of these measures need to be considered through an adaptive management process based on the status of the fishery, available information, and feasibility within each location.

- There is no one best management tool. Specific management measures that are practical and can be adopted will depend on the particular circumstances in each fishery, with specific considerations for tropical and temperate fisheries; number of target species; existing knowledge and capacity; and fishery arrangements.

- Where possible and appropriate, management development should involve community participation, with emphasis on building a sense of community resource ownership.

- As an initial step, three different management scenarios could be developed depending on the existing arrangements, including:

    1) open-access fisheries with little or no information on the fishery;

    2) marine tenure or community-based managed areas with some knowledge of the fishery;

    3) local to national managed fisheries with certain protective measures in place and methods to obtain catch and resource data but an incomplete understanding of effectiveness of measures and critical gaps in necessary information.

The essential steps of an adaptive management process could include:

1) Characterization of the fishery (number of fishers, location and amount of catch by species etc), markets and domestic trade routes;

2) Application of minimum size limit for export;

3) Evaluation of minimum size limit on sea cucumber populations using fishery dependent data and population assessments;

4a) If catch data and/or population data indicate the fishery is declining, small area closures would be implemented within collection areas; or

4b) In absence of sufficient fishery dependent/independent data area closures and other options such as seasonal closures and rotational harvest could be applied as a precautionary approach;

5) As soon as sufficient data are available, a total allowable catch should be implemented;

6) If stocks continue to decline, the implementation of total area closures for the affected species are recommended to allow recovery of stocks; and

7) Catch data and population surveys should continue to be obtained and analyzed; for the worst case scenario described in #7, the fishery could be reopened at precautionary levels once population surveys indicate recovery.

- More specific recommendations on an adaptive management process could be made on country by country basis through an analysis of present fishery status, existing management measures, and perceived problems using information obtained from country reports presented at ASCAM and CITES workshops, beche-de-mer bulletin and other publications, and through expert consultations.

- There is some information that certain sea cucumber populations and/or species are in decline and pressures on these resources are increasing. Given the vulnerable status of these fisheries, difficulties in obtaining critical data needed for management, and challenges in implementing protective measures to address overexploitation, international measures such as a CITES Appendix II listing could offer substantial benefits through the required reporting of trade statistics and the non-detriment finding provided by this listing.

2. Resource, fishery and trade monitoring and data acquisition

- Countries should work to implement monitoring programs with emphasis on:
  1) improved collection, reporting and information sharing of fishery-dependent data on species-specific catch, effort, sizes, locations; and
  2) implementation of field monitoring programs to obtain information on cucumber distribution, densities, and other relevant data.

- Standards for reporting of exports by species and products should be encouraged. Trade routes should be identified and if possible, they should be consolidated. Legitimate trade routes should be encouraged to prevent the proliferation of black market trading that hampers the accurate estimation of stock removals.

- Wherever possible, existing monitoring programs should be encouraged to add sea cucumbers to their purview. While the specific method used to monitor populations can vary, standardized approaches should be utilized within individual fisheries to allow comparison of data over time, with pilot studies undertaken to identify the optimal approach for the particular situation. Field monitoring should utilize stratified random sampling approaches to obtain relevant information for each habitat type or zone, with sufficient replication in as many locations as feasible.

- Sea cucumber fishers, industry and community members should be encouraged to participate in monitoring programs. Technical assistance should be provided in the form of training programs in monitoring approaches, species id, and application of monitoring data towards management should be recommended.

3. Education and capacity building

- One of the greatest needs is for improved education, training and dissemination of resource tools to assist in sea cucumber identification, best collection practices, reporting provisions, processing techniques, and management approaches for all levels of the chain of custody as appropriate (e.g., local fishers, processors, buyers, middlemen, resource managers and owners, and enforcement officials).

- Communication networks should be encouraged, possibly through a web-based forum, with emphasis on possible regional networks that transfer information and provide technical assistance to local communities through some form of national/rural extension network. This could be attached to existing networks or programs (e.g., SPC, SPREP) or involve the creation of a more specific network for related multispecies (invertebrate) fisheries. New programs that have started since this workshop was held are compiled in a table prepared in 2006 by Conand and Bruckner.

- National and local advisory groups involving fishers, processors, buyers, resource owners/managers and fisheries agencies should also be encouraged to enhance conservation and management, and address socioeconomic needs.

4. Enforcement

- There is an overarching need to improve enforcement capacity to address poaching and illegal trade, and ensure that user groups adhere to adopted management measures. The specific enforcement approach will depend on the individual circumstances and could involve national or local governments, or communities. An effective enforcement program in developing countries is likely to require substantial support and assistance from developed countries.

Output 1: Prioritised list of fisheries management options **Table I**

The management measures in the following table were prioritised by feasibility, achievability and relative ease of obtaining the necessary information to implement them. The fishery management measures in the table below may be used individually or in combination. For some species it is likely that more than one measure will be necessary to ensure sustainability.

Priority Measure	Recommendations	Comments	Information needs
Minimum size limit (SL)	That a minimum size limit be set, based on size at onset of sexual maturity (OSM). The SL regulation should be based on dried animals. Recognizing the difficulty of enforcing individual SL for each species, two alternative approaches are proposed: (1) that four size limits be set; (2) that a SL be set in a form of relevance to the trade—i.e., ban trade in the XS (extra small) and perhaps S (small) categories. To avoid the wasteful harvesting of undersized sea cucumber it is recommended that communities be educated as to the minimum wet length of sea cucumber species so that undersized sea cucumber are not harvested. Wet SL should be set for each species, based on size at OSM.	Minimum SL was identified as an important measure to protect against overfishing and recruitment failure if set at a level that ensures adequate reproduction below the SL. Minimum SL based on wet weight is impossible because of extreme size/shape changes. If international/regional SLs are set, these should be regarded as minima for each country. Each country may choose to set higher SL to provide further protection if desired, or if biological analysis demonstrates this is advisable. Since bêche-de-mer is traded in various forms (dried, frozen, salted, etc) a SL for only dried product is practical since all other forms have variable water content and therefore degrees of shrinkage. Note that, under the PNG BDM FMP, trade in portions of bêche-de-mer is prohibited. This should be adopted so that chopped undersized bêche-de-mer are not sold. A minimum SL on dried product will not work for value-added product (pills, meals, etc) created in-country. This needs to be addressed. A minimum SL is not sufficient for species where juveniles are not findable (i.e., the catch is only of mature adults), (e.g., *Holothuria nobilis*) but still are prone to depletion. So SL needs to be used in combination with other measures to constrain fishing pressure.	Samples of each species, spanning the size range over which the transition from immature to sexually mature is made, should be taken. Sexual condition (male, female, immature) should be determined for each animal by inspecting the gonad. The maturation ogive (an S-shaped curve, from 0% mature to 100% mature with increasing size) should be created. The size at 50% maturity is then determined, and the minimum SL set as slightly above this length. (With information on growth and the length-fecundity relationship, it is possible to use more detailed methods (egg-per-recruit analysis) to determine an appropriate SL more precisely.)

Priority Measure	Recommendations	Comments	Information needs
Area closures	That communities identify good habitat for their commercially harvested sea cucumber species, and set aside a portion of habitat in a protected area for protection of a portion of the population to safeguard against depletion of spawning stock biomass. Spatial closures are recommended as a possible tool to enhance stocks in surrounding fished areas but these need to be flexible and developed using best available information on current flows (likely 'source' and 'sink' areas), sea cucumber biology, and community needs and interests.	In principle the idea of protecting a portion of a fished population within areas closed to fishing makes sense. The effectiveness of this management measure depends on its location with respect to larval transport (sources and sinks), and on planktonic larval duration (among other things). In areas with resource tenure, closures may have to be very small, thus communities should be encouraged to identify areas with diverse, high density sea cucumber areas that could be protected to maximize possible benefits. It is noted that setting aside marine protected areas can foster within a community a sense of stewardship and sustainable fishery management, and this may include the re-establishment of traditional fishery management measures.	Information for optimal placement and size of protected areas is difficult to obtain. In many countries and locations it will not be possible to obtain this information. It may be necessary (and sufficient) to use local knowledge on water currents and species to best locate a closed area. In many places it will be necessary to obtain the approval of the local community in the location of the reserve.
Total Allowable Catch (TAC)	That the effectiveness and enforceability of a TAC for sea cucumber be evaluated by reviewing its success elsewhere (e.g., in Papua New Guinea, where a TAC is part of the management plan: The TAC should be set for each Province using the best information available.)	It is noted that a TAC may be an effective way of controlling fishing, but may require large amounts of monitoring for effective compliance. A TAC may be set in two ways: (1) as a proportion of the spawning stock biomass (e.g., 30% in Mexico); or (2) from historical catch records. The latter approach can only work when there is a long time series of catch (and catch rate) data. It is noted that a TAC is appropriate when stock levels are in good condition but TAC will likely be too high if stocks have become depleted. Monitoring of catch as it happens is essential. Implementation and compliance are likely to be major obstacles in many countries. A TAC would have to be set for each species to avoid serial depletion. This is probably impossible if using method (2) because catch data are not often collected by species (this applies especially to catch rates). There may be equitability issues associated with quotas when issued as individual quotas; or in the case of a competitive TAC may result in uncontrolled fishing and likely quota over-runs.	Method 1: Estimates of abundance of fishable biomass (i.e., of legal size). These may be obtained using area-based (e.g., transect) methods, or other methods where appropriate. This is most feasible, and likely to be more reliable, when the fishing areas are small (as in Mexico). Method 2: From a time series of catch data, determine catch levels at which harvests appear sustainable. (This is a very simplified approach, but not much more may be possible in most of the countries.)

Priority Measure	Recommendations	Comments	Information needs
Gear restrictions	1. Diving (SCUBA or HOOKAH): Prohibition on use of compressed air was not supported, but depth restrictions and education on safe diving practices are essential. 2. Trawling: A prohibition on the use of trawl gear is not feasible, but efforts should be directed towards minimizing habitat damage overall and protecting vulnerable habitats that are important for sea cucumbers and other species. In general, trawling should be prohibited in any high relief coral or rocky bottom habitat to reduce bycatch and habitat damage to these fragile habitats, and gear should be as benign as possible.	Pros: Some fisheries (e.g., U.S.) can only feasibly involve harvest using dive gear, as other methods (trawling) would be more destructive. Cons: Trawling is the only possible method in deep water.	
Rotational harvest	Rotational harvest could benefit certain fisheries but it would have to be used in combination with other management tools.	Pros: Can offer biological benefits by allowing individuals to achieve a larger size Cons: Very difficult to implement in areas with resource tenure like Fiji, where community-owned.	Determining appropriate rotation rates requires adaptive management (i.e., not feasible to determine this using population or recruitment information).
Seasonal closures	Seasonal closures could include closures during reproductive periods to protect spawning stock, or closures during other times of the year to reduce overall effort. However natural closures during certain periods of the year (such annual closures during the monsoon season) would still be beneficial to sea cucumber populations.	Where the reproductive season is extended over many months, seasonal closure must be for reasons other than to protect reproductive stock. The multi-species nature of many fisheries, and the asynchrony of spawning season between species, compounds the problem. It is noted, however, that restricting the fishing season, for whatever reason, provides conservation benefits by constraining fishing mortality.	Where the rationale for closure is the spawning season, information on duration of the spawning season is needed.
Limited entry	Limited entry provides a way to cap effort and get information on the fishery with required submission of logbooks.	Cons: Not feasible to implement in countries where limited entry is not acceptable for social or cultural reasons.	Requires a socio-economic analysis to determine impacts and benefits of this approach.

Report from WORKING GROUP 2

Priorities for international conservation and protection

Participants: Kim Friedman (Chairman), Sufian Ahmad, Karl Aiken, Daud Awang, Chantal Conand, Giam Choo-hoo, Allen Hansen, He Jian Xiang, Paula Henry (Rapporteur), Jeff Kinch, Alessandro Lovatelli, Stanley Qalovaki, Yves Samyn, Glenn Sant, Yusof Sharif, Sukarno Wagiman.

Some qualifying statements to introduce the tables presented

Sea cucumber fisheries have a long history of exploitation, with records dating back to the early 18th century. These fisheries should be viewed through 3 characteristics: multi-specific versus mono-specific; tropical versus temperate; traditional (artisenal) versus recent (industrial).

There was no scientific evidence or perception from the working group that sea cucumber stocks presently under exploitation were in any way at risk from extinction. Generally, sea cucumber stocks reach a scarcity level that makes them un-economic to fish long before critical levels of stock failure are reached. The negative effects of stock depletions are not known. The recorded 'boom and bust' nature of these fisheries (unregulated) has followed recoveries and declines in stock abundance.

From an international perspective the technical committee recognized that the framework that would support sea cucumber fisheries management and reporting is at an early stage of development for most fishing nations.

Basic biological and ecological information is still limited for most commercial species. In addition, the recorded history of fisheries is not detailed enough to allow useful determination of sustainable catch rates.

The establishment of appropriate management for sea cucumber fisheries is generally hampered by this situation.

However, it is critical for the following measures to be seen as a priority, and for there to be some leverage which promotes the development of management strategies and harmonised trade reporting.

Explanatory notes to describe criteria discussed when formulating the levels of concern designations

1) High concern
2) Concern in certain countries of its range
3) Potential for future concern as harvests increase
4) No concern
5) Minor species of little commercial importance

The criteria used for designating concern levels do not relate to perceptions that stocks of sea cucumbers are in danger of extinction. The levels 1-5 reflect concerns for more careful management and trade stabilisation.

Criteria used to designate categories 1-5 took into account the following 7 elements:

- Commercial value;
- Vulnerability to harvest and environmental fluctuations;
- Geographic distribution;
- Historical and present status of the different populations;
- Importance in the world trade;
- Concern raised by several countries; and
- Knowledge of particular life strategies (e.g. slow growth) or genetic information (e.g. isolated populations)

Output 1: Geographical Hotspots

1. East Coast of Africa and the Red Sea, including:

   Egypt, Kenya, Mozambique, Somalia, Sudan, Tanzania, Yemen and the West Indian Ocean Island countries, including Comoros, Madagascar, Seychelles

2. Western Pacific, including:

   Fiji, New Caledonia, Papua New Guinea, Solomon Islands, Tonga, Vanuatu

3. Asia, including:

   China, Indonesia, Malaysia, Philippines, Thailand, Viet Nam

4. Central and north western part of South America, including:

   Costa Rica, Ecuador, Guatemala, Honduras, Mexico

Output 2: Main commercial holothurian species

A list of taxa of conservation concern, with an indication of measures to be taken to ensure their long-term management and conservaton (see See Annex 1, Tables 1 and 2)

Output 3: Types of measures identified with proposed actions

A table listing types of measure identified (voluntary; regulatory; regional and international) with proposed actions, and identifying for each the implications for the stakeholders, and the impact on conservation and management of sea cucumbers in the families Holothuridae and Stichopodidae (see Annex 1, Table 3)

Statement of Priority

There is a high demand for sea cucumber products on the international market has caused the over-exploitation of certain fisheries. Inadequate or non-existent appropriate management plans at both national and regional levels have allowed such exploitation to take place. It is highly recommended that relevant regional and international institutions be engaged in the preparation of management plans.

Priority actions to be taken concern trade measures, fishery assessments and basic research studies, as well as public awareness.

Table 1 - Main commercial holothurian species (Stichopodidae, Holothuriidae and Cucumariidae)

CONCERN LEVEL	SPECIES * taxonomy to be revised	FAMILY	COMMON NAME	CONCERN COMMENT NOTE: Indonesia and the Philippines, both producers of significant quantities of sea cucumbers for export have limited data available of what is fished and the state of stocks	Commercial value 1: high; 2: medium: 3: low	REGION	FAO code
2	*Actinopyga echinites**	Holothuriidae	Deep water redfish	Taxonomic only	2	Pacific Western Central, Indian Ocean Eastern	PWC 71 IOE 51 IOE 57
3	*Actinopyga lecanora*	Holothuriidae	Stonefish	Zone 2, notable in PNG fishery	2	Pacific Western Central, Indian Ocean Eastern	PWC 71 IOE 51, IOE 57
2	*Actinopyga miliaris* *	Holothuriidae	Blackfish	Taxonomic confusion - species mixing, Zone 2, susceptible to harvest, Species found at high densities in protected bays (shallow water), widely distributed	2	Pacific Western Central, Indian Ocean Eastern	PWC 71 IOE 51, IOE 57
2	*Actinopyga mauritiana**	Holothuriidae	Surf redfish	Zone 1, esp. Red Sea	2	Pacific Western Central, Indian Ocean Eastern	PWC 71 IOE 51, IOE 60
4	*Actinopyga palauensis*	Holothuriidae			2	Pacific Western Central, Indian Ocean Eastern	PWC 71 IOE 51, IOE 61
5	*Bohadschia atra*	Holothuriidae			3	Pacific Western Central, Indian Ocean Eastern	PWC 71 IOE 51, IOE 62
3	*Bohadschia argus*	Holothuriidae	Tigerfish	Future species of concern, Zone 2	3	Pacific Western Indian Ocean Eastern	PWC 71 IOE 63
4	*Bohadschia marmorata**	Holothuriidae	Brown sandfish	This species and *B. vitiensis* intereported due to similarities in appearance	3	Pacific Western Central, Indian Ocean Eastern	PWC 71 IOE 51, IOE 64
4	*Bohadschia vitiensis**	Holothuriidae	Brown sandfish	This species and *B. marmorata* intereported due to similarities in appearance	3	Pacific Western Central, Indian Ocean Eastern	PWC 71 IOE 51, IOE 65
5	*Bohadschia subrubra*	Holothuriidae	Tigerfish		3	Central, Indian Ocean Eastern	IOE 51, IOE 66
4	*Bohadschia similis*	Holothuriidae	Chalkfish		3	Pacific Western Central, Indian Ocean Eastern	PWC 71 IOE 51, IOE 67

Table 1(cont) - Main commercial holothurian species (Stichopodidae, Holothuriidae and Cucumariidae)

CONCERN LEVEL	SPECIES * taxonomy to be revised	FAMILY	COMMON NAME	CONCERN COMMENT	Commercial value 1: high; 2: med; 3: low	REGION	FAO code
5	*Holothuria arenicola*	Holothuriidae			3	Pacific Western Central, Indian Ocean Eastern	PWC 71, IOE 51, IOE 68
5	*Holothuria cinerascens*	Holothuriidae			3	Pacific Western Central, Indian Ocean Eastern,	PWC 71, IOE 51, IOE 69
4	*Holothuria atra*	Holothuriidae	Lollyfish		3	Pacific Western Central, Indian Ocean Eastern,	PWC 71, IOE 51, IOE 70
4	*Holothuria coluber*	Holothuriidae	Snakefish		3	Pacific Western Central, Indian Ocean Eastern,	PWC 71, IOE 51, IOE 71
4	*Holothuria edulis*	Holothuriidae	Pinkfish		3	Pacific Western Central, Indian Ocean Eastern,	PWC 71, IOE 51, IOE 72
1	*Holothuria fuscogilva**	Holothuriidae	White teatfish	Zones 1, 2, 3. Species not easily accessible (deep water refuge provides surrogate protection). Slow growth and high commercial value. Even qotas in well managed fisheries (E. coast Australia) have been reduced as a precautionary measure.	1	Pacific Western Central, Indian Ocean Eastern	PWC 71, IOE 51, IOE 73
3	*Holothuria fuscopunctata*	Holothuriidae	Elephant trunkfish	Future species of concern, Zone 2. Species not easily accessible (deep water refuge provides surrogate protection).	3	Pacific Western Central, Indian Ocean Eastern,	PWC 71, IOE 51, IOE 74
4	*Holothuria leucospilota*	Holothuriidae			3	Pacific Western Central, Indian Ocean Eastern,	PWC 71, IOE 51, IOE 75
5	*Holothuria impatiens*	Holothuriidae		low commercial value - some concern in Madagascar.	3	Pacific Western Central, Indian Ocean Eastern,	PWC 71, IOE 51, IOE 76

Table 1(cont) - Main commercial holothurian species (Stichopodidae, Holothuriidae and Cucumariidae)

CONCERN LEVEL	SPECIES * taxonomy to be revised	FAMILY	COMMON NAME	CONCERN COMMENT	Commercial value 1: high; 2: med; 3: low	REGION	FAO code
1	*Holothuria nobilis** *(H. whitmaei* in EIO and Pacific)	Holothuriidae	Black teatfish	Zones 1, 2, 3. Susceptible easily accessed shallow water stock of concern. Slow growing species found at low densities. Even in well managed fisheries (e.g. East coast Australia) the quota has needed to be withdrawn pending further studies.	1	Pacific Western Central, Indian Ocean Eastern,	PWC 71, IOE 51, IOE 77
1	*Holothuria scabra*	Holothuriidae	Sandfish	Zones 1, 2, 3. Susceptible shallow water stock (studies presently planned to investigate for deeper water stocks in Australia). Muddy bottom species easily targeted. Can be found at high densities. Subject to population fluctuations due to environmental location. Genetically isolated populations found on relatively small scales. Represents most of the global market. Aquaculture potential. Evidence of localised economic depletions found across Pacific, Madagascar, Tanzania, Red Sea. Australia presents a contrary view with a stable fishery at 200-300 metric tonnes (wet weight) per annum.	1	Pacific Western Central, Indian Ocean Eastern,	PWC 71, IOE 51, IOE 78
2	*Holothuria scabra var. versicolor**	Holothuriidae	Golden sandfish	Zone 2. More information needed for other zones. Catches of this species are often reported under sandfish. Has a high commercial value.	1	Pacific Western Central, Indian Ocean Eastern,	PWC 71, IOE 51, IOE 79
4	*Pearsonothuria graeffei*	Holothuriidae	Flowerfish		3	Pacific Western Central, Indian Ocean Eastern,	PWC 71, IOE 51, IOE 80
2	*Stichopus chloronotus*	Stichopodidae	Greenfish	Future species of concern, Zone 2. Value increasing.	2	Pacific Western Central, Indian Ocean Eastern,	PWC 71, IOE 51, IOE 81
2	*Stichopus herrmanni* * *(formerly S. variagatus)*	Stichopodidae	Curryfish	Zones 1, 3. Future concern in Zone 2. Found in protected waters, easily fished, problems with processing.	2	Pacific Western Central, Indian Ocean Eastern,	PWC 71, IOE 51, IOE 82

Table 1(cont) - Main commercial holothurian species (Stichopodidae, Holothuriidae and Cucumariidae)

CONCERN LEVEL	SPECIES * taxonomy to be revised	FAMILY	COMMON NAME	CONCERN COMMENT	Commercial value 1: high; 2: med; 3: low	REGION	FAO code
2	*Stichopus horrens*	Stichopodidae	Dragonfish	Zones 3, especially in parts of Malaysia and Thailand.	3	Pacific Western Central, Indian Ocean Eastern, Indian Ocean Eastern	PWC 71 IOE 51, IOE 83
1	*Thelenota ananas*	Stichopodidae	Prickly redfish	Zones 1, 2, 3. Large species of medium to high value. Susceptible due to low fecundity and late sexual maturity.	1	Pacific Western Central, Indian Ocean Eastern,	PWC 71, IOE 51, IOE 84
3	*Thelenota anax*	Stichopodidae	Amberfish	Potential replacement of higher value species.	2		
4	*Thelenota rubralineata*	Stichopodidae		Large species; poorly known	3	Pacific Western	PWC 71
3	*Athyonidium chilensis*	Cucumariidae		More info needed. Recent non-traditional fishery.		Pacific Southeast	PSE 87
5	*Stichopus mollis*	Stichopodidae				Pacific Southwest	PSW 81
4	*Apostichopus japonicus*	Stichopodidae			1	Pacific Northwest	PNW 61
4	*Parastichopus parvimensis*	Stichopodidae				Pacific Eastern Central	PEC 77
3	*Parastichopus californicus*	Stichopodidae		Future concern	2	Pacific Eastern Central	PEC 77
1	*Isostichopus fuscus*	Stichopodidae		Concern in Ecuador, (Galapagos) and Mexico. Note small range. Generally mono species fishery without other options for fishers. Pls refer to Doc. 6.4	2	Pacific Eastern Central	PEC 77
3	*Cucumaria frondosa*	Cucumariidae			2	Atlantic Northwest	ANW 21
4	*Actinopyga agassizi*	Holothuriidae			3	Atlantic Western Central	AWC 31
4	*Holothuria mexicana*	Holothuriidae			3	Atlantic Western Central	AWC 31
4	*Astichopus multifidus*	Stichopodidae			3	Atlantic Western Central	AWC 31
3	*Isostichopus badionotus*	Stichopodidae			3	Atlantic Western Central	AWC 31

Table 2. Main commercial holothurian species from concern levels 1, 2 and 3 (see Table 1)			
CONCERN LEVEL	**SPECIES * taxonomy to be revised**	**FAMILY**	**MEASURES THAT COULD BE TAKEN**
1	*Holothuria fuscogilva**	Holothuriidae	High level of concern. Generally overfished. Exporting countries need to have a regionally harmonised national management plan for this species. Need Internationally harmonised reporting codes for export. Priority given to this species for basic biological and ecological research and stock assessments.
1	*Holothuria nobilis**	Holothuriidae	High level of concern. Generally overfished. Exporting countries need to have a regionally harmonised national management plan for species. Need Internationally harmonised reporting codes for export. Priority given to this species for basic biological and ecological research and stock assessments.
1	*Holothuria scabra*	Holothuriidae	High level of concern. Generally overfished. Exporting countries need to have a regionally harmonised national management plan for this species. Need Internationally harmonised reporting codes for export. Priority given to this species for basic biological and ecological research and stock assessments.
1	*Thelenota ananas*	Stichopodidae	High level of concern. Generally overfished. Exporting countries need to have a regionally harmonised national management plan for this species. Need Internationally harmonised reporting codes for export. Priority given to this species for basic biological and ecological research and stock assessments.
1	*Isostichopus fuscus*	Stichopodidae	High level of concern. Generally overfished. Exporting countries need to have a regionally harmonised national management plan for this species. Need Internationally harmonised reporting codes for export. Priority given to this species for basic biological and ecological research and stock assessments.
2	*Actinopyga echinites**	Holothuriidae	Compare taxonomic differences in Indian and Pacific populations.
2	*Holothuria scabra versicolor**	Holothuriidae	Medium level of concern. Catches difficult to determine. Exporting need to have a regionally harmonised national management plan for this species. Need Internationally harmonised reporting codes for export. Priority given to this species for basic biological and ecological research and stock assessments.
2	*Actinopyga lecanora*	Holothuriidae	Medium level of concern. Overfishing becoming more widespread. Exporting countries need have a regionally harmonised national management plan for this species. Internationally harmonised reporting codes for export need to be adopted. Priority given to this species for basic biological and ecological research.
2	*Actinopyga miliaris**	Holothuriidae	Medium level of concern. Overfishing becoming more widespread. Exporting countries to have a regionally harmonised national management plan for this species. Internationally harmonised reporting codes for export need to be adopted. Priority given to this species for basic biological and ecological research.

Table 2 (cont) Main commercial holothurian species from concern levels 1, 2 and 3.			
CONCERN LEVEL	**SPECIES * taxonomy to be revised**	**FAMILY**	**MEASURES THAT COULD BE TAKEN**
2	*Actinopyga mauritiana*	Holothuriidae	Medium level of concern. Overfishing becoming more widespread. Exporting countries to have a regionally harmonised national management plan for this species. Internationally harmonised reporting codes for export adopted. Priority given to this species for basic biological and ecological research.
2	*Stichopus herrmanni* *	Stichopodidae	Medium level of concern. Overfishing becoming more widespread. Exporting countries to have a regionally harmonised national management plan for this species. Internationally harmonised reporting codes for export adopted. Priority given to this species for basic biological and ecological research.
2	*Stichopus horrens*	Stichopodidae	Medium level of concern. Overfishing becoming more widespread. Exporting countries to have a regionally harmonised national management plan for this species. Internationally harmonised reporting codes for export adopted. Priority given to this species for basic biological and ecological research.
2	*Stichopus chloronotus*	Stichopodidae	Medium level of concern. Overfishing becoming more widespread. Exporting countries to have a regionally harmonised national management plan for this species. Internationally harmonised reporting codes for export adopted. Priority given to this species for basic biological and ecological research.
3	*Bohadschia argus*	Holothuriidae	Future concern. Overfishing present once higher value species depleted. Exporting countries to have a regionally harmonised national management plan for this species. Internationally harmonised reporting codes for export adopted. Priority given to this species for basic biological and ecological research.
3	*Holothuria fuscopunctata*	Holothuriidae	Future concern. Overfishing present once higher value species depleted. Exporting countries to have a regionally harmonised national management plan for this species. Internationally harmonised reporting codes for export adopted. Priority given to this species for basic biological and ecological research.
3	*Parastichopus californicus*	Stichopodidae	Future concern. Overfishing present once higher value species depleted. Exporting countries to have a regionally harmonised national management plan for this species. Internationally harmonised reporting codes for export adopted. Priority given to this species for basic biological and ecological research.
3	*Isostichopus badionotus*	Stichopodidae	Future concern. Overfishing present once higher value species depleted. Exporting countries to have a regionally harmonised national management plan for this species. Internationally harmonised reporting codes for export adopted. Priority given to this species for basic biological and ecological research.

Table 3. The types of measures identified (voluntary; regulatory; regional and international) with proposed actions, implications for the stakeholders, and the impact on conservation and management of Sea cucumbers in the families Holothuridae and Stichopodidae

MEASURE	DETAILED ACTION	POSSIBLE BODY FOR ACTION OR ASSISTANCE	IMPLICATION FOR STAKEHOLDERS
Basic biology ecology	Taxonomic research	Global Taxonomic Initiative, National and regional Bodies	Trade definition/legal definitions. Distribution awareness. Design of MPA's
	Population parameters (larval, recruitment, growth, mortality)	University	Understanding of species vulnerability in order to design appropriate management strategies
	Restocking issues	WORLDFISH	
	Habitat understanding & effects of sea cucumber removal	IRD, WIOMSA	
Fishery assessment (Density and biomass, indirect measures, MSY)	Design improvement & Harmonization of methodology	SPC, CSIRO, GBRMPA, FAO, WIOMSA	Allow comparisons across regions of fishery experience
	Case study reports (both good &bad)	SPC, USP, FAO, WIOMSA	Potential of understanding of carrying capacity & TAC settings
Trade measures	Harmonization of trade reporting	CITES, FAO, WIOMSA	Understanding catch and trends and commercial activity
	Trade bulletins		Understanding the market
Fisheries management	Management plans with regionally harmonized comparable data collection	FAO, SPC, Other regional fisheries bodies	Stock awareness, achieving optimal sustainability
			Short- to medium-term economic hardship
	Research into restocking effects	WORLDFISH	
Capacity building	Management plans	FAO, SPC,	
	Post harvest for fishers	SPC, FAO WIOMSA	
	Management training for national administrators		
	Training of customs / clearance officers	CITES	
	Research and assessment training	WIOMSA	
Communication and awareness	Educational training material for fishers/ administrator	SPC, CITES	
	Trade bulletin		

Report from WORKING GROUP 3

Potential CITES implementation issues

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Output 1: An evaluation of the pros and cons of including species of sea cucumbers in the families Holothuriidae and Stichopodidae in the Appendices of CITES

Pros:

1. Curtail illegal trade and harvest
2. Requirement for ensuring exports are sustainable (Appendix II)
3. Cessation of overharvest /perpetuation of sustainable fisheries
4. Awareness raising amongst stakeholders and decision-makers
5. Enhanced opportunities for technical assistance and capacity building
6. Could help address FAO concerns about overexploitation, as expressed in the ASCAM workshop (October 2003, Dalian, China)
7. Listing in Appendix II or III can assist in the conservation and management of sea cucumber species for long-term socioeconomic benefits from sustainable fisheries
8. Regulatory measures to comply with CITES provisions
9. Comprehensive and standardized trade and quota reporting, to species level
10. May encourage the development of new Regional Fishery Management Organizations (RFMO's) for sea cucumbers

Cons:

1. Burden on both range countries and importing countries

- Permitting requirements
- Institutional infrastructure to deal with new CITES trade (e.g., cost of management planning, monitoring programs, new research initiatives, development of new legislation, elevated wildlife inspection)
- New training required for trade interdiction and specimen ID
- New set of non-detriment findings with little data
- Regulatory measures to comply with CITES provisions

2. Short-term socio-economic impacts

- Reduction in fisheries income
- Reduction in tax revenue
- Disruption of local fishing communities

3. Potential to diminish cooperation in market surveys, IUU trade investigations

<u>Output 2</u>: If appropriate, suggestions for further CITES activities concerning the management and conservation of sea cucumbers in the families Holothuriidae and Stichopodidae, including geographical and species priorities

"No additional listings" scenario:

1. CITES Parties should endorse the findings of the FAO ASCAM workshop.

2. CITES Authorities should draw the attention of their national fisheries agencies to the importance of sea cucumber fisheries and the vulnerability of particular species in international trade. This could include the need for:

    a. Development of national fishery management plans or fishery regulations
    b. Minimization of sea cucumber bycatch in other fisheries
    c. National or provincial monitoring programs for sea cucumbers of commercial importance
    d. Development of aquaculture and restocking programs, as appropriate

3. CITES Parties should encourage the regional cooperative management of commercially important sea cucumber species, including the formation of appropriate Regional Fishery Management Organizations (RFMO's).

4. CITES Parties should encourage their national fisheries agencies to collaborate in the international development of standardized population surveys and trade monitoring protocols.

5. CITES Parties should raise awareness of sea cucumber conservation problems in other Conventions and agreements.

6. CITES Parties involved in the international trade of sea cucumbers should collaborate in the development of universal marking and labeling schemes for specimens.

"Listing" scenario:

1. Appendix-III listing of *Isostichopus fuscus* by additional range States.

2. Appendix-III listing of additional sea cucumber species where necessary to complement national laws, regulations, and management plans

3. Appendix II

    a. Parties should propose all sea cucumber species currently in commercial trade for inclusion in Appendix II (c. 30-45 spp. in Holothuriidae and Stichopodidae)
    b. Parties should propose limited number of commercially important species in Appendix II and monitor effectiveness
    c. Parties should propose both families Stichopodidae and Holothuriidae under Article II 2(a) and 2(b) (attach annex of all species in these families, noting range states)

4. Adopt measures and decisions noted above in the "non-listing" scenario

<u>Output 3</u>: A list of measures that range States should consider in case species of sea cucumbers are included in Appendix II or III, indicating their feasibility, implications for stake holders, practical recommendations for their implementation, and an evaluation of their costs and benefits.

Appendix III measures:

1. Pre-existing laws, regulations, or management measures that directly affect the international trade in a given species from a given range State.
2. Establishment of a permit issuance system, in coordination with relevant national agencies
3. Consultation as per Res. Conf. 9.25 (rev).
4. Knowledge of species in trade, and forms in which they are traded.
5. Labeling and identification of products in trade.

Appendix-II measures:

1. All measures above, as per Appendix III listing.
2. Nature of export levels: ensure non-detrimental trade.
3. Monitor export levels to ensure species is sustainably harvested and in keeping with its role in the ecosystem.
4. Law enforcement training.

Additional measures to facilitate Appendix-II listing:

1. Feasibility analysis for labeling
2. Identification tools/practical guides and forensic techniques
3. Technical assistance for: population survey methods, quota setting, cooperative management
4. Training and consultation on non-detriment findings
5. Public outreach to stakeholders, decision-makers, NGOs
6. Interagency collaboration between CITES authorities, law enforcement agencies, fisheries agencies, NGOs
7. Call for assistance from other Parties
8. Collaboration with traders, fishers, and others for pragmatic implementation

Sea Cucumber Biology, Taxonomy, Distribution and Conservation Status

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1. Basic information on the biology, taxonomy and distribution of sea cucumbers in the families Holothuridae and Stichopodidae

1.1 Basic information on sea cucumbers

Holothurians have a long history of consumption by oriental populations, mostly chinese and japanese (Conand 1990). The most important sea cucumber product is the dried body wall which is marketed as beche-de-mer (trepang or hai-som). In some countries medicines are produced, for example "gamat oil" in Malaysia (Baine & Choo Poh Sze 1999). Holothurians represent one of the five extant classes of the phylum Echinodermata. Dating back to 460 million years, they are characterized by their lack of segmentation, an endoskeleton of calcareous ossicles and a large coelome with complex chambering giving the ambulacral or water-vascular system where respiration, locomotion and sensory function are combined. The body symmetry is typically pentaradial with a secondary bilateral symmetry. The alimentary canal is complete, the nervous system is not centralized and the reproductive system is simple (Hyman 1955; Boolootian 1966).

They share a typical morphology, with a soft, cylindrical body, elongated from mouth to anus. They lie on the sea floor, on the trivium the three ambulacral zones (ABE of the Carpenter system). They feed using buccal tentacles which morphology varies according to the systematic of the orders within the class.

There are present in all regions of the ocean, from intertidal to deep ocean and from polar to tropical. There are around 1500 species, new species being described each year with an increase of interest on the group (Massin *et al.* 1999; Massin *et al.* 2004, Samyn & Berghe 2000 ; Samyn et al 2001 ;Uthicke et al 2004). The six orders of this class are Dendrochirotida, Dactylochirotida, Aspidochirotida, Elasopodida, Apodida and Molpadida. These are distinguished by the presence or absence of tube feet or podia (ambulacral system), the shape of the mouth tentacles, and the presence or absence of oral retractor muscles, respiratory trees and cuvierian tubules (see Conand 1990 for a general figure of the anatomy). Most commercial species belong to the **Aspidochirota** (families ***Holothuridae*** and ***Stichopodidae***) but a few **Dendrochirota** are showing some interest and will be presented shortly.

*1.2 Basic information on Aspidochirota (*families *Holothuridae* and *Stichopodidae) and Dendrochirota*

Aspidochirota have many oral tentacles of peltate type used to feed on the bottom, as they are, with the exception of the species *Holothuria cinerascens* detritus–feeders. On the trivium (which forms a creeping ventral sole) the podia are arranged in three rows. On the bivium (dorsal surface) they occur in modified forms as papillae. The body wall, the edible part, is composed of an epidermis and an underlying dermis of fibrous connective tissue with spicules, pigments, coelomocytes. The spicules form the internal squeleton. These microscopic calcareous components occur in a wide variety of forms used for the identification, which is there fore not easy and requires special preparations, from different parts of the body (dorsal as well as ventral body wall, tentacles and podia). The main forms are tiny rods, plates, rosettes, buttons, and different kinds of tables.The anatomy is also characterized by the peripharyngeal calcareous ring formed of calcified plates, differing between the species. They are attached to five longitudinal muscles. The digestive tract is long, comprising a muscular pharynx, an oesophagus, and an intestine in three loops. The third loop going backwards terminates into a large cloaca, opening through an anus sometimes ringed with anal teeth (example of *Actinopyga* species).

Two respiratory trees terminate in the cloaca. Cuvierian organs attached at the base of the respiratory trees, are very sticky tubules. They can be expelled through the anus and are used as defensive organs. The reproductive system consists of an unpaired genital gland composed of one or two tufts of tubules, terminating anteriorly by a genital papilla. The main difference between the families Holothuridae and Stichopodidae is the anatomy of the genital gland with one tuft in Holothuridae and two in Stichopodidae which also have special forms of spicules.

Dendrochirota have an introvert, which is a collar of flexible tissue behind the tentacles pulled into the body by retractor muscles; the tentacles are dendritic (branched) adapted to filter-feeding; the body wall is firm or soft; the calcareous ring has developed posterior processes; the separate two gonad tufts characterize this order.

2 . A short description of the main species in trade

Commercial sea-cucumber species are harvested according to the main geographical areas. In general, more interest has been given to the biology of the species targeted in traditional fisheries than to more recent ones. Despite the abundance and the large size of these animals and their importance in benthic communities, little information is published on their population biology, compared with other living marine resources.

Tropical fisheries from the Indo-Pacific are multispecific, whereas temperate fisheries are generally monospecific. Traditional tropical fisheries in the Western-Pacific and Indian Oceans produce dry product. Recently, some countries have started exploitations on the Eastern-Pacific coasts. Temperate fisheries for fresh or frozen product were long limited to the North-Western Pacific Ocean and there are now other countries interested on different species.

Table 1 lists the commercial species according to the geographical regions, based on the FAO zones. When possible the commercial interest from 1 (high value) to 3 (low value) is added in Table 1.

Many species are largely distributed in the tropical Indo-West Pacific. Recent careful observations are showing problems in taxonomy and several of the species listed could be different between these two oceans and necessite revisions. This raises the important issue about modern taxonomy, based on cladistic studies and genetics. This point deserves special attention, as the genetics of holothurians is a new field which should develop, but it is money consuming.

2.1 Indo-West Pacific Regions

The genus are listed alphabetically for the Holothuridae first. Only the species with high and medium commercial value will be presented briefly. More detailed descriptions and photographs are found in several books or papers, as many countries have published inventories (Cherbonnier 1988 ; SPC 1994; Guille *et al.*1986; Conand 1990; Conand 1998; Conand 1999; Richmond 1997; Samyn 2003). A programme granted by WIOMSA, has started in the Western Indian Ocean and will bring new data on the main species, as well as on the fisheries, in view of a better mamagement (Conand et al. 2006 ; www.wiomsa.org)

Genus *Actinopyga*

Actinopyga echinites is a medium sized species whose tegument varies in color, from light brown to orange. It has numerous papillae dorsally and the anus is ringed by five calcareous teeth as for the other species of this genus. The cuvierian tubules are rarely expelled. It is a common species on the shallow reef flats. Some traits of its population biology (densities, reproduction, biometry) have been studied from New Caledonia and Papua New Guinea.

Table 1 - Main commercial holothurian species. Commercial value code 1: high; 2: medium; 3: low. * taxonomy to be revised. [1] *H. whitmaei* has been re-described ; *H.nobilis* distribution is now restricted to the IO , and *H. whitmaei* to the PWC and the W. Coast of Australia

REGION	FAO code	SPECIES	Family	Commercial value
Pacific Western Central-	PWC 71+	*Actinopyga echinites*	Holothuridae	2
Indian Ocean Eastern+	IOE 51+	*Actinopyga lecanora*	Holothuridae	2
	IOE 57	*Actinopyga miliaris* *	Holothuridae	2
Indian Ocean Eastern		*Actinopyga mauritiana*	Holothuridae	2
		Actinopyga palauensis	Holothuridae	2
		Bohadschia atra	Holothuridae	3
		Bohadschia argus	Holothuridae	3
		Bohadschia marmorata *	Holothuridae	3
		Bohadschia subrubra	Holothuridae	3
		Bohadschia vitiensis *	Holothuridae	3
		Bohadschia similis	Holothuridae	3
		Holothuria arenicola	Holothuridae	3
		Holothuria cinerascens	Holothuridae	3
		Holothuria atra	Holothuridae	3
		Holothuria coluber	Holothuridae	3
		Holothuria edulis	Holothuridae	3
		Holothuria fuscogilva	Holothuridae	1
		Holothuria fuscopunctata	Holothuridae	3
		Holothuria leucospilota	Holothuridae	3
		Holothuria impatiens	Holothuridae	3
		Holothuria nobilis	Holothuridae	1
		Holothuria scabra	Holothuridae	1
		Holothuria whitmaei[1]	Holothuridae	1
		H. scabra versicolor	Holothuridae	1
		Pearsonothuria graefei	Holothuridae	3
		Stichopus chloronotus	Stichopodidae	2
		Stichopus hermanni *	Stichopodidae	2
		Stichopus horrens	Stichopodidae	3
		Thelenota ananas	Stichopodidae	1
		Thelenota anax	Stichopodidae	2
		Thelenota rubralineata	Stichopodidae	3
Pacific Eastern Central	PEC 77	*Isostichopus fuscus*	Stichopodidae	
	AWC 31	*Actinopyga agassizi*	Holothuridae	?
		Holothuria mexicana	Holothuridae	?
Atlantic Western Central		*Astichopus multifidus*	Stichopodidae	?
		Isostichopus badionotus	Stichopodidae	?
	PNW 61	*Apostichopus japonicus*	Stichopodidae	1
Pacific Northwest		*Cucumaria japonica*	Cucumariidae	?
	PNE 67	*Parastichopus parvimensis*	Stichopodidae	?
Pacific Northeast		*Parastichopus californicus*	Stichopodidae	2?
Pacific Southwest	PSW 81	*Stichopus mollis*	Stichopodidae	?
Pacific Southeast	PSE 87	*Athyonidium chilensis*	Cucumariidae	?
Atlantic Northwest	ANW 21	*Cucumaria frondosa*	Cucumariidae	?

Actinopyga lecanora is also a medium sized species whose tegument makes it look as a stone. It is relatively rare in most sites and its biology has never been studied.

Actinopyga mauritiana is relatively larger. Its color is variable according to locations, from uniform brown to brown with many white dots and small papillae. There could be different morphs in the Pacific and Indian Ocean. Its habitat is restricted to the outer reef flats under the influence of the surf. Several studies have been conducted on the population biology and particularly the sexual reproduction in New Caledonia, the Solomon Islands, Guam.

Actinopyga miliaris and *Actinopyga palauensis* are two species with black tegument; they are of medium size. Despite the high densities of some populations, there are no references on the populations of these species.

Genus *Bohadschia*

The species are of low commercial value. Their cuvierian tubules are very abundant and sticky which makes the processing difficult. They are collected in countries where the over-exploitation has diminished the other commercial species.

Bohadschia atra is a large species found in Madagascar during an enquiry made with the collectors and recently described (Massin *et al.* 1999). This shows that even large species, exploited in some places are probably still undescribed.

Genus *Holothuria*

Holothuria fuscogilva is one of the two (or more) teatfish species, as the body wall presents lateral processes. It has been described in 1980 by Cherbonnier, but the fishermen from the tropical Pacific used different names for this white teatfish and *H. nobilis* the black teatfish. It is a large species (mean length 40 cm); its color is variable from yellow to grey and often presents brown patches. It is a rather deep species found to 40 m depth, but its densities are generally rather low. An example of scientific over-exploitation appeared due to the monthly sampling in New Caledonia, where the catch per unit effort (CPUE) decreased strongly after a few months.

Holothuria nobilis the black teatfish is entirely black in the Pacific but the presence of white "teats" in the Indian ocean has led to conduct a revision (Uthicke et al. 2004, Uthicke & Byrne pers. comm.). The population biology of the black teatfish has been studied in several countries as this is one of the most exploited species. It is smaller than the white teatfish (with a mean length of 37 cm in New Caledonia; Conand, 1989 ; Shiell & Uthicke 2005). It is a typical reef flat species. It has not yet been studied in details in the Indian Ocean.

The two sandfish *Holothuria scabra* and *Holothuria scabra versicolor (*Conand 1986, 1999*)* have also raised the interest recently. The genetics, as there is no difference in the spicules and calcareous ring and there were some debate about the differences observed, will allow to distinguish them clearly (Rasolofonirina R., Vaïtilingon, D., Eeckhaut, I. & Jangoux M., 2005 and Purcell 2005).

Holothuria scabra is the sand fish, a species largely distributed and probably giving most of the tropical captures for trepang. It shows some variability in color but most often it is entirely gray to dark. Its lateral wrinkles are characteristic. It shows a preference for muddy sands and is often found in the vicinity of mangroves. Many studies and a recent synthesis (Hamel *et al.* 2001) have been conducted on this important species, which is used for stock enhancement or aquaculture in different places (India, the Solomon Islands, Madagascar, Indonesia).

Holothuria scabra versicolor differs by a number of characters, by a larger mean size and a deeper habitat. The dorsal tegument is highly variable from beige to black, with many specimens having black patches. The papillae and tube feet are also more developed. Its seasonal reproductive cycle differs from *H. scabra.*

Many other *Holothuria* species have low value but are often collected when the high valued species are becoming too rare.

Family Stichopodidae

The main Stichopodidae are less numerous they belong to two genera *Stichopus* and *Thelenota*. Their characteristics are: a body square-shaped or trapezoidal in cross section, cuvierian organs always absent, gonad in two tufts appended on each side of the dorsal mesentery and dominant spicules in branched rods and C- and S-shaped rods.

Genus *Stichopus*

The genus *Stichopus* has a bivium covered by tubercules and papillae at least on its sides; the spicules develop as tables, branched rods and C and S rods.

Stichopus chloronotus is a rather small species with a firm body of quadrangular shape; its green tegument gives it the name of greenfish the ventral mouth is surrounded by a row of 20 stout tentacles. It lives in shallow areas of the coral environment, with some populations attaining high densities. Some populations show a high rate of asexual reproduction by fission. The genetic has been compared for Pacific and Indian ocean sites, showing that asexual reproduction is an important feature in most populations, over a wide geographic range, but also that the potential for widespread dispersal mediated by sexually produced larvae is large (Uthicke *et al.* 2001; Conand *et al*.2002).

*Stichopus hermanni (*former *S. variegatus*) is a medium-sized species (mean about 35 cm) with a firm body wall which disintegrates easily when collected as the other *Stichopus.* Its color yellow to greenish gives it its name of curryfish. The bivium is covered by irregular conical warts arranged in 8 longitudinal rows, with smaller papillae in between. It occurs in reefs and lagoons, in sea-grass beds, rubbles and muddy-sand bottoms. As for most species the sexual reproduction takes place during the warm season. Its potential fecundity is low and sexual maturity late, compared with the Holothuridae already studied, which makes it vulnerable to over-exploitation.

Genus *Thelenota*

Thelenota ananas is a large species (maximum length 98 cm, mean 45 cm in New Caledonia) found in the reef environment. Its bright orange-red color and the large papillae makes it very vulnerable to fishing. Its densities are generally low. Its potential fecundity is low and sexual maturity late, compared with the Holothuridae already studied, which makes it vulnerable to over-exploitation. Few studies have been made and the species is now becoming rare.

Thelenota anax is even larger (mean length 60 cm) and rare, but is exploited in several countries. It lives on the white coral sand of the reef slopes and is relatively deep. Nothing is known about its biology.

2.2 Other tropical Regions

Eastern Central Pacific

The fisheries are more recent than in the indo west pacific and target only a few species of large size and thick tegument.

Isostichopus fuscus (Stichopodidae) is exploited in the Golf of California, Mexico, Ecuador mainland and Galapagos islands. It is a conspicuous species (mean length 25 cm), living in the shallow waters (coral and rocky bottoms). Many studies have been conducted on its reproductive biology (Herrero-Perezrul et al. 1999), on the population density and the fishery impact (Toral-Granda and Martinez in press). It is the only sea cucumber which is listed on CITES Appendix III (Ecuador).

Western Central Atlantic

Small fisheries have recently started in Venezuela, Mexico and Cuba, based on *Actinopyga agassizi, Holothuria mexicana (*Holothuridae family*), Astichopus multifidus and Isostichopus badionotus (*Stichopodidae family). The description is after Hendler *et al.* 1995.

Actinopyga agassizi (Holothuridae) is a large species (maximum 35 cm in the Florida keys). Its body has numerous wartlike papillae. The five anal teeth are conspicuous. The coloration is variable, most individuals are mottled. It is a nocturnal species, living on coral reefs, rocky areas and sea-grass beds.

Holothuria mexicana (Holothuridae) is also a large species (max 50 cm). The body wall is rigid; there are a few warts on the smooth upper surface; the colour is dark grey, brown or black in adults, but brownish yellow in young specimens; the tube feet are brown with dark tips. It is encountered as solitary individuals on offshore reefs.usually between 2-10 m depth. Its feeding activity is cyclical, peaking before midnight.

*Astichopus multifidus (*Stichopodidae) can reach 50 cm. Its bivium (dorsal side) is covered with numerous papillae which give a hairy appearance. The body wall is soft with numerous spicules C-, O-, S-shaped and also miliary grains. This species crawls slowly across the bottom and do not attach to the substrate. It is characteristic of soft bottom, muddy or sandy, in and around seagrass beds.

Isostichopus badionotus (Stichopodidae) can reach 45 cm. It is distinguished by many dark darts on the dorsal side and thick conical papillae on the lateral sides and three bands of crowded cylindrical tube feet. The body wall is thick and rigid; its color varies largely. It is a common shallow -water species in the western Atlantic, living on mud, sand or rocks, exposed when adult but the juveniles attach under the rubble. Its feeding activity is cyclical, peaking before midnight.

2.3 Temperate Regions

Many articles published in the Beche-de-mer Information Bulletins from number 1 to 19 (SPC) have been used to present the following species.

Northeast Pacific

Parastichopus californicus (Stichopodidae) is a common species from British Columbia to Mexico. Its distribution goes from tide pools to 80 m. This large species (50 cm max) has a red to brown color. This species, as *Apostichopus japonicus* can eviscerate seasonally in autumn. It can escape to sea star predation

by swimming movements. Its fishery has been monitored in Washington State (Bradbury 1997; Bradbury *et al.* 1998).

Parastichopus parvimensis (Stichopodidae) has a geographical distribution.from California to Mexico
It is fished in Mexico. It is common on soft sediments and on rocks, from shallow waters to 60 m, with a strong seasonal component, as they migrate into the deep in autumn. Spawning occurs in May-June; juveniles (0.5-6.0 cm) recruit to kelp holdfasts, from October to December; sub-adults (2-6 cm) are found under rocks and adults (8-20 cm) on sand. Many specimens have no viscera from August to December, but it is not known if this is from evisceration (as other species) or resorption (Muscat 1983).

Northwest Pacific

Apostichopus japonicus (Stichopodidae) is probably the first sea cucumber species to have been exploited and studied by Chinese and Japanese in the Northwest Pacific (Choe 1963; Arakawa, 1990; Ito and Kitamura, 1998). The literature is therefore important. During many years of artisanal cultures have taken place. Recently this species has given rise to an industrial large scale aquaculture in North East China (Chen Jiaxin and other contributions in Lovatelli *et al.* in press), It would be of interest to compile all the data referring to this species as it is the most studied temperate species

*Cucumaria japonica (*Dendrochitotida: Cucumariidae) is called Kinko in japanese. It is distributed from northern Japan to Russia. Its body length is up to 20 cm and roundish; its color varies from grayish purple to white. The young specimens inhabit shallow kelp habitat while the adults can aggregate on much deeper rocky or muddy substrates. It is catched by trawling and is not used for dried product but rather for eating raw or boiled. (Levin 1995).

Pacific Southwest and Southeast

Athyonidium chilensis (Dendrochitotida: Cucumariidae) is abundant in Peru and Chile (Ravest Presa 2000). Little is known about this species.

Stichopus mollis (Stichopodidae) is a common species, up to 36 cm in length, in shallow water of New Zealand and parts of Australia. The knowledge is restricted to the seasonal evisceration and regeneration and to the ecology and reproductive biology (Sewell 1990). Mladenov and Campbell (1998) presented a resource evaluation in the Fiordland of New Zealand, from an experimental harvest; they pointed out that the potential impact on the environment should be monitored.

Atlantic and other

*Cucumaria frondosa (*Dendrochitotida: Cucumariidae) is a cold water species of a large size (up to 50 cm). It has been a by-catch of dredging before the project of a fishery as a pilot projet was set up (Hamel and Mercier 1999). It is also a species which biology has been extensively studied (Hamel and Mercier 1996).

There are presently prospections in some countries for other species, as *Holothuria forskali* and *Stichopus regalis*, but their commercial value is not known.

3. Summaries of the conservation status of sea cucumbers in the families Holothuridae and Stichopodidae, indicating the main threats

3.1 Conservation status

The "Fishery System" of sea cucumbers is very complex, involving many levels from the fisherman to the consumer and where different actors intervene. Table 2 shows the different levels for the sea cucumber and there are interactions between the actors.(Conand 2001; Conand 2004). Therefore conservation has to be well explained and understood at each level.

Table 2 - The different levels of the « Holothurian System » and the possible management

Fishery system	Management actions
1 Natural resources in commercial species	1a Research on biology and stock assessment 1b Hatcheries - production of juveniles 1c Sea ranching - mariculture
2 Fishermen catches collected by wading, snorkelling, scuba diving	2a Respect of fishery legislations: size (bans of juveniles), period, zones, national or international (CITES?) legislations 2b Collection of standardized statistics 2c Education
3 Processing by fishermen or processors	3a Improving the quality during all phases of processing 3b Storage, grading 3c Education
4 Fishery services national, then international trade	4a Communication between the actors 4b Storage, grading 4c Standardized statistics 4d Access to information - legislations
5 Import and consumption	5 Information on market regulations and preferences

The conservation status of sea cucumber mostly varies with the fishing region and therefore groups of species. Both Bruckner *et al.* (2003) and Baine (2004) have distributed questionnaires in different countries and from the results obtained presented the existing regulations for 20 to 30 countries, which are the main fishing places. The following is based on their reviews, many contributions from the Beche-de-mer Information Bulletins (SPC) and the ASCAM presentations (Lovatelli *et al.* 2004).

In **temperate regions**, the public awareness for conservation is generally stronger and new fisheries, when they have started, have been followed, monitored and management decided. This is the case for the east and west coast of Canada and USA. In Japan, the fishery for *Apostichopus japonicus*, as the other species are only occasionally fished, is traditional (Choe 1963) and has also been managed using several measures as Fishery laws, permits and a complex Fishery Adjustment System. These are presented, using the case study of the Fishery Organization: Semposhi Fisheries Cooperative Association, Northern Hokkaido, by Akamine (2004).

In **tropical regions**, the fisheries are on a small scale but have a great socio-economic importance for these less developed countries. In the Indo west pacific, an exception is Australia where the fishery has a long history but regulations have now been introduced for *H. whitmaei* and the results followed (Uthicke 2004). The main fishing countries Indonesia and the Philippines are traditional but have no regulations. Some Pacific islands (Fiji, Tonga) have introduced legal size limits (but are they controlled ?) or even a ban (Mozambique, Solomon islands). In other countries, as Mexico, Galapagos, Cuba and Venezuela, the fisheries are more recent and the attention has been raised on their management but despite this fact several conflicts or illegal fisheries have occurred for these resources.

3.2 Threats

The main threat is **over-exploitation** by the fisheries for the processed dry product trepang (beche-de-mer in the Pacific). The species with the high economic value (see Table 1) are more threatened, but given their rarefaction other species with lower commercial value are now declining. The major consequence is the depletion of sustainable breeding populations to permit natural replenishment of populations. In Malaysia other utilizations are made from sea cucumber, for medicines, as "gamat oil" "gamat water", balms after extraction from Stichopodidae and pharmaceutical research for new products is also ongoing. (Baine and Choo 1999; Choo *et al*. 2004). Another more general threat is the **degradation of the habitats**. This is more important in the tropics and the overall decrease of the coral reefs worldwide is widely recognized and evaluated. The coral-reef holothurians are particularly vulnerable.

4 . Knowledge gaps and research priorities in the area of biology, taxonomy and conservation status

4.1 Taxonomy

As already shown during the description of the main commercial species, it appears that the taxonomy is a very difficult field in holothurians. There are only a few specialists, as this field has lost interest in the last decades. But recently with the development of new methods of cladistic and more recently genetics, the systematic is being revisited. It is no more based (as it used to be) on one or a few type specimens from one site. Therefore questions about the large distribution of some species are asked. Research is urgently needed on the main commercial species when differences have been noticed by observers. It could lead to the description of different new species. The knowledge of the distinction of the species is a prerequisite to any conservation based on individual species. This kind of conservation is necessary as it is the case for other marine resources.

Scientific teams from different zones of distribution of the targeted species and with capacities in classical taxonomy, cladistic and genetics should be encouraged to collaborate. The more acute problems are in the tropical Indian and west Pacific, as they the centers of biodiversity. As a priority, the commercial species of the genera *Actinopyga, Bohadschia, Holothuria, Stichopus* certainly need further studies.

Another aspect, which has never been approached, is the identification of the **processed specimens**. It is generally based on photographs, but some species look very much the same when they are dried. As the trade is mostly done with the dried product, the identification at this stage has to be improved. It will be necessary to check if enough spicules are kept on the body wall after processing.

4.2 Biology and ecology

Many parameters of the population biology of most commercial species are poorly or even not known. Very often holothurians are considered to share the same characteristics and traits; this is entirely wrong and the different species probably have different strategies; thus the findings on one species cannot be applied to others. It should be clearly recognized that ecological traits differ markedly among species, thus a management as a multi species fishery is strongly discouraged.

The recent ASCAM workshop organized by FAO in China (see Lovatelli *et al.* 2004 and many references to the papers of the sessions) has allowed to develop recommendations agreed by the participants. From the reports presented during this workshop on sea cucumber fisheries, management and aquaculture, it was clear that sea cucumbers in most countries are suffering from heavy exploitation and population depletion. The main recommendations deal with parameters for fishery models and have been used to prepare this contribution.

Research on **growth rates**, particularly in early stages must be gained from individual species, obtained in laboratory and field studies. In addition, data from several locations need to be available in order to know if patterns are general or location-specific. Information on mortality and longevity in the wild are also needed, to allow sustainable catch rates to be estimated.

Research on **larval ecology and recruitment** processes of holothurians is also needed to develop fishery models, and these processes will be widely variable in space and time. More studies should examine the factors affecting the movement of sea cucumber larvae within the water column and factors influencing settlement. An understanding of larval movement and settlement processes will improve predictions on dispersal and the likelihood of self-recruitment and natural replenishment of populations. Specifically, more information is needed on the source and sink of recruits for local populations.

Stock assessment and **stock delineation** are also essential for conservation. Common methods of data collection and presentation of results should be developed for commercially exploited species. Ideally, initial stock surveys should be conducted before a fishery commences, in order to obtain information on virgin biomass. Monitoring the recovery of stocks after fisheries have been closed should also be encouraged. Research should focus on:

- Habitat types (e.g. cover of sea grass or corals, sediment or substratum characteristics) should be recorded for each survey unit (e.g. transect).

- The size and spatial context of the populations need to be defined, in particular, the area surveyed and the likely area occupied by the sub-population.

- Stock delineation is important for managing stocks and understanding recruitment. Such information is particularly relevant for restocking over broad spatial scales, due to likely adverse effects on genetic diversity if genetically different stocks are mixed.

Maximum sustainable yields should be estimated for different types of sea cucumber fisheries, based on surveys of stock size and estimates of recruitment, growth and natural mortality. In many cases, however, these data may not be available. If this is the case, total allowable catch **(**TAC) should be conservative, assuming a low % of virgin biomass can be taken, until monitoring of stocks, recruitment and catch data indicates that catch rates could be increased. Moreover, TACs alone are not sufficient for the management because this tool does not consider the size structure of existing stocks. A fishery could be made up of small animals, which are harvested at the expense of egg production of the site.

Minimum stock size for viable breeding populations need to be maintained at a minimum threshold level to ensure successful reproduction in the wild. This is because sea cucumbers use chemical cues to spawn and need to be close to mates for fertilization of oocytes. Below such threshold densities of adults, populations will fail to repopulate naturally. A disproportionate reduction of recruitment when densities of spawners are reduced has been termed the "Allee" effect in the general ecological literature. Studies are needed to establish the thresholds for minimum size of effective breeding populations.

The **role** of sea cucumbers **in ecosystems** has to be more studied. Data available indicate that removal of these animals could lead to major changes to the ecosystem, such as decreased overall productivity. However, to confirm this effect, large-scale experimental work in multiple areas with natural densities and over-fished areas must be conducted.

4.3 Conservation Status

There is a general lack of information on appropriate management approaches and analytical tools. The fact that over fishing and stock depletion is still occurring indicates that specific approaches are needed for managing sea cucumber trading and fisheries. During the FAO ASCAM workshop it was recognized that a critical need is to establish and implement management plans towards sustainability of adequate breeding populations of all fished species (Lovatelli *et al.* 2004). Countries should also aim to develop management prior to opening further fisheries. Management plans for sea cucumbers fisheries should be conservative because stocks are vulnerable to over fishing. The most incipient threat is the depletion of sustainable breeding populations to permit natural replenishment of populations. Different modes of management have been used for sea cucumber fisheries, but few cases, both of failures and successes, have been documented. There is a need for a review that summarizes case studies where management has worked and how participatory management can be used.

Sea cucumber fishing is very important to the livelihoods of coastal communities, particularly artisanal and small-scale fishers in developing countries. Therefore, socioeconomic issues in sea cucumber fisheries are important, and should be recognized and incorporated in fishery management programs. In particular, livelihood options should be made available to fishers if management regulation put restrictions on the fisheries, such as bans on fishing.

Fisheries regulations should aim to protect ample breeding populations of each species. If the populations of any species are fished below levels perceived to be minimal for breeding populations, then bans or moratoria should be placed. For areas that have been closed to fishing by moratoria, the lifting of fishing bans should only proceed after it is established that stocks are viable for reproduction and can sustain fishing.

The participants of ASCAM flagged a number of **recommendations for fisheries managers**, which should be followed to prevent depletion of breeding stocks:

- The collection of sea cucumbers using compressed air (either SCUBA gear or hookah), or weighted hooks should be restricted. Bans on using compressed air can protect deep stocks, but caution should be given, because shallow stocks may be more important for spawning. In cases where scuba or "hookah" diving is permitted, the divers need to be trained to avoid risk to life of the divers and adhere to accepted OH&S guidelines, including the use of safe equipment.

- A "code of conduct" should be promoted for responsible fishing practices. This would involve common sense fishing practices such as not collecting under-sized sea cucumbers and preserving a proportion of the populations to act as breeding stock.

- Habitats should be protected as well as the resource. Authorities should endeavor to protect the ecosystems in which sea cucumbers live and, conversely, recognize the important role that sea cucumbers play in ecosystem processes. Where sea cucumber habitats have been damaged, rehabilitation should be considered.

- Attention should be given to evaluating the occurrence and significance of sea cucumbers as by-catch in trawl nets and dredges. These indiscriminant fishing methods can have impact populations and habitat. By-catch of sea cucumbers in other fisheries needs to be both researched and documented.

Socio-economic and legislation. Public awareness of sea cucumber fisheries should be raised at a range of levels, to highlight their importance and vulnerability to over fishing. Networking and cooperation among researchers and fishery workers should be promoted. This could be by forming associations for processors and traders, researchers, fishery managers and farmers. Additionally, newsgroups via email or internet would be valuable for exchange of information.
Legislation should involve the following:

- Participation of stakeholders (including fishers, processors, policy makers, managers, exporters) in forming management plans

- Authority divested at local/customary level, in certain circumstances (e.g. Melanesian artisanal fisheries with customary tenure)

- Enforcement to ensure protection of sea cucumbers and their habitats

Scientists should test the effectiveness of **Marine Protected Areas** (MPAs) or *No-Take Zones* and methods of management have not been documented. There is a need for a review that summarizes case studies where management has worked and how participatory management can be used.

Knowledge on the effectiveness of MPAs (especially *No-Take Zones*) and comparison of a range of management methods (such as broad fishery closure) should be collated. Research should also be encouraged to determine the appropriate sizes, numbers and spatial design of MPAs. This could also include a review of existing literature and case studies on MPAs.

Restocking is generally only a last resort if other management measures to recover a depleted fishery have failed. Good management to preserve breeding populations should be the first solution, because there are risks of changing genetic diversity of existing stocks when juveniles are released for restocking or stock enhancement(Purcell, 2005).

Several recommendations from the Ascam workshop for restocking are:

- Studies needed about economic viability and returns from restocking programs in which hatchery-produced juveniles are released into the wild.

- The value and significance of restocking to ecosystem functioning and long-term repopulation needs to be included in cost-benefit analyses.

- Release of hatchery-produced juveniles should only be conducted at sites with the same genetic stock as the broodstock used for production. Translocation of animals into foreign grounds should be prohibited.

- Spawners (both male and female) must be chosen in sufficient numbers to warrant genetic diversity and gene frequencies in the offspring similar to that in the receiving areas.

- Transfer of disease, parasites and introduced species from restocking needs care. Transfer protocols and disease checks need to be developed to ensure healthy juveniles are used for restocking.

- The carrying capacity of the habitat (in terms of both number and biomass) should be evaluated before restocking.

- Methods on the best strategies for releasing juveniles should be well determined prior to restocking.

Recent progress in **aquaculture** were presented at ASCAM (Lovatelli *et al.* 2004; SPC Beche de Mer Bulletin 2004). The importance of this sector in northern China has been demonstrated by several participants and will certainly influence the international trade. It will be necessary to follow its development and impacts. Several programmes have started to cultivate *H. scabra* in the Indo-Pacific, as WorldFish in New Caledonia (Purcell 2005) and Madagascar (Rasolofonirina & Jangoux 2004). Several recommendations from the Ascam workshop are:

- Publication of a manual or guide on sea cucumber aquaculture.
- Enhancement of international exchanges.
- Fundamental biological research including a better knowledge of the diseases and parasites.
- Hatchery techniques.
- Farming/sea ranching.

One of the concerns is the potential effect commercial-size aquaculture facilities on the environment. As the industry develops, the benefit and usefulness of farming and sea ranching in different environments and countries should be addressed and weighed against the cultural and environmental costs. Ultimately, guidelines for ethics and conservation measures should be developed and promoted.

If **international interventions** (e.g. IUCN/CITES) are used to assist in the conservation and management of sea cucumbers, caution should be placed on intervening or regulating trade for all regions due to differences in the socio-economical situation of fishermen and the status of sea cucumbers habitats and environment.

5 - Information on key-reference materials and standard literature for sea cucumbers.

The SPC Beche-de-mer Informations Bulletins regularly published as issues (SPC) and immediately put on the web **http://www.spc.int/coastfish/news/BDM/23/index.htm** are key-reference materials and http://**www.spc.int/coastfish/news/search_bdm.asp** to search into the data base. They include original contributions and abstracts of the recent litterature on holothurians. The Bulletin « Echinoderms Newsletter » on the web **http://www.nmnh.si.edu/iz/echinoderm** also include useful informations. The International Echinoderm Conference takes place every three year. Numerous presentations concern sea cucumbers. The Proceedings are in books published previously by Balkema, now by Swets and Zeilinger, The Netherlands. (see Mooi & Telford 1998; Barker 2001). In different countries inventories have been published (Cherbonier 1988; Guille et al. 1986; Schoppe 2000) and manuals for processing sea-cucumbers intended for fishermen and trade, in simple terms and local languages (T. & Nebelsick J. 2004).

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Harvest and Trade; Utilization of Sea Cucumbers: Sea Cucumber Fisheries; Current International Trade; Illegal, Unreported and Unregulated Trade; Bycatch; Socio-Economic Characteristics of the Trade in Sea Cucumbers

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Introduction

The "Holothurian Fishery System" presented earlier (Conand & Byrne 1993; Conand 1998, 2001 and 2004) is a good model for all sea cucumber fisheries (Figure 1). The five levels of this system between the resource on the sea floor and the plate of the consumer, are very important both for fishery evaluations and for durable management (see also Table 2 in document 1 for this CITES workshop). At each level and between the levels, different participants intervene.

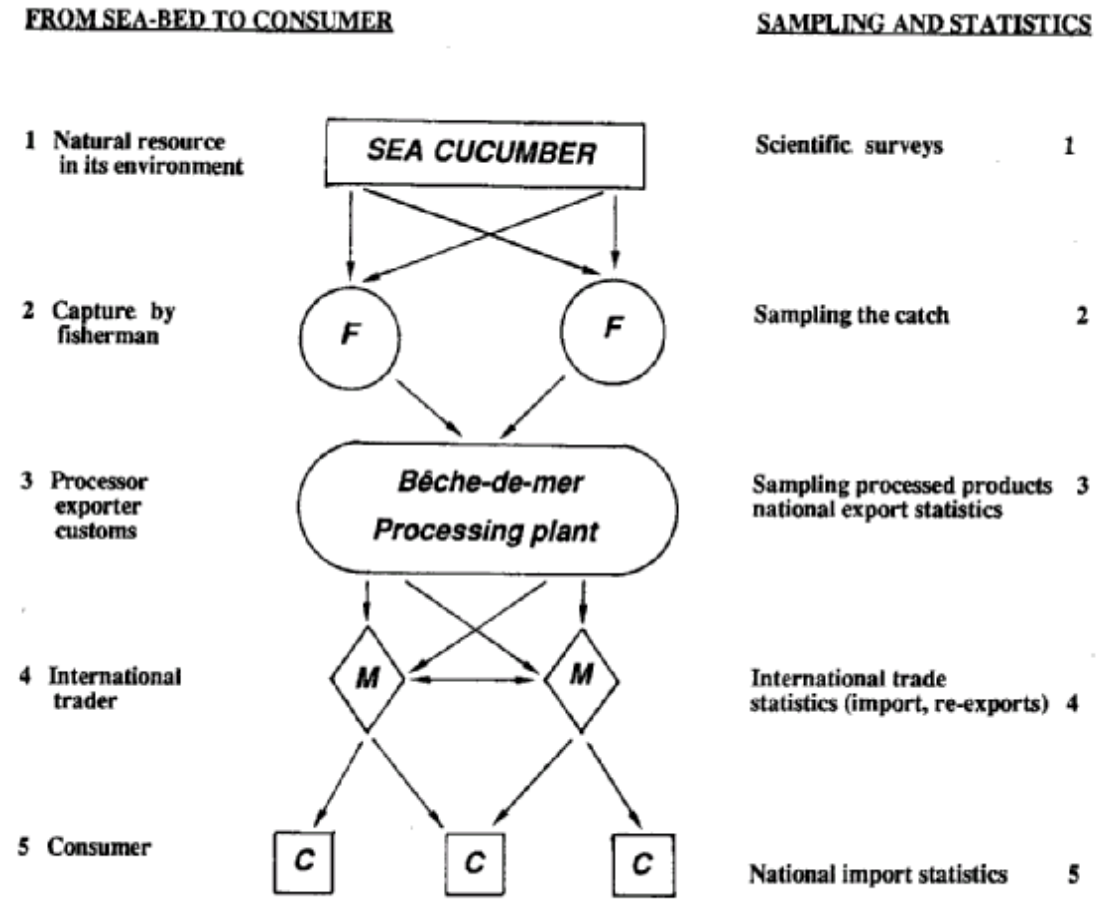


Figure 1. The holothurian fishery, from the sea-bed to the consumer and the levels of collecting statistics

In most of the fisheries, the catch is processed into a dried product, called "Trepang" in the Indian ocean, "Beche-de Mer" in the tropical pacific, "Hai-som" by Chinese and "Iriko" by Japanese (Conand 1990; Preston 1993). This processing is complex (see paragraph 5); the dehydratation is variable between holothurian species and processors, but a mean decrease in weight is of about 90%. The studies and reports must therefore be very careful in the unit used and many inaccuracies have resulted from not taking this point into account.

The recent meeting "Advances in Sea Cucumber Aquaculture and Management (ASCAM), organized by FAO in China in October 2003 (Lovatelli *et al.* 2004) has gathered fifty experts from different parts of the world and from China. The contributions have presented the recent status of many fisheries, the existing management and the aquaculture advances. The participants have also made recommendations on these three topics. The present document will take these new findings and ideas into account.

As presented in the document 1 for this CITES workshop, The SPC Beche-de-Mer Information Bulletins contains many useful publications (http://www.spc.int/coastfish/news/BDM/).

1. General information on the current levels of harvest and trade in sea cucumbers, with wherever possible: indications of recent trends in harvest and trade, main fisheries, main exporting and importing countries, sources of sea cucumbers (i.e. wild or aquaculture), origins, trade routes, and principal species in trade

1.1. Current levels and recent trends of harvest and trade in sea cucumbers and ***main fisheries***

The fisheries can be presented according to the geographical area and the species harvested. Tropical fisheries from the Indo-Pacific are multispecific, whereas temperate fisheries are generally monospecific. Traditional tropical fisheries in the Western-Pacific and Indian Oceans produce dry product. Recently, some countries have started exploitations on the Eastern-Pacific coasts. Temperate fisheries for fresh or frozen product were long limited to the NorthWestern Pacific Ocean and there are now other countries interested. Fishery statistics have been collected from several sources, including producer countries (catch and export statistics) and international FAO data (annual yearbooks for catches, FAO 1992 to 2001). These data are synthesized for the last decade to show where most products originate and which are the new trends. The gaps or inaccuracies will be discussed to help formulate recommendations for a future better fishery knowledge and management.

Table 1 presents the data on the harvest of sea cucumbers, adapted from FAO Statistics by country and corrected with the recent information obtained for several countries, during the ASCAM Workshop in October 2004. This table is in two parts: 1) All the species excepted *Apostichopus japonicus*, as the data are mainly for dry product; 2) *Apostichopus japonicus* data for Japan, Korea and China (partly) with data in fresh weight. As the processed product is only 10% or less of the live sea cucumber weight, it is essential to distinguish these categories.

In Table 1, the countries are presented alphabetically, but the FAO regions are precised. The data are given for the last decade and its mean is calculated, which helps to follow the recent trends.

Table 1: Captures or beche-de-mer productions (t) by country and mean value for the decade (from FAO data and other sources)

Country	FAO region	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	**mean**
Holothurioidea dry weight												
Chili	P SE	237	13	4	106	115	1	30	108	1510	107	**223**
Cuba									*20*	*20*	*13*	
Ecuador	P EC	29	12	12	12	12	12	15	15	15	15	**15**
Egypt	IOW						-		-	20	139	**16**
Fidji	P WC	447	191	400	835	850	790	400	880	800	824	**642**
Indonésie	IOE					269	338	630	689	903	970	**380**
Indonésie	P WC	3,130	2,364	3,130	2,562	2,800	2800	2428	1928	2138	2280	**2556**
Solomon	P WC	715	720	700	700	750	203	253	376	48	50	**452**
Kenya	IO W	277	14	41	55	15	41	38	15	30	13	**54**
Kiribati	PWC					-	136	154	89	64	60	**50**
Madagascar	IO W	423	450	1,800	1,800	1,800	1800	482	500	500	500	**1006**
Malaysia	P WC	...	...	...	...	...	…					
Maldives	IO W	119	72	66	94	145	318	85	54	205	226	**138**
Mexico	PEC						-	271	234	426	481	**141**
Mozambique	IO W	0	0	0	6	54	7	2	8	12	12	**10**
New Caledonia	P WC	1,090	777	798	480	493	565	402	493	615	489	**620**
New Zealand	P SW	0	0	0	4	1	0				2	**1**
Palau	P WC	2	2	2	2	6	7	7	6			**3**
Papua New Guinea	P WC	600	650	600	640	650	1515	2037	1185	1824	1453	**1115**
Spain	M					4	4	4	1	9	4	**3**
Philippines	P WC	3,679	3,109	1,497	2,062	2,123	1191	830	849	730	791	**1686**
Sri Lanka	IO W	65	65	92	100	100	272	203	170	145	120	**133**
Tanzania	IO W	535	980	1,591	1,460	1,644	1527	1800	189	372	340	**1044**
Tonga	P WC	...	...	...	...	86	80	90				**26**
Canada	PNE	0	0	1,505	0	1 288 ?						**279**
U.S.A.	ANW					1 288 ?		2406	3504	4309	1504	**1301**
U.S.A.	P NE	481	472	636	729	491			228	274	300	**361**
Vanuatu	P WC	39	40	40	50	45	50	50	50	50	50	**46**
Yemen	IO W	48	65	63	60	60			1			**30**
Total holothuroidea		11916	9996	12977	11757	12513	11657	12617	11592	15019	10743	**12331**
Apostichopus japonicus												
Japan	P NW	6,072	5,996	6,106	6,602	7,226	7160	6952	6662	6957	7229	**6696**
Repub Korea	P NW	1,583	2,068	2,117	1,892	1,979	2217	1439	1204	1419	900	**1682**
China											358	
Total Apostichopus		**7,655**	**8,064**	**8,223**	**8,494**	**9,205**	**9,377**	**8,391**	**7,866**	**8,376**	**8,487**	**8378**

1) All the species except *Apostichopus japonicus*

In **2001**, the last statistics show, if considering the countries with data over 1000 tons, that:

- Indonesia is the first world fishery, with products mostly coming from the pacific western central zone.
- The second in the statistics are U.S.A; but these data seem questionable, as there could be some problem with the Canadian production, from 1996. Another problem could be the data from the Atlantic Northwest fishery, which is not documented….
- The third fishery is in Papua-New-Guinea.
- The world total is over 10 000 tons, which corresponds to more than 100 000 tons captured.
- 3 countries are no more reporting, Palau, Tonga and Yemen;
- On the whole, there are 23 countries listed, with among them, 3 countries over 1000 tons, 11 countries between 1000 and 100 tons and 9 countries under 100 tons.

Figure 2 shows the captures by FAO zones for 2001. Some countries do not appear despite some fisheries, for example Australia, Bangladesh, Chagos, Venezuela and India.

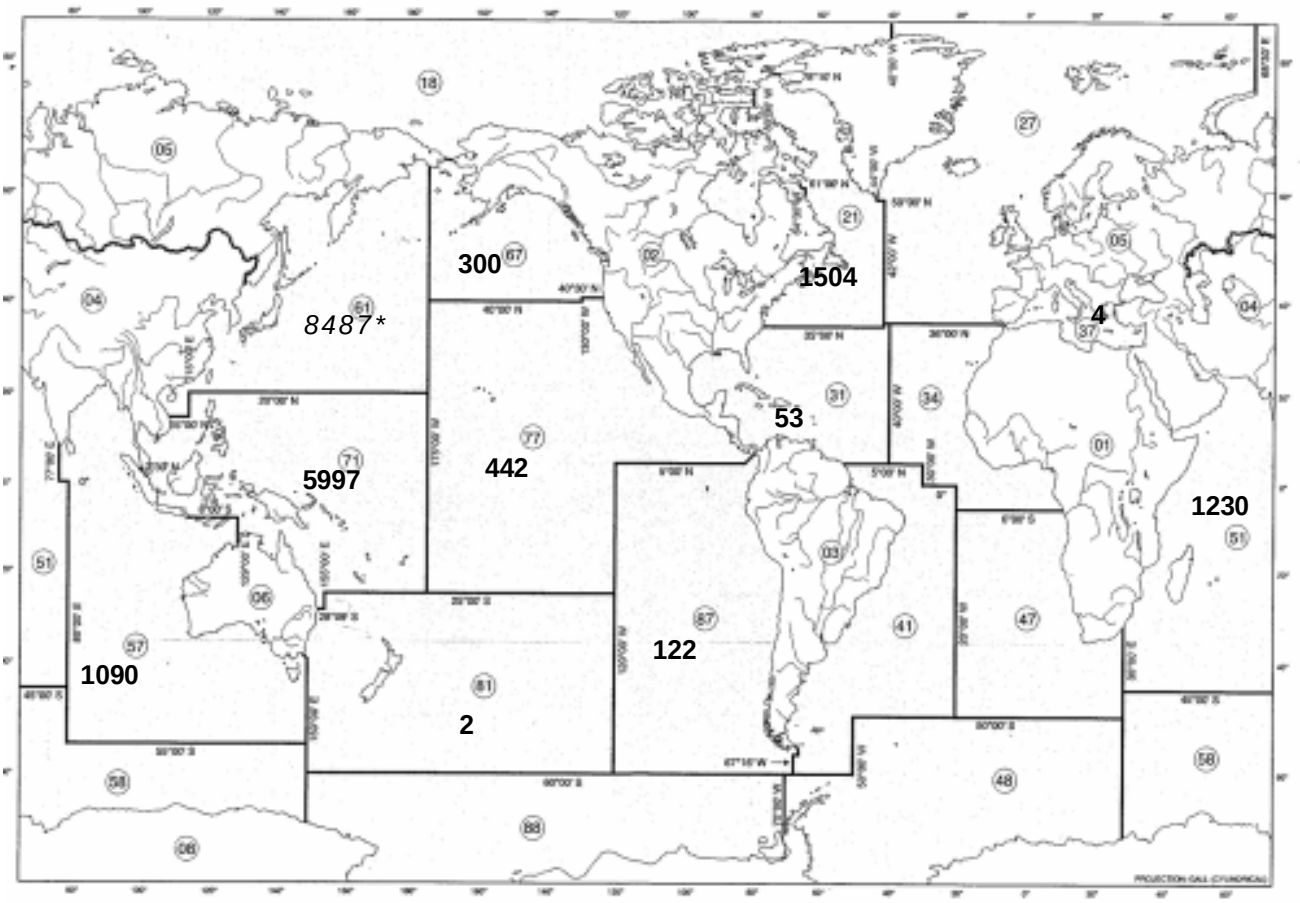


Figure 2: Beche-de-mer production(t)in bold, for 2001, according to FAO zones and different data.

*captures (t) for zone 61

For the **last decade** (1992-2001), the calculated mean catches show:

- Indonesia is the world leader, but there is a small decrease since 1997; more information is given by Tuwo (in press).
- The second is the Philippines, as it was traditionally (Sachithananthan 1972; Conand 1990, Conand 2004). The decrease started in 1994 and the present catch is only 1/5 of the previous one. Gamboa (2004) gives more information about this country.
- The third is the U.S.A., with the issues already raised for 2001
- The fourth is Papua-New-Guinea, with a strong increase since 1997 (see Polon 2004)
- The fifth is Tanzania where the catches regularly decrease since 1997 (see Mmbaga and Mgaya 2004)

On the whole, from the 26 countries listed, the mean catch for the decade is over 1000 tons for 6 countries, between 1000 and 100 tons for 8 and under 100 tons for 12.

2) *Apostichopus japonicus* fisheries

In 2001, the last statistics show:

- Japan is the major country for the fishery with 7 229 tons (live weights)
- Rep of Korea is second with 900 tons
- China is appearing with 358 tons in 2001

For the last decade (1992-2001), the calculated mean catches show:

- Japan has remained stable
- Rep of Korea is slightly decreasing
- The data are not available for the period for China.

Table 2: World imports of sea cucumber, fresh/frozen/dried/salted/ in brine, 1995-2001 (Q=TONS; V=US$'000) (after Ferdhouse 2004) *Source: FAO FISHDAB*

Country		**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
China	Q	-	49	1	9	139	186	2 059
	V	-	49	3	30	265	793	1 229
Hong Kong	Q	5 789	5 020	4 523	3 975	2 922	4 759	4 382
	V	40 898	43 376	38 147	39 565	33 571	55 533	50 430
Japan	Q	25	10	5	5	4	3	3
	V	799	350	134	163	121	141	81
Korea, Rep	Q	7	36	16	2	10	29	51
	V	128	154	302	23	68	127	400
Malaysia	Q	521	358	-	18	21	32	2
	V	755	564	4	8	34	24	16
Singapore	Q	-	-	-	-	-	-	-
	V	-	-	-	-	-	-	-
Taiwan PC	Q	1 273	1 079	1 014	859	899	887	676
	V	5 792	5 327	5 291	4 549	4 735	4 514	3 979
Thailand	Q	32	32	71	78	75	133	115
	V	102	90	446	282	417	528	504
World total	Q	**7 653**	**6 597**	**5 630**	**4 946**	**4 079**	**6 040**	**7 299**
(incl. others)	V	**48 507**	**49 987**	**44 327**	**44 620**	**39 331**	**61 691**	**56 722**

1.2 Main exporting and importing countries

Exporting countries: as the fisheries for the dried products, presented in part 1.1, are occurring in countries where there is no, or little, consumption, these countries are also exporting.

The main **importing countries** are traditionally Hong Kong, Singapore, Taïwan and China; Malaysia also imports but smaller quantities (Sachithananthan 1972; Conand and Byrne 1993; Conand 1990; Conand 2001; Conand 2004; Ferdhouse 2004):

Based on FAO (2003), the global imports of *fresh, frozen* and *dried* sea cucumber (including salted in brine but excluding canned products) totaled 7 299 tons in quantity and US$ 56.7 million in value in 2001 (Table 2). Note that the imports of sea cucumber into Singapore, were not reported in these trade figures.

- **Hong Kong (after Ferdhouse, in press and Conand, 2001)**

Hong Kong, special Administrative Region of China, is the largest importer of sea cucumber in the international market since 1930 (Sella and Sella 1940; Sachithananthan 1972; Conand 1989; Conand 1990; Conand and Byrne 1993; Conand 2001). The market is dominated by imports of dried tropical sea cucumber of all varieties. The cold water species are imported from the USA and Canada in gutted frozen form for the up markets in mainland. Imports of sea cucumbers declined by almost 50% in 2000s compared to mid 1990s. The import market has stabilized at a volume of about 4 000 TONS per annum during the last 6 years. In 2002, imports recovered to 4 417 tons at a value of HK$ 440 million (US$ 56 million) (Table 3A and 3B). The main suppliers were Indonesia, the Philippines, Singapore, Papua New Guinea, Solomon Islands, Madagascar and Australia. For the last few years, supplies have been dwindling from regular sources except from Indonesia. New supplies from Africa and the Middle East have entered the market. However, the quantity is not sufficient to offset the lower exports from the other sources.

A survey indicated that in general sea cucumber is perceived as an expensive product. The consumption is limited to the middle-aged group, festival celebration (Chinese New Year), wedding dinners, banquets etc. Hence, demand fluctuates according to the age group and most of all by disposable income. The market preference is similar to the mainland. Consumers in Hong Kong prefer large and medium sized dried skin-on calcium coated *sandfish* and *teatfish* which are the high value species, but also *Apostichopus japonicus*.

However, for Hong Kong traders the main attraction is the expanding mainland market. In 2002, Hong Kong re-exported nearly 3 000 tons of sea cucumber which was 67% of the total imports in that year. China was the largest outlet (72%); all types of sea cucumber are exported to the China market mainly by road and also by sea depending on the destination. The other markets are Taiwan PC, the USA and some other niche markets (Table 3C).

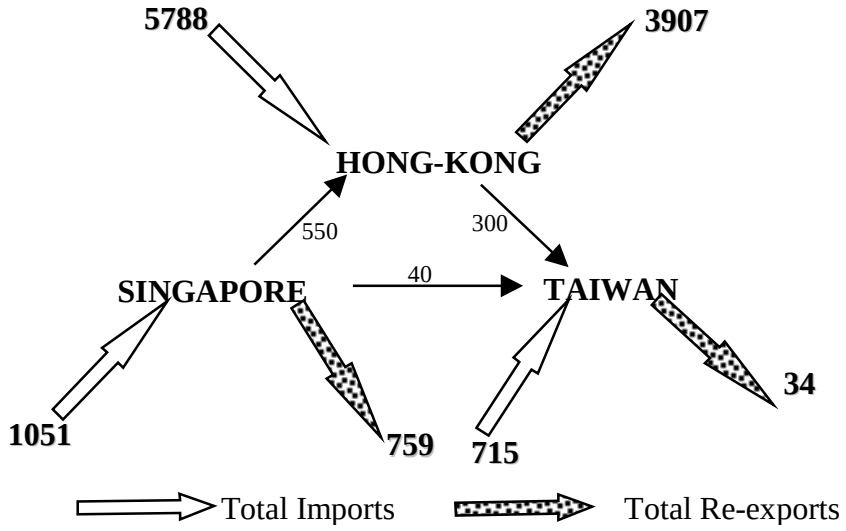
As direct imports to China is subject to high import duty and rather complicated procedures, exporters from other countries prefer to supply to Hong Kong traders. The territory still retains the status of a duty free port for imported products.

Table 3A: Hong Kong: Imports of beche-de-mer (dried, salted or in brine), 1997 – June 2003 (Q=TONS; V=HK$ 1000) (after Ferdhouse 2004) *Source: Agriculture, Fisheries and Conservation Dept., Hong Kong.*

Countries		**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**Jan-Jun 2003**
USA	Q	41	44	114	182	90	155	88
	V	3 307	3 242	6 032	10 473	5 439	10 318	5 790
Canada	Q	18	20	5	3	59	18	13
	V	2 337	2 911	660	80	3 332	1 373	630
UA Emirates	Q	21	-	-	11	0.2	21	1
	V	600	-	-	1 393	13	1 585	0
Yemen	Q	-	-	3	-	3	113	71
	V	-	-	256	-	332	11 497	3 831
Taiwan	Q	22	71	41	40	57	119	34
	V	2 024	5 300	6 255	7 695	17 705	29 485	9 447
Indonesia	Q	1 097	961	757	1 007	1 060	1 008	429
	V	484 424	42 073	31 207	40 907	34 084	31 986	13 467
Philippines	Q	165	467	591	1 070	737	775	268
	V	18 931	18 855	31 608	63 751	39 400	39 004	15 109
Korea PR	Q	2	2	-	3	-	1	12
	V	232	369	-	273	-	211	782
Japan	Q	29	53	55	75	103	127	94
	V	23 321	41 386	53 593	81 230	90 771	131 763	121 827
China	Q	27	77	30	13	12	27	22
	V	1 314	214	1 830	2 074	778	1 218	837
Vietnam	Q	56	47	34	1	3	1	4
	V	2 516	2 904	957	215	950	142	448
Maldives	Q	117	23	4	39	29	38	25
	V	6 085	1 296	229	2 345	1 626	1 080	1 080
Sri Lanka	Q	76	52	19	65	33	50	49
	V	8 982	4 616	1 838	3 732	1 894	2 918	2 441
India	Q	-	1	2	1	4	2	-
	V	-	396	523	114	807	356	-
Malaysia	Q	22	60	19	59	66	124	69
	V	1 452	3 090	1 382	3 939	3 677	8 982	5 267
Singapore	Q	479	349	212	345	335	364	149
	V	33 471	22 834	15 872	24 005	24 925	28 305	7 969
Mozambique	Q	82	25	1	0	1	37	33
	V	1 932	204	76	40	220	3 307	2 558
Madagascar	Q	204	216	154	178	179	169	122
	V	28 400	22 080	18 084	17 745	15 497	9 946	4 837
South Africa	Q	47	49	21	28	29	53	34
	V	2 303	4 151	1 085	2 188	969	1 035	584
Kenya	Q	-	-	2	52	39	20	9
	V	-	-	148	3 377	1 407	1 873	2 447
Mauritius	Q	-	-	-	3	-	6	1 716
	V	-	-	-	271	-	1 408	339
Tanzania	Q	182	72	31	115	56	92	40
	V	10 853	4 781	5 237	8 708	4 676	5 462	1 613
US Oceania	Q	29	20	12	18	41	-	-
	V	2 680	2 463	1 789	1 935	-	-	-

Table 3B: Hong Kong: Imports of beche-de-mer (dried, salted or in brine), 1997 – June 2003 (Q=TONS; V=HK$ 1000) (after Ferdhouse 2004) *Source: Agriculture, Fisheries and Conservation Dept., Hong Kong*

Countries		**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**Jan-Jun 2003**
Aust & Oceania	Q	70	39	32	14	22	17	12
	V	11 776	6 769	5 737	2 735	3 703	3 383	2 539
Kiribati	Q	4	3	4	9	14	9	1
	V	104	264	522	683	1 005	883	192
Tonga	Q	12	-	-	-	-	-	-
	V	1 705	-	-	-	-	-	-
W. Samoa	Q	11	4	6	-	-	-	-
	V	1 045	833	533	-	-	-	-
Australia	Q	63	73	118	139	187	139	59
	V	13 008	16 870	23 615	42 061	40 910	32 792	19 154
Solomon Is.	Q	122	252	50	144	260	249	141
	V	6 897	12 779	2 641	7 325	14 896	12 027	4 846
Fiji	Q	528	291	166	364	276	162	86
	V	26 232	23 956	14 523	28 149	21 770	12 659	4 973
New Zealand	Q	15	8	1	11	31	16	3
	V	1 333	469	186	2 227	3 998	1 241	192
Vanuatu	Q	35	25	8	28	16	8	1
	V	1 038	1 116	286	1 315	888	401	44
PN Guinea	Q	453	613	336	532	493	368	212
	V	33 215	52 684	27 201	45 655	37 405	38 097	23 711
Total	**Q**	**4 523**	**3 975**	**2 922**	**4 759**	**4 382**	**4 417**	**2 222**
(incl. minor exporters)	**V**	**295 341**	**306 442**	**260 425**	**432 665**	**393 297**	**439 628**	**270 499**



Flux of bêche-de-mer from reciprocal exchanges between markets

Figure 3: Reciprocal exchanges of product between the main markets (from Conand 2001)

Table 3C: Hong Kong: Re-export of beche-de-mer (dried/salted/in brine), 1997 – June 2003 (Q=TONS; V=HK$1000) *Source: Agriculture, Fisheries and Conservation Dept., Hong Kong.*

Country		**1998**	**1999**	**2000**	**2001**	**2002**	**Jan-Jun 2003**
USA	Q	21	17	23	38	106	48
	V	2 938	2 544	2 880	2 750	6 409	3 657
Canada	Q	27	16	13	27	14	8
	V	3 779	2 722	2 717	3 395	3 906	1 232
France	Q	-	0.001	-	0.001	-	-
	V	-	-	-	28	-	-
UK	Q	-	-	-	-	-	-
	V	-	-	-	-	-	-
Taiwan	Q	224	158	209	117	152	39
	V	20 797	15 479	25 164	9 927	16 662	4 488
Indonesia	Q	-	10	0.1	-	-	-
	V	-	236	13	-	-	-
Korea RP	Q	50	50	82	62	36	10
	V	4 616	4 780	7 102	4 294	2 703	644
Thailand	Q	-	31	30	40	40	8
	V	-	5 265	6 005	6 555	7 656	2 000
Japan	Q	1	0.1	1	1	1	0.2
	V	302	46	711	325	213	92
China	Q	2 780	2 268	3 771	3 543	2 127	938
	V	97 438	78 159	176 034	141 171	73 903	25 544
Malaysia	Q	9	22	21	6	6	1
	V	714	2 550	2 866	667	1 046	78
Singapore	Q	37	81	70	28	19	10
	V	5 769	12 293	9 854	6 122	4 253	2 664
Australia	Q	1	3	1	2	2	2
	V	277	288	79	359	203	129
Total	**Q**	**3 174**	**2 658**	**4 221**	**3 867**	**2 944**	**1 305**
	V	**139 691**	**125 099**	**233 885**	**176 792**	**130 575**	**49 288**

- **Singapore (after Ferdhouse, 2004 and Conand, 2001)**

Sea cucumber is a preferred seafood delicacy of the highest order, a positioned shared with dried sharkfins. However, sea cucumber is expensive, thus followed the demand pattern dictated by consumer's disposable income.

From Singapore a large share of imports are re-exported to other destinations. Imports fluctuated from 820 tons in 1997 to 629 tons in 2000 due to the economic recession in the region. Hong Kong was the main supply source. The other exporters to this market were India, Yemen, the USA and South Pacific island countries. During late 1990s, imports increased from Madagascar, Tanzania consisted of cheaper quality *sandfish* and some white *teatfish*. The best quality products come from Australia and the other pacific sources. Imports also take place from Indonesia which are not reflected on the official statistics (Table 4A and 4B).

Table 4A: Singapore: Imports of beche-de-mer (dried/salted/in brine), 1997-2000 (Q=TONS; V=S$ 1000) (after Ferdhouse 2004) ***Source: National Statistics, Singapore.***

	1997		1998		1999		2000	
Country	**Q**	**V**	**Q**	**V**	**Q**	**V**	**Q**	**V**
Australia	12	NA	7	585	14	1 185	4	337
New Zealand	5	NA	13	820	12	1 428	19	1 047
China RP	13	NA	21	1 437	4	385	5	853
Taiwan	86	NA	75	3 852	16	865	27	1 340
Hog Kong	201	NA	73	7 374	93	9 972	104	12 964
India	97	NA	58	3 332	43	2 837	82	6 732
Sri Lanka	36	NA	30	2 282	18	1 203	15	2 388
Malaysia	2	NA	5	111	5	317	3	296
Myanmar	1	NA	1	83	-	-	-	-
Vietnam	-	-	-	-	3	317	1	162
Fiji	-	-	-	-	20	890	-	-
Maldives	23	NA	18	2 139	11	974	10	1 644
Papua New Guinea	-	-	2	80	1	70	1	129
Solomon Islands	4	NA	-	-	-	82	-	-
Mauritius	5	NA	4	224	4	170	-	-
Kenya	7	NA	6	275	2	76	-	-
Madagascar	-	-	-	-	10	137	5	349
UAE	9	NA	1	71	5	288	7	369
Yemen	2	NA	9	430	23	506	21	382
USA	-	-	3	82	57	2 255	49	2 751
Oceania	-	-	12	443	101	3 840	122	6 218
Total (incl. others)	**820**	**-**	**538**	**32 448**	**692**	**37 221**	**629**	**48 145**

Table 4B: Singapore Exports of beche-de-mer (dried/salted/in brine), 1997-2000 (Q=TONS; V=S$ 1000) (after Ferdhouse 2004) ***Source: National Statistics, Singapore***

	1997		1998		1999		2000	
Country	**Q**	**V**	**Q**	**V**	**Q**	**V**	**Q**	**V**
Hong Kong	502	-	236	3 543	161	3 111	295	4 351
Malaysia	255	-	146	3 943	238	6 247	214	7 143
Taiwan	116	-	81	3 359	132	6 146	138	5 236
Myanmar	-	-	-	-	-	-	-	-
Thailand	19	-	20	586	8	177	17	345
USA	-	-	2	139	1	87	2	111
Brunei	1	-	-	-	-	-	-	-
Total (incl. others)	**895**	**-**	**542**	**12 251**	**586**	**16 530**	**723**	**18 356**

Although the market demands high value products, the small population in Singapore (2.3 million) is not able to support the total import. Thus a loin share gets re-exported to Hong Kong, Malaysia, Taiwan PC, Myanmar and Thailand. AFTA (ASEAN Free Trade Agreement) also allows re-exports to the ASEAN member countries (Malaysia, Thailand, Myanmar). While exports to Malaysia consist of medium grade sandfish of different sizes and a small quantity of teatfish, high quality products are exported to Taiwan PC.

Domestic consumption of sea cucumber in Singapore has been low during the last few years. The economic recession since 1998 coupled with the SARS problem in 2002-2003, have affected the domestic seafood consumption.

• China (after Ferdhouse, 2004)

China is the largest market for sea cucumber. However, the actual trend in the market is not reflected on the published data. The official trade statistics from Hong Kong indicated that re-exports to mainland varied between 2 000 - 3 500 tons annually during 2000-2002 (Table 5). In 2001, re-exports to China from Hong Kong SAR were 3 543 tons.

The 2001 official statistics from China reported an annual imports of 2 059 tons according to which only 13 tons came from Hong Kong (Table 5). Imports from Indonesia in that year were 1 146 tons - 50% of the total official imports in that year. The other major suppliers were the Philippines (791 tons), Korea (21 tons) and Thailand (55 tons). Minor supplies came from Canada and Russia.

Table 5: China: Imports of sea cucumber, frozen/dried/salted/in brine, 1999-2001 (Q=TONS; V=US$'000) (after Ferdhouse 2004) ***Source: Bureau of Fisheries, PR China.***

Country	**1999**		**2000**		**2001**	
	Q	**V**	**Q**	**V**	**Q**	**V**
Russia	0.5	7 500	0.85	8 500	1.20	6 000
Ecuador	0.09	525	-	-	1.16	11 258
Philippines	28.8	23 599	45.02	348 241	791.48	489 250
South Korea	0.06	1 300	12.34	76 766	21.10	107 840
Papua New Guinea	-	-	-	-	0.62	4 992
Canada	14.63	22 107	-	-	17.54	41 385
Madagascar	7.19	13 793	10.58	24 031	0.94	2 560
USA	9.47	10 293	27.17	65 397	6.41	40 276
South Africa	-	-	-	-	1.08	1 642
Japan	14.28	19 795	-	-	0.02	1 023
Sudan	-	-	-	-	-	-
Thailand	-	-	-	-	55.91	18 780
Hong Kong	50.19	154 001	13.76	54 509	13.50	11 369
Indonesia	9.12	4 766	44.06	84 846	1 146.41	488 502
Chile	-	-	-	-	1.20	720
Total	**139.15**	**265 306**	**186.24**	**793 045**	**2 059.05**	**1 229 799**

Taking into consideration the exports from Hong Kong to this market, the annual import into China could be around 5 500 tons. This shows the importance and supremacy of China in the international market for sea cucumber. It is important to note that the market is capable to absorb all kinds and qualities of sea cucumber due to the varied degrees of purchasing power. Per capita income of the population in southern provinces is much higher than the average national per capita income of the country. Hence both high and low valued species and qualities of sea cucumbers are imported into China for domestic consumption.

- **Taiwan (after Ferdhouse, 2004 and Conand, 2001)**

Demand for high value fish and fishery products is relatively high in Taiwan. This is related to high per capita income and the traditional influence of the Fijian and Teochew provinces (the origins of the Taiwanese). Household consumption of processed sea cucumber is high, although the species are not popular with highlanders.

Traditionally the Taiwanese market has preference for various kinds of spiky sea cucumber which are both tropical and coldwater species. The coldwater prickly redfish are imported from Alaska and Canada in frozen form. Taiwan also imports frozen sea cucumber from Peru which are processed into dried

Table 6: Taiwan: Imports of beche-de-mer, 1997-2002 (Q=TONS; V=NT$1000) (after Ferdhouse 2004) ***Source: Fisheries Statistical Year Book, Taiwan PC***.

Year	Products	Spiked		Others		Total	
		Q	**V**	**Q**	**V**	**Q**	**V**
1997	Frozen	-	-	348	47 762	348	47 762
	Dried	39	19 675	658	90 039	697	109 714
	Salted/in brine	-	-	14	1 562	14	1 562
	Total	**39**	**19 675**	**1 020**	**139 449**	**1 059**	**159 124**
1998	Frozen	-	-	274	42 812	274	42 812
	Dried	41	25 763	530	81 581	371	107 344
	Salted/in brine	-	-	1	163	1	163
	Total	**41**	**23 763**	**805**	**124 572**	**846**	**150 335**
1999	Frozen	-	-	299	43 343	299	43 343
	Dried	37	25 033	508	75 592	545	100 625
	Salted/in brine	-	-	54	4 535	54	4 535
	Total	**37**	**25 033**	**862**	**123 489**	**899**	**148 522**
2000	Frozen	-	-	295	44 594	295	44 594
	Dried	32	23 126	517	68 406	549	91 532
	Salted/in brine	-	-	44	4 507	44	4 507
	Total	**32**	**23 126**	**855**	**117 507**	**887**	**140 633**
2001	Frozen	-	-	198	35 483	198	35 483
	Dried	20	16 089	426	62 237	446	78 326
	Salted/in brine	-	-	-	-	32	3 736
	Total	**20**	**16 089**	**624**	**97 720**	**676**	**117 545**
2002	Frozen	-	-	208	38 429	208	38 429
	Dried	12	10 468	733	89 047	745	99 515
	Salted/in brine	-	-	62	9 599	62	9 599
	Total	**12**	**10 468**	**1 002**	**137 075**	**1 015**	**147 543**

products for the domestic market. Demand for high value *sandfish* is rather limited but increasing slowly through supplies from Hong Kong. Consumption of sea cucumber was low during the economic recession in 1998-2000. However, imports (Table 6) recovered since 2001 and totaled 1 015 tons in 2002, against 624 tons in 2001. Nearly 28% of these were frozen products imported from coldwater sources. Imports of tropical species take place from India, Indonesia, the Philippines and from mainland China.

Import duty on sea cucumber is high in Taiwan. The tariffs also differ according to the species that range from 20-40% on the invoice value. The spiky varieties enjoy lower tariff compared to the other species. Import duty on frozen products is also lower than that of dried/salted products. Unlike Hong Kong, a few importers dominate the market in Taiwan. The market also demands high quality products.

•Malaysia (after Ferdhouse, 2004)

Malaysian population is multi-racial where Chinese are the second largest group. The country's population has increased since then to 23 million in 2003 but the ratio of Chinese origin people has declined, as the average family size has became smaller than before. Hence the market for sea cucumber in Malaysia has shrunken. Consumption of sea cucumber among the ethnic Chinese in Malaysia is not as high as Singapore or Hong Kong. The market imports a small volume of fresh/chilled and frozen sea cucumber from the neighboring Indonesia but dried products are the predominant type. Nearly half of the imported sea cucumber is re-exported to other markets. Imports in 2002 were low at 160 tons, compared to over 500 tons in 1998. The major share of supplies came from Indonesia followed by Hong Kong and China. Dried sea cucumber were re-exported from Malaysia to Hong Kong, Taiwan, Singapore and Thailand .

Local consumption is related to the festive season and occasions (wedding/birthday etc.) due to the price factor. Households buy processed/soaked products particularly during the Chinese New Year for family dinner. These are sold at traditional wet markets, some supermarkets and also at Chinese wholesale shops who sell other dried fishery products and Chinese herbs. In Malaysia the Chinese traders dominate the import and domestic markets.

• Reciprocal exchanges between the main markets

The Reciprocal exchanges take place between some of the markets, leading to an over-evaluation of the world tonnage. This important characteristic of this market has been studied by Conand (2001). It is not easy to understand and complicates the evaluation of catches from the market data. In fact the same product can appear twice, or even three times, in the imports if it has been re-exported. As observed earlier, though the detail of the figures do differ, between Hong Kong and Singapore the data spread is the same interval. The general flux is always from Singapore to Hong Kong. The reciprocal exchanges between Taiwan and the other markets are limited. They are non-significant with Hong Kong and minor with Singapore. The interaction is mainly between Hong Kong and Singapore (Figure 3, from Conand and Byrne 1993).

1.3 Sources of sea cucumbers (i.e. wild or aquaculture), origins

The **natural resource** has been the only source of sea cucumbers for a very long time, as the Chinese have thought them for more than thousand years and the Japanese for some hundred years (Akamine 2004).

The **aquaculture** experiences in Japan and in China for *Apostichopus japonicus* date back to the years 50, but have only recently been increased to an industrial size in the Northeast of China (Jiaxin 2003; Jiaxin 2004; Yaqing C. 2004). In the issue 19 of the Beche-de Mer Bulletin (S.P.C.) two Chinese companies are presented, showing the present development and promising prospective. The country data are not available to the author's knowledge, but it is essential to follow this production, its development and consequences.

Some tropical Indian and Western Pacific countries are developing aquaculture for *Holothuria scabra* (Indonesia see Tuwo 2004; India see James 2004; the Solomon see Battaglene 1999; Madagascar see Rasolonofirina *et al*. 2004. In Ecuador, *Isostichopus fuscus* is the targeted species (Mercier *et al*. 2004).

A particular attention should be given in the future to follow these activities and their impact.

1.4 Trade routes, and principal species in trade

Trade routes are very similar in the tropical indo-Pacific countries. The processing is generally made in the local communities by the fishermen, their wife or local collectors. Then, the Chinese merchants buy the products, and eventually re-do some steps of the processing if necessary (drying for example). They then ship the products to the main markets (see part 1.2), according to their commercial or family relations. Re-exports and subsequent double reporting of trade figures is a characteristic of this trade (Conand 1990, 2001).

Principal species in trade: they have been presented in the document 1, prepared for this workshop by C. Conand (see Table 1 list of species, according to FAO zones and commercial value).

In the traditional tropical Indo-Pacific fisheries, there are about 30 species of some commercial interest but only 13 in categories 1 (high value) and 2 (medium value). Altogether at the world scale, there are about 42 exploited species, and a few more could be added in the future.

The S.P.C. handbook (1994) shows photographs of the live and dried specimens and details the processing methods.

2. Description of the main utilization of sea cucumbers as food, in Traditional East Asian Medicines, live aquarium trade, and other uses

2.1 Body wall processed as food

The main utilization of sea cucumbers as food is the consumption of the body wall, prepared as dried product then soaked before cooking; other preparations of the tegument also exist and appear in some statistics:

- **Dried product** (trepang, beche-de-mer, hai-som) The Chinese are the main consumers. China is the largest market and consumer of sea cucumber. Unfortunately, the level of total annual supply in this market is not yet known. Most of the imported sea cucumber in China comes through Hong Kong. The other major consuming countries and territories in the region are Hong Kong, Taiwan, Singapore and Malaysia. In the minor markets in North America (USA and Canada) and Western Europe, consumption of sea cucumber is rather occasional, compared to other seafood preferred by the Oriental people living in those countries.

- **Boiled:** some imports appear in the statistics of several countries as boiled or salted (see tables).

- **Raw:** Japan is the market for raw sea cucumbers. The body wall is consumed raw, but also the preserved gonads (konoko) and the intestines (konowata) are delicacies.

- **Traditional food in Pacific islands:** in Fiji, there is a local market for *Holothuria scabra* which is sold to be cooked in coconut milk (see one photograph in Conand 1990).

2.2 Other organs used for human consumption

- **Japanese** eat raw sea cucumber body wall, but they also like the preserved **gonads** (konoko) and the **intestines** (konowata) are delicacies.

- The fresh **gonads** are consumed in some South Pacific Islands as Cook Islands where "matu" the ripe gonads of male *Holothuria leucospilota* are harvested traditionally (Zoutendyk 1989).

- Various species are eaten pickled in limejuice in some Pacific Islands, but the subsistence use of the **intestines** of *Stichopus hermanni* in Palau and Pohnpei is of interest and has been described by Lambeth (2000). The sea cucumbers are collected during the morning low-tide when the intestines are clear of sand, before feeding, and cut in two pieces or a small slit is done. The intestines are removed and the animal rejected to the reef to regenerate; the women believe that they regenerate very fast.

2.3 Traditional East Asian Medicines

East Asia countries have utilized sea cucumbers as medicines since ancient times.

For **Malaysia** Baine and Choo (1999 a and b) and Choo (2004) have given some information's. Malaysians value sea cucumbers for their medicinal benefits. Malays have traditionally utilized certain species of *Stichopus* (locally known as gamat) for their medicinal properties and traditional medicines processed from gamat are used in wound healing, treatment of stomach ulcers and as a painkiller. Apart from the traditional gamat water and oil, sea cucumbers have been incorporated into products, which include juice, balm, liniment oil, cream, toothpaste, gel facial wash, body lotion, facial wash and soap. Sea cucumber is cholesterol-free. It is high in protein (55% of dry body weight) and contains 10-16% mucopolysaccharides (substances used for building cartilage) and saponins; it is helpful in reducing arthritis pain and arthralgia (due to the mucopolysaccharides content) and pharmacology studiesindicate that the saponins of sea cucumber have anti-inflammatory and anticancer properties (Dharmananda, undated).

Scientists from the University of Malaya working on *S. hermanni* reported on the painkilling, anti-inflammatory and anti-itching properties of this sea cucumber (Awaluddin 2001). Research carried out by Malaysian scientists indicated that three types of antimicrobial agents, namely atratoxin A, B_1 and B_2 were found in *H. atra*, and these agents exhibited high activity against various species of yeast and fungi. Ethanol extracts from *H. atra* have antifungal properties.

The **Chinese** have long regarded sea cucumbers as a general health tonic, beneficial for treating tendonitis and arthritis, and as an aphrodisiac, among many other medicinal claims (Jiaxin 2003; Jiaxin 2004). Eating Trepang is a hobby of Chinese. The history can be traced back to Ming Dynasty (1368-1644 BC.) at least. Afterwards, sea cucumber was recognized as a tonic and a traditional medicine of animal source recorded in so many ancient litterature, from Ming Dynasty to Qing Dynasty (Fan 2001). According to analysis by principles of traditional Chinese medicine, the sea cucumber nourishes the blood and vital essence (*jing*), tonifies kidney (treats disorders of the kidney system, including reproductive organs), and moistens dryness (especially of the intestines). It has a salty quality and warming nature. Common uses include treating weakness, impotence, debility of the aged, constipation due to intestinal dryness, and frequent urination. Thereunder the tradition, the preference of Chinese eating sea cucumber is derived from the belief of a tonic, but than seafood. Hence, the popular Chinese name for sea cucumber is *haishen*, which means, roughly, ginseng of the sea.

other delicacies, such as shark fin and bird's nest soup, as a disease preventive and longevity tonic. From the nutritional viewpoint, sea cucumber is an ideal tonic food. It is higher in protein than most any other food except egg whites (at 99%), and it is lower in fat than most foods (Table 1). While the amino acids, especially necessary amino acids and necessary trace elements is good enough for healthy of people, who suffer some illness.

For modern applications, the dried or extracted sea cucumber is useful as a nutritional supplement, prepared in capsules or tablets. The fully dried material has a protein concentration as high as 83%. From the Western medical viewpoint, the reason sea cucumber is valuable is because it serves as a rich source of the polysaccharide condroiton sulfate, which is well-known for its ability to reduce arthritis pain: as little as 3 grams per day of the dried sea cucumber has been helpful in significantly reducing arthralgia. Its action is similar to that of glucosamine sulfate, which is useful for treating osteoarthritis. Sulfated polysaccharides also inhibit viruses; there is a Japanese patent for sea cucumber chondroitin sulfate for HIV therapy.

Chinese studies reveal that sea cucumbers also contain saponin glycosides. These compounds have a structure similar to the active constituents of ginseng, ganoderma, and other famous tonic herbs. Additional Chinese studies indicate anticancer properties of both the sea cucumber saponins and the polysaccharides.

Natural substances

There are many references on the chemical composition of sea cucumbers and the research looking for new compounds, molecules, or bio-active substances, is progressing fast, but some of the results stay confidential, as the pharmaceutical industries are involved.

A synthesis has been presented by Verbist (1993) for the Echinoderms, where the following substances have been detected in sea cucumbers; the references are given in tables:

- Hematolytic substances are found in 38 species of holothurians
- Hemaglutinating substances found in 5 species of holothurians
- Cytotoxic and antitumoral substances found in 31 species; 35% of the extracts are giving a positive response. The cytotoxic compounds have been isolated (ex: holothurin A and B, Stichoposide, Cucumarioside).
- Antimicrobial and antifungal activities have been shown with many extracts.
- Immune factors are found in holothurins, which are also active on nerve and muscle.
- Other substances (saponins, muccopolysaccharides, etc.) have been less studied but are present.

Another more recent synthesis is more focalized on the triterpene glycosides from holothurians (Kalinin *et al*. 1996).

These pharmaceutical researches are an important, but not well documented field.

2.4 Live aquarium trade

To the author's knowledge, there is no live aquarium trade. The main reason could be that the body wall contains toxins, which are able to kill other animals, if they are put in contact with sea cucumbers, or the sticky cuvierian tubules for the species, which have these organs.

2.5 Other uses

Toxins contained in the body wall of tropical species (ex: *Holothuria atra*) are traditionally used for poisoning small fish in tide pools (Conand 1990).

Dendrochirotes as they are filter-feeders are said to be useful as **biofilters**.

3. Information or recent examples of illegal, unreported or unregulated fisheries and trade, with an indication of the overall scale, trends, and the impacts on sea cucumber stocks

Information about of illegal, unreported or unregulated fisheries and trade is not easily accessible. From a questionnaire widely distributed in many countries, Baine (2004) has given a summary of the replies presented here and organised in Table 7:

Table 7. Information on illegal fishing supplied by respondents to the questionnaire exercise (after Baine 2004).

Country	**Are you aware of illegal sea-cucumber fisheries and trade activities?**	
Australia (Northern)	N	
Brazil	Y	Some private collection and consumption (Japanese)
China	N	
Cook Islands	N	Suspicion that an opportunistic fishery may exist from transient fishermen.
Cuba	N	
Ecuador (Galapagos)	N	Not at present.
Indonesia	Y Y	Indonesian fishermen fish in Australian waters. Fishing in foreign waters, smuggling pout of the country, deliberate under reporting
Kiribati	N	Amount exported is not high.
Malaysia	Y	Especially not sparing spawning and immature individuals.
Marshall Islands	Y	Occurs on some atolls although species remain abundant
N. Caledonia (NP)	Y	Fishermen do not declare their activities. No regulation of trade.
N. Mariana Islands	Y	Some personal use despite moratorium.
Papua New Guinea	Y	Mainly through one vessel in a remote area of the country
Philippines	N Y	No clear regulations so no illegal fishing. Fishers do illegally fish Malaysian waters. Illegal fishing by trawl and some probable illegal exports.
Solomon Islands	N	All exporters are licensed – no limit on tonnes exported
Vietnam	Y	Regulation needed.

Additional information about of illegal, unreported or unregulated fisheries and trade includes:

- Historically, the **Galapagos** marine reserve in Ecuador has suffered high levels of illegal fishing, coinciding with increased migration to the islands. Fishers have been provided with boats and motors financed by mainland and foreign traders (Martinez 2001). The impetus to fish has been high and violent clashes with the National Park Service have occurred in the past. The Galapagos history of the fishery management will be detailed in Sant's document prepared for this workshop (Sant 2006).·

- Illegal fishing has also been recorded in **other countries**: Madagascar (Irwing 1994), Malaysia (Baine and Choo 1999), Mexico (Ibarra and Soberon 2002), Papua New Guinea (Kinch 2002) and Venezuela (Rodriguez and Marques Pauls 1998).

- The questionnaire exercise (Table 7) additionally identifies some illegal activities in other countries New Caledonia, Vietnam, the Philippines, Indonesia, the Marshall Islands and Brazil. But, illegal fishing is not thought to occur in the Cook Islands, Kiribati, China, Ecuador (at present), and the Northern Territory of Australia.

- Many references are also found in the Beche-de-Mer Bulletins.

The complexity of trade routes for sea cucumbers, often involving import and subsequent re-export, or transshipment ports that export mixed shipments of different origins makes it difficult to determine the country of origin. It is also difficult to determine whether the harvest was legal, as shipments often include multiple species that are difficult to differentiate when dried, and those countries that have established regulations for holothurian fisheries generally prohibit the harvest of selected species or in specific locations. Furthermore, the processed product generally passes from the producing country to the main world distribution centers (Hong Kong, Singapore and Taiwan) before being imported to the consumer country. Trade statistics are further complicated by the variety of products available in international markets, including several types of dried holothurians (spiked & not spiked), as well as frozen, live, fresh or chilled, and salted or in brine.

Illegal sea cucumber fishing is not a prolific problem in countries with this resource. However, being such a lucrative market, it has caused major problems in certain areas and is a point important for the discussion in the CITES perspectives.

4. Examples of sea-cucumber-bycatch and indications of scale and impact

In most **tropical** countries, fishing is done by hand, at low-tide wadding on the reefs or bottom, by snorkeling and in some cases by scuba-diving (S.P.C. 1994; Conand 1999). These techniques are very selective and therefore there is no by-catch. In a few cases dredging or trawling are used, for example in Madagascar, and it has been reported to the author that large *Holothuria scabra* are found with prawns.In **temperate** countries, dredging is used. In Japan *Apostichopus japonicus* can by collected with different fishing gears but the fishery is regulated (Choe 1963). In Quebec (Canada) *Cucumaria frondosa* (Hamel and Mercier 1999) are accidentally dredged during the scallops harvest season aand returned to sea where most die. The exploitation was suppose to start on this by-catch. Inin Russia, *C. japonica* are also collected using dredges, but this is very little documented.

5. Socio-economic aspects of the sea cucumber fishery, including relative economic importance, a description of the chain of custody, values and prices, and market trends.

5.1. Socio-economic aspects

Traditional fisheries. The sea cucumber fisheries were traditionally situated in less developed counties of the tropical Indo-West Pacific. These small-scale artisanal fisheries do not necessite sophisticated gears, nor ice and were an important source of incomes for the villagers. A participative management, with all the actors trying to collaborate, has thus been encouraged in Madagascar, but with the shortage in money, this program has not been sustainable (Rasolofonirina, and Conand 1998; Conand, De San, Refeno,,Razafintseheno, Mara, Galet-Lalande and Andriajatovo 1998; Conand 1999).

Table 8: Prices of Sea Cucumber in the International Market, October 2003 (after Ferdhouse 2004). ***Source: INFOFISH Trade News, 1 October 2003.***

Products	**US$/kg**	**Market**	**Origin**
White teatfish, skin-on, 3-5 pc/kg *H. fuscogilva* - Grade-A - Grade-B	 23.00 13.00	c&f South East Asian Ports	South Pacific
Prickly Redfish, 6-15 pc/kg *Thelenota ananas*	 15.00		
Black teatfish, 3-5 pc/kg - Grade-A - Grade-B	 18.00 10.00		Australia
Stonefish	18.00	c&f Singapore	Indonesia
Sandfish, Grade A 10-30 pc/kg 15-40 pc/kg	48.00 56.00 40.00		South Pacific
Greenfish 50-120 pc/kg *Stichopus chloronotus*	25.00		
Surf Redfish, 15-35 pc/kg *Actinopyga mauritiana*	11.00		
Tigerfish, 25-55 pc/kg	3.00		
Brown Sandfish, 25-110 pc/kg *Bohadschia marmorata*	5.00		
Curryfish *Stichopus hermanni*	19.00		
Elephant Trunkfish, 3-8 pc/kg	5.00		
Lollyfish	1.50		

Recent fisheries. The Ecuador sea cucumber fishery for *Isostichopus fuscus* (Galapagos and mainland) with its numerous conflicts in the first years of development, is a good example of the socio-economic impacts. It is described in many papers (see Martinez 2001; Sant 2004 among other) and it has temporarily been solved by putting recently the species on CITES Appendix III.

In the different countries and fishery context, it is important to give more attention to the socio-economic issues of these fisheries, to help sustainable management measures being introduced and evaluated.

5.2. Values and prices and market trends (after Conand 1990 and Ferdhouse 2004)

Prices of dried sea cucumber in the **international** (Table 8 for 10/2003) as well as domestic marketsvary according to the species (high, medium and low value), sizes and quality of the species. Data have been presented for the period 1980 in New Caledonia and the South Pacific (Conand 1989; Conand 1990). Presently, *sandfish* fetches the high-life prices, the lowest are offered for *lollyfish*.Over the decade the ranking of the species has also changed. Some medium value species have moved to the category of high value species as supplies of *sandfish*, the high value species as *teatfish* are getting scarce due to low supplies. In the **Hong Kong** market for 2001-2003) (Table 9), the average import prices of Australian origin sea cucumber have been the highest in recent years due to the species and quality factor. A similar trend is also observed for the pacific origin sea cucumber. The Hong Kong market also controls international market pricesof sea cucumber. However, quality is the main factor that determines prices of sea cucumber in general.
Outside China the difference between the import and retail prices is very wide for all categories of sea cucumber. For example, in Malaysian market the retail price of quality dried sandfish is around US$110/kg. The retail price of processed frozen wet sea cucumber is US$ 23-24/kg. A similar trend is also noticed in the other markets in Asia.

Table 9: Hong Kong: Average import prices of Sea Cucumber, 2001-January/June 2003 (US$/kg) (after Ferdhouse 2004). ***Source: Agriculture, Fisheries and Conservation Dept., Hong Kong.***

Country	**2001**	**2002**	**January-June 2003**
Australia	28.05	30.25	41.62
Indonesia	4.12	4.07	4.02
PNG	9.73	13.27	14.34
Philippines	6.85	6.45	7.23
Singapore	9.54	9.97	6.86
Sri Lanka	7.36	7.48	6.39
Madagascar	11.10	7.55	5.08
South Africa	4.28	2.50	2.20
Mozambique	28.21	11.46	9.94
Tanzania	10.71	7.61	5.17
Fiji	10.11	10.02	7.41
Solomon Islands	7.35	6.19	4.41
India	25.86	22.82	-
Maldives	7.19	3.64	5.54

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Management and Conservation Strategies and Practices for Sea Cucumbers

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EXECUTIVE SUMMARY

This document presents a summary of current sea cucumber fishery practices and management options, with discussion on opportunities for sustainable wild harvest, aquaculture, efforts to enhance wild populations and trade controls. Sea cucumbers are both economically and ecologically valuable marine invertebrates, with a growing international trade for food, medicinals, nutritional supplements, biomedical research, aquarium displays and other uses. The greatest threat to sea cucumber resources is overfishing, primarily as a result of the present fishery system, which usually involves foreign buyers offering a low price to indigenous fishermen for valuable species. While indigenous fishermen may be concerned with sustainable resource utilization, buyers focus on the largest profit in the shortest time period. As a result, fishermen initially target the largest individuals of the high value species; once these are fished out, larger numbers of individuals of a smaller size are taken, along with harvest of medium and low value species. Once an area is depleted, fishermen and buyers must look for new sources.

Developing management strategies for an exploited fishery resource requires consideration of specific details of the biology of the target species and their population dynamics, details on the fishery, processing and marketing methods, and the social and economic context of the fishery. Alternative and complementary conservation measures such as aquaculture and stock enhancement programs can help conserve and rebuild wild populations. However, these measures also require considerable investment in research on life history and ecological data, as well as information on optimal conditions for reproduction, settlement, growth and release into the wild. Proposed or existing fishery management strategies have included minimum sizes, spatial and temporal closures, rotational harvest, harvest or export quotas, gear restrictions and limited entry. While each of these approaches can assist in sustainable management of the resources, they are likely to be most effective when multiple strategies are combined under one plan, such as a minimum size and quota for each target species along with establishment of protected areas. In developing countries, regional management plans combining multiple fishery approaches and emphasizing adaptive management are likely to be most successful at ensuring conservation and sustainable harvest, provided that the measures are adopted through consensus with multiple stakeholders and local communities take on some of the responsibilities for management.

INTRODUCTION

Trends in Sea Cucumber Fisheries and Trade

The harvest of sea cucumbers for bêche-de-mer provides a valuable source of income for many coastal communities in developing countries throughout the tropical and subtropical IndoPacific. Until recently, sea cucumbers were harvested primarily at low subsistence levels through small scale artisanal fisheries, as access was restricted due to smaller and fewer boats and certain gear types such as SCUBA and hookah were not used. Many of these fisheries had been operating for up to 1000 years, with the particular species, product type and use varying between islands (Conand, 2001). Since the 1980s, sea cucumber fisheries have been characterized by boom and bust cycles, with a growing number of reports of over-harvesting as fishermen

attempt to supply an increasing demand for bêche-de-mer in Asian markets (Adams, 1992; Trinidad-Roa, 1987; Conand 2000; 2001; Ibarra and Soberon, 2002). Production from tropical holothurian fisheries increased almost fivefold between 1985 and 1989, reaching an estimated worldwide trade of 9,000 metric tons (mt) dried (Conand and Byrne, 1993). By 1995, exports of sea cucumbers to Chinese markets were approximately 13,000 mt, valued at over USD $60 million (Conand 1997; 1999). Recent trends in the export fishery include increases in the number of producing countries and species in trade, and an expansion of fisheries in both tropical and temperate regions into non-traditional fishing areas such as the Caribbean, eastern Pacific and North America (Conand and Byrne, 1993; Ibarra and Soberon, 2002; Fiendel, 2002; Buitrago and Boada, 1996; Rodríguez and Marques-Pauls, 1998; Fuente-Betancourt et al. 2001). Statistics from one of the largest importers show an increase from 25 source countries in 1987-1989 to 49 countries in 2000-2001 (Hong Kong Special Administrative Region data). In addition to a growing international trade of bêche-de-mer, additional species are being harvested for aquarium organisms, biomedical research, pharmaceuticals, traditional medicines, nutritional supplements and plant fertilizer (Beumer, 1992; Baine and Sze, 1999; Chen, 2003).

Recent Status of Sea Cucumber Fisheries and Target Stocks

The rapid decline of sea cucumber populations worldwide has triggered fluctuations in market prices, rapid expansion and spread of fisheries, severe overfishing, and poaching by nationals and foreign fishermen (Conand, 1999; Kinch, 2002; Jun, 2002; Conand, 2001). During the 1980s and 1990s, increased commercial harvesting and export of sea cucumbers stimulated financial gains for fishermen and local communities that process the meat, but the benefits to any one fishing community are typically short-lasting (Kinch, 2002). In at least 10 countries, catch per unit effort for high value species declined shortly after fisheries became established, forcing a shift in fishing effort to smaller individuals and lower value species [e.g., Australia (Uthicke and Benzie, 2000); Fiji (Adams, 1992); India (Nithyanandan, 2003); Indonesia (Moore, 1998); Madagascar (Jangoux et al., 2001); Malaysia (Baine and Choo, 1999); New Caledonia (Conand and Byrne, 1993); Papua New Guinea (Kinch, 2002); Philippines (Trinidad-Roa, 1987); and Solomon Islands (Holland, 1994)]. Sea cucumber fisheries were historically managed by local communities or through tenurial systems. In more modern times, commercial fisheries have often been poorly managed, with management measures applied in response to dwindling stocks. For example, commercial harvest in most developing countries initially begins as an open access fisheries, with a subsequent closure or relocation of the fishery within a few years due to overexploitation (Castro, 1995; Lokani, 1996; Trianni, 2002).

The marked increase in landings and export of holothurians in combination with few existing management measures, as well as limited fisheries, trade, biological and population data for commercially important species, are key factors contributing to the decline and extirpation of holothurian populations (Conand and Byrne, 1993). Certain aspects of sea cucumber life history and ecology such as a late maturity and ease of collection renders them highly susceptible to over-exploitation, and may result in recruitment failure with prolonged recovery times (Richmond, 1996). It is now apparent that certain populations of high value sea cucumbers like the sandfish (Holothuria scabra) have been exploited so heavily in some Pacific Islands that it will take decades for stocks to recover in absence of adaptive management measures (Preston, 1993; Kinch, 2002).

Purpose of this Document

This document has been prepared by NOAA Fisheries for a technical workshop that will be convened by the CITES Secretariat in Kula Lumpar, Malaysia from 1-5 March, 2004. The purpose of the workshop is to develop conservation priorities and actions to secure the conservation status of sea cucumbers, addressing trade monitoring and controls, national legislation, fisheries management provisions, other conservation

approaches, enforcement, and capacity building. This document summarizes current sea cucumber fisheries practices, management options and conservation practices applied both domestically and regionally, including opportunities for sustainable wild harvest, aquaculture, and efforts to enhance wild populations. The benefits and drawbacks of these measures and their contribution to the recovery of overfished stocks are evaluated. Brief descriptions of sea cucumber fisheries are provided for each of the major exporting countries, as well as possible adaptive management approaches that have been recommended and/or implemented to reduce pressure on depleted stocks or promote sustainable harvest.

CURRENT SEA CUCUMBER FISHERIES PRACTICES

Holothurian fisheries are based on about 30 of the over 1000 existing species, with most utilized as a raw, frozen, salted or dried product for human consumption (e.g., bêche-de-mer; trepang); numerous additional species are harvested at a much lower volume for aquarium displays, biomedical research, dietary supplements and other uses (Conand, 1993; Baine and Sze, 1999; Chen, 2003; Conand, 2001). Tropical and subtropical fisheries in the western Pacific are multi-species as compared to tropical fisheries in the Indian Ocean (*H. scabra*), eastern Pacific (Isostichopus fuscus) and Caribbean (*Isostichopus badionotus, Holothuria mexicana* and *Astichopus multifidus*). In the western Pacific, fisheries primarily target shallow water (up to 50 m depth) deposit-feeding holothurians belonging to two families and eight genera: *Actinopyga, Bohadschia, Microthele* and *Holothuria* (Holothuridae) and *Isostichopus, Parastichopus, Stichopus* and *Thelenota* (Stichopodidae). The more recent temperate water fisheries are each based on one or two species that are found in the western Pacific around Japan, Korea and Russia (*S. japonicus*), southern hemisphere off New Zealand (*S. mollis*), eastern Pacific coast of North America (*P. californicus* and *P. parvimensis*) and western Atlantic coast of North America (*Cucumaria frondosa*).

Holothurians that are targeted by bêche-de-mer fisheries range in size from about 5 cm to over 1 m in length, while aquarium specimens are typically smaller (2-20 cm). Bêche-de-mer species may be classified into three categories of commercial importance based on their abundance, appearance, odor and color, thickness and quality of body wall, and main market demand and value (Conand, 1993). Worldwide, the single most important species by volume is the temperate holothurian, S. japonicus, with over 12,000 mt consumed in Japan and Korea in 1983 (McElroy, 1990). However, the total landings of *S. japonicus* in Japan declined from 25,000 mt in 1983 to 7000 mt in 1995, while the volume of tropical sea cucumbers in trade has grown considerably (Conand, 1986; McElroy, 1990; Ito and Kitamura, 1998). Currently, the species of highest commercial value are *H. fuscogilva* (white teatfish), *H. nobilis* (black teatfish) and *H. scabra* (sandfish), worth US$15-40/kg on the Asian market in 2002, with bigger specimens fetching a higher price per kilogram than smaller specimens (Infofish trade news, 2002). Species of medium value include *A. echinites* (brownfish), *A. miliaris* (blackfish) and *T. ananas* (prickly redfish) (USD $10-12/kg). Species of low value include *B. marmorata, H. atra, H. fuscopunctata, S. chloronotus* and *S. variegates* (USD $2-10/kg). Most other tropical and temperate species are medium to low value.

Fishermen may operate from shore, or out of small boats (dugout canoes, sailing boats, motor boats) fitted with SCUBA, a hookah system or trawl gear. For instance, in Papua New Guinea, small, motorized banana boats and outrigger canoes with sails and outboards are used to access sites, but most collection is done by walking on the reef flat at low tide and snorkeling while hand collecting (Lokani et al., 1996). In British Columbia, geoduck and urchin dive fishermen target sea cucumbers to supplement their operations; boats are 22 foot skiffs to 40 foot salmon boats converted for diving, with 2-3 divers and one tender per boat (Muse, 1998). In tropical countries, the sea cucumber fishery is often one part of a multi-species fishery for reef fishes, corals, and other invertebrates. In remote tropical areas, vessels may remain at sea for several weeks.

Fishing gear and methods for sea cucumber fisheries include:

- Small bottom trawls (roller pulling nets, beam trawl nets, scallop-drag gear etc.) used primarily in soft bottom habitats away from reef structures;
- Direct collection by hand (reef flat gleaning at low tide or wading) or collection with spears, hooks and scoop nets in shallow-water mangrove lagoons, reef flats and grass beds;
- Collection by hand using snorkel and diving gear (SCUBA and hookah) and lift bags for deeper reef and lagoonal environments; and
- Collection at night with SCUBA, snorkeling or wading using underwater lights or torches.

MEASURES TO ENSURE SUSTAINABLE OR ENHANCED SEA CUCUMBER FISHERIES

Possible approaches to ensure sustainable sea cucumber fisheries include:

1) Aquaculture and mariculture to provide an alternative source of bêche-de-mer;
2) Reseeding and relocation of juveniles/adults to rehabilitate degraded areas and enhance wild stocks;
3) National controls on harvest or export, including a CITES Appendix III listing (Ecuador) or placement of overharvested species on National endangered or threatened species lists, with prohibitions on take or export (India, Mexico);
4) Specific domestic fishery management strategies to conserve wild populations while allowing sustainable harvest.
5) Regional management approaches and cooperation in resource harvesting and marketing by multiple stakeholders and resource management agencies; and
6) International controls on exports such as a possible CITES Appendix II listings for one or more species.

Aquaculture and Mariculture

Sea cucumber farming practices have greatly expanded over the last five years, with programs underway in China, Indonesia, Vietnam, Marshall Islands, Japan, Maldives, New Zealand, India and other countries. Aspects of the development of sea cucumber larvae are described for a number of commercially important species, and researchers are successful at inducing spawning, gamete fertilization and early larval rearing for several of these (Conand, 1993; Ito, 1995; Ramofafia et al., 1995; Morgan, 2000; Pitt, 2001). Broodstock can be collected from the wild and induced to spawn in captivity. In addition, several high-value species have been reported to reproduce asexually by fission and induced fission is being examined as a potential technique to propagate commercially important species (Reichenbach et al., 1998). For many species reliable feeding regimes for sea cucumber larvae through the planktonic part of their life cycle to settlement have been developed (Purcell et al., 2002). One, temperate species (*A. japonicus*) can be produced successfully in large commercial quantities. The rapid expansion and intensification of sea cucumber farming has led to the occurrence of various diseases, causing economic losses and becoming one of the limiting factors in the sustainable development of the industry (Yin-Geng et al., 2003). while Aquaculture of tropical sea cucumbers has been more challenging due to can be difficulties in to holding adults in in captivity, and reduced feeding, weight loss and poor gonadal development has been reported (Battaglene, 1999). Currently, most effort in the tropics is geared towards *H. scabra*. Some of the recent successful sea cucumber farming venturesculturing efforts include:

- The Sea Farming Center in southern Japan that can produce up to 1 million juveniles per year (Ito and Kitamura, 1998).

Table 1. Information needed to develop sustainable management plans for sea cucumber fisheries.

Information Requirement	Description	Methods
Taxonomy	Unambiguous identification of species	Morphological, microscopical (spicule analyses) & molecular analyses; photographic keys for live and dried specimens.
Distribution	Extent of species occurrence within- and between-countries Spatial structure of populations (clumped or uniform)	Museum specimens, fisheries-dependent & fisheries-independent surveys
Habitat	Habitat requirements and preferences; effects of habitat type (e.g., soft sediment, grassbed, cobble) on growth, reproduction and survival	Remote sensing and *in situ* mapping and habitat characterization; fisheries-dependent & fisheries-independent surveys; broad-based underwater censuses, physio-chemical measurements
Stock structure	Single or multiple stocks Standing stock (size, biomass) Exchange of individuals among stocks	Genetics, tagging, habitat surveys, fisheries-independent surveys
Reproduction	Number, timing and season of broadcast spawning events Age- & size-specific fecundity Age & size at first reproduction	Fisheries-dependent & fisheries-independent surveys, laboratory studies, tagging and underwater studies
Recruitment	Duration of larval existence; Dispersal of larvae and juveniles; Settlement cues (physical, chemical or biological)	Tagging, genetic analyses, ecological surveys
Growth	Age-specific growth rates Seasonal growth rates Relationship between environmental attributes and growth	Tagging, cohort analysis
Natural mortality	Age-specific mortality rates Size-specific mortality rates	Fisheries-independent surveys, life-table analysis
Fishing mortality	Size of fishing fleet Spatial and temporal distribution of fishing effort Size-specific fishing mortality Sex-specific fishing mortality	Logbooks, fisheries-dependent surveys, fisheries observers, catch sampling
Density dependence	Compensatory or dispensatory (?) reproductive output (including Allee effects); Density-dependent growth (resource limitation)	Fisheries-independent surveys, meta-analyses from multiple populations and years

Table 2. Management approaches to enhance sustainability of sea cucumber fisheries.

Approach	Description	Benefits
Seasonal closure	Fishery closure during breeding season	Enhance recruitment of stocks; one problem is that some species reproduce from Nov-Jan while others peak between June-July.
Spatial closure	Fishery closure in sensitive areas or in areas that are depleted	Can include establishment of no-take areas which may help in the recruitment of stocks to fished areas and zoning for multiple uses which may reduce conflicts among different user groups.
Rotational closure	Rotate between participating islands; divide collection areas into sections, each open to harvest during a certain time period on a rotational basis.	This will reduce pressure in one area and allow a fished site to recover. Allows countries to pool resources and obtain minimum needed for export without destroying resources in one area.
Temporal closure	Fishery closed at night.	Certain species such as *H. scabra* emerge at night and would be easily overexploited at night.
Quotas	Species-specific total allowable catch for each location; total closures for certain species with low abundance.	Avoid declines in CPUE masked by shifts in fishing effort to other less valuable species; ensure that the total depletion of high value species does not occur.
Minimum size	No take until species have reached reproductive maturity.	**Biological justification**: maximize yield per recruit; allows individuals to reach reproductive maturity and spawn at least once before harvest. **Economic justification**: bigger specimens commend a higher price than smaller specimens **Drawback:** animals can change size and shape dramatically once caught; at least one species (curryfish) fetches a higher price at a smaller size.
Maximum size	Take of juvenile species for mariculture grow-out, aquarium organisms, and other uses.	Harvest of juveniles at a vulnerable stage in their development may provide a source for individuals for commercial grow-out with minimal implications to wild populations.
Gear restrictions	Limitations on use of trawls	Reduce bycatch and habitat destruction.
Gear restrictions	Prohibitions on use of SCUBA or hookah.	Provides a refuge for part of the population (depth).
Limited entry	Limitations on amount of effort based on a licensing or permitting system; restrict entry to locals or nationals.	Improves compliance with management measures. Ensures that profits from fishery benefit local community. Assigning territorial rights to fishing coops may reduce problems associated with uncontrolled open-access fishing.
Logbooks	Information on catch location, species composition, method of collection, quantity and	Facilitate acquisition of more reliable fishery dependent data for use in management; increase compliance with management measures.

- China is is one of the first locations to successfully raise *A. japonicus* sea cucumbers on a large commercial scale in ponds and enclosures at sea. For instance, Chen (2003) , with reports of production of about 1000 mt of *A. japonicus* each year, and 1025 mt of several other species in another location during 2001. (Chen, 2003). Total landings of *A. japonicus* from farms in Liaoning and Shandong Provinces is reported to have exceeded 5,800 mt in 2000 (Jiaxin, 2003). In addition, in the Dalian area more than 2000 hectares of ponds are being used for polyculture of shrimp and sea cucumbers (Yaqing et al., 2003)
- A sea cucumber ranching operation was established on an atoll in the Maldives involving *H. scabra* from India, a species that is not native to this area. In less than one year, juveniles have grown to 15 cm and are being harvested for export.
- Collection of small (juvenile) sandfish (*H. scabra*) from the wild for grow out in ponds and pens has been reported from India, Indonesia and Vietnam (Pitt, 2001).
- India is able to produce larvae and juveniles of *H. scabra* from wild brood stock, which are produced in a hatchery, and are grown out in cages and pens on the sea floor in several Bays and harbours, and also in shrimp ponds in polyculture (James, 2003)
- Madagascar established a sea cucumber hatchery in 2000 that can now produce juveniles (1-2 cm) of *H. scabra*, and a sea cucumber grow-out farm has been established (Jangoux et al., 2001).
- Indonesia has developed sea cucumber farms in four areas with substantial production, including Papua (378 mt), Central Sulawesi (200 mt), southeast Sulawesi (3 mt) and East Kalimantan (1 mt); some of the production is actually wild harvested juveniles that are grown to market size in cages or ponds (Tuwo, 2003).
- The possibility of usingIn several countries commercial shrimp farming ponds are being used for grow out of sea cucumbers is being explored, as holothurians ingest large amounts of sediment and may improve water conditions by removing organic debris. Preliminary experiments show high survivorship and rapid rates of growth until the wet season, when salinities fluctuate andnd mass mortalities may occur (Pitt, 2001; Chen, 2003).
- Rearing of *Isostichopus* on land and in abandoned shrimp ponds is underway in Ecaudor, with 30-50% survival of larvae and rapid growth (8 cm in 3.5 months) (Mercier et al., 2003).

Restocking

The release of juvenile sea cucumbers produced in hatcheries is thought to be one way of rebuilding wild stocks (e.g., "restocking" or "reseeding") to the point where they can sustain regular harvest. There is also the potential to increase harvests beyond historical levels by releasing sufficient cultured juveniles into the wild to reach the carrying capacity of the habitat and overcoming recruitment limitations (e.g., "stock enhancement") (Munro and Bell, 1997; Battaglene and Bell, 1999). Relocation of recruits and juveniles from areas of high abundance to depleted areas as a form of sea ranching has also been recommended, but not attempted on a large experimental scale. In addition, artificially aggregating adults is also another option to enhance stocks. These approaches may be beneficial in areas where populations of certain species have been reduced to such low levels by fishing that remaining individuals are incapable of successful reproduction due to Allee effects, or when recruitment is be limited due to a) certain physio-chemical properties of the site (e.g., water circulation patterns); or b) the larvae of target species have limited dispersal capabilities. However, there are numerous concerns associated with reintroduction of hatchery produced species, including possible genetic considerations and disease introductions.

Holothuria scabra appears to be the tropical holothurian most suited to restocking in the western Pacific and Southeast Asia; however, it has not been demonstrated that farm-raised juveniles will survive in the wild and

information is lacking on optimal release strategies (Pitt, 2001). Research in restocking and stock enhancement of tropical sea cucumbers is being undertaken or has been proposed in Ecuador, Philippines, India, Kiribati, Maldives, Marshall Islands and the Solomon Islands (Battaglene and Bell, 1999).

- Some of the earliest restocking experiments were attempted in Japan. In one area, 1,700 juveniles were released and fishing was closed for two years to allow these to mature. At the end of the prohibition, the 90 fishing boats that targeted this area had an estimated total catch that was 30 X higher than previous catches in this area (Arakawa, 1990). More recently, 11 farming centers released 2,557,000 juvenile sea cucumbers (9 mm) in 1995 (Ito, 1995); it is unclear whether follow-up studies were conducted to determine what proportion of these survived.

- International Center for Living Aquatic Resources Management (ICLARM) has been examining the potential for releasing cultured juveniles of *H. scabra* and *A. mauritiana* in the Solomon Islands as a means of restoring and enhancing tropical sea cucumber stocks (Battaglene, 1999). ICLARM produced over 200,000 juveniles from six spawning events in the mid-1990s. In 2000, they released 2600 juveniles in the Western Province in areas where spawning adults were found; survival rates are unknown (Battaglene, 2000).

- In preliminary trials from the Solomon Islands, 15-90% of the hatchery bred animals released in sea grass sites were missing after 24 hours (Dance et al., 2000). In a second trial, juveniles were released in sand or silt reef flat, mangrove and seagrass sites, with the highest short-term survival at mangrove sea grass sites and high rates of predation occurring in reef environments (Dance et al., 2000).

- A sea cucumber project in New Caledonia aims to determine the best strategies for releasing into the wild the sandfish (*Holothuria scabra*), for purposes of restocking and stock enhancement of inshore fisheries. The sandfish have beenwill be cultured from local broodstock and have shown high survival and growth in certain habitat types. Transportation methods and the sizes, densities, habitats, times of the day and year for release will be optimized by tracking the fates of juveniles at inshore sites in the Provinces of New Caledonia (Purcell, Gardner and Bell, 2003).

- In Suez Canal University, the release of cultured juveniles of *A. mauritiana* on the red Sea coast is being explored to restore depleted populations and possible enhancement of fisheries (Gabr et al., 2003).

CONSERVATION PRACTICES AND STRATEGIES

While sea cucumber fisheries remain unregulated in most developing countries, other developing and developed countries have established measures to manage and conserve holothurian resources, in an attempt to prevent over-harvesting (Table 4, 5; Appendix I). In most countries with open-access sea cucumber fisheries, fisheries have passed through four phases, inevitably leading to overfishing (Ibarra and Soberon, 2002). Fishermen first target dense populations with easy access, especially nearshore, shallow environments; stocks are initially underexploited, but the catch keeps on growing as effort increases and the industry flourishes. As the industry matures, the level of capture becomes constant, but more fishing effort is needed to achieve these levels. As all of the suitable species and size classes are removed from one area, the distribution of fishing effort expands to more remote areas and deeper environments. This practice may result in extensive areas that are essentially free of harvesting pressure, but it also leads to the localized depletion of stocks where fishing has occurred.

Development of sustainable management approaches for sea cucumber fisheries are not easy, and current management tools like size limits, gear restrictions, spatial and temporal closures, quotas and marine reserves have not been very effective in managing large commercial export fisheries in tropical regions (Preston, 1993; Dalzell et al., 1996). Part of the problem is that developing countries do not have the human resources to collect data on the biology, ecology and population dynamics of sea cucumbers necessary to develop adaptive management plans, or the capacity to enforce regulations. The multi-species nature of most tropical sea cucumber fisheries, as well as the remote and artisanal nature of these fisheries, makes it difficult to obtain data needed to manage sea cucumber fisheries.

Traditional Management and Tenurial Arrangements

Traditional, tenure or community-based management approaches were highly successful in Pacific islands and other areas when holothurians were harvested at much lower levels only for traditional and subsistence uses. These approaches are less effective now, since:

1) some of the traditional cultures are being lost;
2) population growth and increasing international demand places greater pressure on the resources;
3) sea cucumbers populations are being targeted that were not traditionally exploited, due to availability of motorized boats, SCUBA and hookah gear which allows fishers to reach distant and deepwater habitats; and
4) non-local collectors are fishing in many areas, and poaching and illegal trade has increased (Samyn, 2000).

Regional Management Approaches

When developing management plans for sea cucumber fisheries, the target species in some locations should be considered as transboundary stocks. Management of these stocks plans requires bilateral and international agreements targeted at protection of reef habitats, spawning aggregation areas and parental stocks. Although adult sea cucumbers are relatively sedentary, fertilized eggs and developing larvae may disperse away from the natal reef. If larvae are widely dispersed, managing an adult population of sea cucumbers may not guarantee a healthy stock if that managed population depends on an upstream source of larvae for replenishment. This is particularly relevant in the Indo-Pacific where larval dispersion may occur across international borders, separating healthy and overexploited reef systems. Conversely, if larvae are locally retained, local management will have local consequences. In these situations, poor ecosystem and fisheries management may cause declining stocks, but good management will lead to local recovery of fished populations and sustainable fisheries.

To date, only Papua New Guinea and Australia have initiated a regional management approach for the Torres Strait Fishery. They have ratified the Torres Strait Treaty, which includes provisions for joint management and cooperation in surveillance activities (Lokani et al., 1996).

There has also been a recent resurgence of interest in community involvement and participation in all aspects of marine resource management and monitoring. One approach involves collaborative efforts between industry, resource management agencies, local communities and non-governmental conservation and sustainable management organizations. As an alternative approach, communities have taken on the responsibility for managing their resources, with the government providing limited support and infrastructure. Examples include:

- Development of an association of licensed exporters in Fiji (Bêche-de-mer Exporter's Association) to maintain quality standards and provide the Fiji government data on the fishery (Preston, 1990).

- While the Fisheries Division in Fiji has no authority to set up no-take reserves, the Fisheries Act allows resource custodians to endorse fishing permits and to ban fishing for a particular species in an area under their control (Adams, 1992).

- Sea cucumber fishermen from a village in Sulawesi near the Wakatobi Marine National Park have agreed to avoid harvesting juveniles (Moore, 1998).

- Shared management was introduced in Madagascar in 1998, with partnership between the Madagascar National Trepang traders group and the government resource managers.

National Conservation Measures

Several countries have adopted conservation measures to prevent illegal fishing and export, and to recover depleted sea cucumber stocks. These include:

- The Ecuadorian government requested international assistance in preventing illegal exports and adopted a CITES Appendix III listing in 2003.

- India added all sea cucumbers to Schedule I list of the Wildlife Protection Act in 2001, with a prohibition on exports.

- Mexico declared I. fuscus in danger of extinction in May of 1994; the species was placed on a "species under special protection" list in March 2000.

MEASURES IN FISHERIES COUNTRIES TO CONTROL OR MONITOR HARVEST AND TRADE AND TO PROTECT OR ENHANCE STOCKS

The management goal for sea cucumber fisheries is to preserve, protect, and perpetuate sea cucumber resources; provide for their sustainable harvest; protect the habitat necessary to sustain these harvests; and minimize by-catch mortalities of other species. For effective conservation, a sea cucumber fishery must conserve target stocks, sustain marine ecosystems and non-target species, and also provide economic and social benefits consistent with the goals and desires of coastal communities. Domestic management options include a number of tools that have been applied to manage tropical and temperate fisheries, summarized under input controls (restrictions on fishing effort) and output controls (restrictions on sea cucumbers that can be retained by the fishery) (Table 2, 4 and 5; Appendix I).

I nput Controls

Fisheries closures: Sea cucumber fishery closures include prohibitions on the take of certain species, or entire closures of the fishery. Entire fisheries (e.g., Venezuela, Ecuador) or certain sites (e.g., Mexico, Panama) have been closed to harvest a short time after the fishery commenced, due to rapid overexploitation and biological or commercial extirpations of target species (Castro, 1995; Rodríguez and Marques-Pauls, 1997; Guzman and Guevara, 2002). In other locations, the take of certain species is now prohibited due to their rarity. This

Table 3. Other tools, approaches, and information needs that contribute to the development of sustainable management plans for sea cucumbers.

Approach	Description	Benefits
Baseline surveys and monitoring	Baseline surveys and monitoring of Population abundance estimates including abundance and diversity in areas under exploitation and control areas.	Field data necessary to determine sustainable harvest guidelines including which sites are feasible for harvest and to set their quotas; establish permanent surveys sites to monitor harvest pressure, recovery from harvest and seasonal variation in recruitment.
Fishery-dependent data	Monitoring of catch data (numbers of individuals harvested, sizes, dates and location of collection) and trade.	Fishery dependent data necessary to feed into development of management plan and subsequent adaptive management measures.
Industry/ community associations	Development of associations of licensed fishers and exporters in partnership with local communities and national resource management agencies.	Multi-stakeholder decision making process increases likelihood of success: Improve understanding of conservation and management needs; facilitate enforcement of community-adopted management measures; provide training and reporting of catch and export data; contribute to resource assessments.
Training in processing	Improve skills of sea cucumber processors to minimize wastage.	A proportion of the catch is rejected due to decomposition caused by incomplete drying and improper storage.
Sea cucumber research	Research programs on taxonomy, biology and ecology, including growth, length and weight analyses; reproductive biology; and genetics.	Provide information needed on life history, population connectivity, habitat requirements etc. than can feed into management actions.
Aquaculture/ mariculture	Spawning, growth and settlement of larvae; raise juveniles to commercial size.	Reduce demand on wild populations; grow-out may be preferable for curryfish, which fetches a higher price at a smaller size and can be grown to market size faster.
Sea ranching operations	Grow-out of farm raised juveniles or juveniles removed from wild.	May reduce demand on wild populations. Effect of harvest on juveniles unknown.
Restocking programs	Release of farm-raised juveniles.	Recover extirpated stocks; Increase yield of fishery.

includes bans on the harvest or export of three of the most widespread and highest value species, including *H. scabra* (Fiji, PNG), *H. atra* and *H. nobilis* (parts of Australia). In India, all sea cucumbers were placed on Schedule I list of the Wildlife Protection Act (1992) in 2001, and their collection was strictly banned. This was a conservation step taken by the government of India to revive depleted stocks, but illegal fishing pressure has persisted and field monitoring studies indicate low biomass of target species with little or no recovery (Nithyanandan, 2003).

While a closure may be necessary to prevent extirpations or to rebuild depleted stocks, there are few social or economic benefits of this approach, as it is likely to lead to illegal fishing and export and substantial loss of revenue for fishermen.

Gear Restrictions: The most common gear restrictions for sea cucumber fisheries include prohibitions on the use of SCUBA, hookah and other types of underwater breathing apparatus; restrictions on locations that can be trawled; and limitations on the size and shape of trawl gear. Restricting collection to free-diving, wading, and reef flat gleaning (ban on SCUBA or hookah) would limit the amount of time available to search for animals hidden away in the coral reef and it would prevent most fishing below 30 m. This is a conservative method that should reduce recruitment overfishing because up to half the stock of some species live at depths greater than 30 m (Preston and Lokani, 1990). In New Caledonia, black and grey color morphs of sandfish occur in different habitats, with black primarily found in deeper water. Genetic studies indicated that both populations were closely linked, suggesting that deep populations can constitute a buffer and a source of new recruits to the fished shallow zones, as long as trawl or dive fisheries are prohibited in these areas (Uthicke and Benzie, 1999). While a ban on the use of underwater breathing gear may protect a critical portion of the population of species such as white teatfish and prickly redfish that have a wide depth distribution, other high value species have a relatively shallow distribution and are unlikely to benefit from this measure (Lokani et al., 1996).

Spatial closures: Spatial closures that have been used to protect sea cucumber populations include limits on the depth of collection, closure of specific locations, and closure of a certain percentage of the coastline. The establishment of no-take protected areas or other types of marine reserves and sanctuaries can benefit sea cucumber fisheries by protecting a portion of the spawning stock that may provide recruits to replenish fishing grounds, and by enhancing catches in adjacent, fished areas through emigration of juveniles or adults. Marine reserves offer benefits to both fishery and non-fishery interests, but these are likely to be successful only when developed in consensus with local communities and user groups, and when properly enforced. Other factors fundamental to the design of effective sanctuaries include size, shape, and number of protected areas; habitat types included; the life histories of the target species; the location of protected areas relative to currents that may disperse larvae; and, the type of activities that are allowed.

A recent study from Australia found that the protection of whole reefs from fishing is an effective management tool for the conservation of sea cucumbers, while the division of a reef into a fished and unfished zone is only effective when protected areas are large or there is considerable genetic exchange among sites (Uthicke and Benzie, 2000). In Australia, *H. nobilis* populations were found to have high gene flow, suggesting that recruits can be received from a wide geographical area and stocks could be managed on a regional scale. In contrast, separate genetic stocks of *H. scabra* were detected, which implies limited recruitment within regions that may reduce the potential for recovery of overfished areas. Thus, *H. scabra* needs to be managed as separate stocks and local refugia adjacent to collection sites must be established that have breeding populations of this species (Uthicke and Benzie, 2001).

Seasonal closures or rotational harvest areas: Temporal closures are generally timed to protect certain life history stages of a population or certain critical periods in their life, such as the time of spawning, and may also be applied to maximize the quality of the product. Often referred to as "pulse fishing", rotational harvest typically involves harvesting a stock heavily, letting it lie fallow for a few years, and then harvesting it heavily again. Seasonal closures and rotational harvest areas are effective strategies to control effort and limit yield in one particular area to sustainable levels.

The main benefit of rotational harvest is that there would be an accumulation of individuals during the closed period, with many growing to larger sizes, increasing their value in the marketplace. One concern is that each time the closure is lifted, the removal of all or most of the spawning stock occurs. Thus, all new recruits must come from elsewhere, unless the closure is left in place for a sufficient period to allow self-seeding. Another disadvantage is that fishermen cannot fish in those areas during the closed years, and other sites must be available to provide continuing employment. One way to address this involves designing a system where different island states rotate harvest closures among species and countries, so that when the harvest is closed in one area, it would be open in others.

Limited entry: Limited entry typically involves some form of licensing or permitting to restrict the number of fishermen or the number of vessels. Restricted access to a fishery resource can reduce competition among fishermen, help ensure long term economic and social viability and promote conservation among fishery participants by giving those in the fishery a greater stake in the resource. It may also assist in obtaining data on the fishery necessary for management, as most licensing schemes typically involve a requirement of logbook submissions detailing location and amount of catch and other fishery-dependent statistics. This approach appears to work well in developed countries, including the U.S. and Australia, where other alternative sources of income are available for displaced sea cucumber fishers. In the U.S., licenses are given only to those fishermen that landed a certain volume of sea cucumber in previous years. However, limited entry may not be favored in developing countries, as it may have negative social effects. By reducing take or by limiting the number of fishermen or vessels, certain fishermen or communities dependent on these resources for their livelihood may become unemployed, with few alternative sources of income.

Output Controls

Quotas: A quota is a set limit on the amount of resource that can be harvested or exported during any year or fishing season. Quotas are usually established to achieve a desired level of harvest, such that maximum sustainable yield will not be exceeded. Quotas for sea cucumber fisheries have included total allowable catch for the fishery overall, specific quotas for individual species, or quotas for specific areas. To be effective, a desired maximum catch must be established and continuous monitoring of the catch must occur to determine when the quota is reached. When the quota limit is reached, harvesting must cease until the next fishing year.

Management by total harvest quotas (e.g., "sea cucumbers ") versus managing for individual species may be problematic because of the patchy spatial component of the fishery and holothurian populations, and the possibility that the high value species will continue to be fished until stocks are extirpated. Another disadvantage of using a quota is that a substantial amount of data on the fishery and the resource is necessary to determine maximum sustainable yield. There are several approaches to determining maximum sustainable yield including:

- Application of data on total catch and fishing effort over a number of years, with the maximum catch per unit effort providing an estimate of the maximum sustainable yield (Richmond, 1996). In a typical scenario, when a bêche-de-mer fishery is first established, the total catch increases as harvesting effort increases. Some maximum level of harvest is rapidly reached at which time additional fishing effort becomes less and less effective, and ultimately catch declines. The point at which catch per unit effort is maximized would be equivalent to MSY. This scenario may not work for multi-species fisheries, however. As one species is depleted, fishing effort shifts to less valuable species, but the total CPUE for the "sea cucumber" fishery may actually increase, giving a false sense of security. There is also the danger that fisheries targeting more abundant species can support continued fishing pressure on rare, but extremely valuable, species. Thus, the management presumption that a fishery will become economically extinct before it is biologically extinct is not necessarily true. The most effective quota system would involve dividing a location into harvest areas, each with its own quota developed for each target species.

- MSY can be estimated from biological parameters of the harvested stock, such as growth rates, natural and fishing mortality rates, stock size and recruitment rates. This requires data on size and age structure of populations and patterns of growth, which is not be available in most areas.

- MSY can also be estimated more simplistically by 1) estimating the size of the harvested stock; 2) determining the average age of individuals in the exploitable size classes; and 3) set an annual harvest quota at a value equal to the stock size divided by its age. For example, if the harvestable portion of the stock is 10 years old and you take 10% of the population each year, 10 years later the stock would have rebuilt itself to the original condition (Richmond, 1996).

When a quota is used to manage sea cucumber fisheries, it is important that this quota is reevaluated frequently, as new information becomes available, so any necessary adjustments can be made to prevent overexploitation.

Minimum sizes: Minimum sizes are typically based on the size at first sexual maturity, to ensure that the stock does not crash because of recruitment failure. There are numerous benefits to delaying harvest until a species has reached some minimum size, including the contribution of an individual to the population before its removal and a higher market value typically associated with larger individuals. Large female sea cucumbers typically produce more eggs than small females, there by contributing more to the abundance of future generations (Richmond, 1996). Blanket size limits on all bêche-de-mer species has been suggested as one of the mechanisms to prevent growth overfishing, but this is impractical because the size at sexual maturity established size requirement. Nevertheless, a number of countries such as Australia, Papua New Guinea, Fiji, and Tonga have recommended or adopted separate size limits for each species (Table 7; Appendix I). The advantage of using minimum size for managing an export fishery is that enforcement can be done at the market place, avoiding the need to intercept harvesters while fishing. Since the price of sea cucumbers is based on size, cucumbers have to be weighed at the market already, providing an opportunity to detect undersized animals.

The disadvantage of this approach is that rejected undersized animals are already dead, and they represent a loss to the reproductive capacity of the stock as well as economic loss to the fishermen (Richmond, 1996). Another disadvantage of using minimum sizes is that this method does not guarantee that the maximum sustainable yield will be harvested, and it does not predict how many sea cucumbers will be harvested. In fisheries managed solely by minimum size, the harvest will be large in initial years, as all the individuals larger than the minimum size will be subject to harvest. Over time, the largest individuals will become scarce, and annual fishery will depend on how many animals grow to legal size in a year. However, determining size at reproductive

Table 4. Examples of existing regulations for sea cucumber fisheries in temperate waters. THQ= Total harvest quota; HAQ=Harvest area quota; mt= metric tons.

Location and species	Open Season	Harvest Area	Gear type	Quota
Alaska, USA	Oct-March	13 Fishery Management units (FMU).	SCUBA, Surface supplied air; snorkel. No mixed gas or saturation diving.	Max harvest for each fisher and each FMU.
Washington, USA	All year	5 management areas; Rotation of harvest with 3.5 yr closure after 6 month fishing period.	SCUBA or surface supplied air. Experimental trawl fishery.	Quota for each area; quota for recreational harvest.
Oregon, USA	All year	Permits issued geographically until 2003, with half for the southern coast and half for the northern coast.	Dive gear and trawl gear.	No quota.
British Columbia, Canada	October; 1-20 days long	25% coast open under a quota; 25% under experimental fishery to evaluate effects of varying harvest levels; 50% of coast is no-take.	Dive fishery; hookah and SCUBA.	THQ=385.6 mt; individual license quotas of 4.5 mt; HAQ for each area .
California	All year	Recreational dive harvest allowed below 6 m; Sea cucumber trawl gear prohibited in trawl rockfish conservation areas; small closed sites around Channel Islands.	Trawl and dive fishery.	No quota.
Maine	Oct-June; no night harvest	No area restrictions.	Trawl gear (modified “urchin drag”gear or scallop drag gear).	No quota.
Newfoundland Canada	Year round fishery	No area restrictions.	Harvested as scallop bycatch, also small dive fishery (12 divers).	Max catch by divers, 24,000 lbs daily.

Table 4a. Specific details on temperate fisheries in North America

1.Alaska fishery is based on *Parastichopus californicus* **Closed Season:** selected to protect spawning aggregations; can be closed early if harvest level is reached; **Fishery management units**: each has biomass estimate completed within last two years; **Quota:** harvest level for each site based on surplus production model that includes 1) an estimate of virgin population size and allowance of harvest rate of 5%; and 2) additional conservative measures: quota is reduced to 50% of the harvest rate derived from the model plus another 30% to account for field sampling variability (Ruccio and Jackson, 2000).

2. Washington fishery is based on *Parastichopus californicus* and *P. parvimensis* **Season:** Year round dive fishery; Experimental trawl fishery closed during soft-shell Dungeness crab periods and in shrimp areas. Experimental trawl fishery in specific locations; beam trawl gear with max beam width or otter trawl with minimum mesh size. **Quota**: for each area determined using surplus production models and estimates of biomass from catch-effort data, video surveys, and dive surveys. There is also a daily limit of 25 animals for two species (*P. californicus* and *P. parvimensis*) for the recreational fishery (Bradbury, 1994)

3. Oregon's fishery is primarily a dive fishery based on *Parastichopus californicus*; harvest by trawl required an experimental gear permit until 2003. The target species has been placed under category B of the Developmental Fisheries List, which include species with less potential for viable fisheries; a permit is no longer required (McCrae, 1994; pers. comm).

4.British Columbia fishery is based on *Parastichopus californicus* **Season**: occurs during October after reproduction (when internal organs are atrophied) to maximize product quality. **Total quota** is determined from a precautionary fixed exploitation rate which is divided into harvest area quotas based on an estimate of a coastwide density of 2.5 sea cucumbers per meter of shoreline, an allowable harvest of 4.2% of biomass, shoreline length and average weight (Muse, 1998; Fisheries and Oceans Canada, 2002).

5. California fishery started in 1978 and is based on *Parastichopus californicus* and *P. parvimensis.* A special permit was required for sea cucumber harvest beginning in 1992-1993, with separate permits for each gear type and a limit on the total number of permits implemented in 1997. There are no restrictions on catch. Until 1996 an average of 75% of the annual catch was from the southern California trawl fishery. Between 1997-199, the dive fishery accounted for 80% of the take. Recent surveys show a 50-60% decline in abundance between 1994-1998, but no correlation was noted between decline in abundance and data on landings. The only increase in abundance was noted at two no-take reserves (39% increase) (Rogers-Bennett and One, 2001; Schroeter et al., 2001).

6. Maine fishery is a low value/high volume fishery that started in 1994 and is based on *Cucumaria frondosa*. The "urchin drag"gear used in the fishery is limited to 5"6" width and 22' length; head bail constructed of less than 1.5" round steel stock. Logbook data indicates fishing effort is clumped with most cucumbers coming from three locations in eastern Maine (Feindel, 2002).

maturity requires a significant amount of data and the primary burden is placed on the fishermen, who must determine the species being harvested and whether that species meets the minimumestablished size requirement. Nevertheless, a number of countries such as Australia, Papua New Guinea, Fiji, and Tonga have recommended or adopted separate size limits for each species (Table 7; Appendix I).

CONCLUSIONS

Commercially valuable sea cucumber populations are in decline or overexploited in many locations due to a high demand for bêche-de-mer and other holothurian products, and the high value to fishermen, particularly in developing countries where this provides a substantial component of their livelihood. One of the primary reasons for the decline is that management measures have not been applied until after the stocks crashed. In most countries, sea cucumbers have been harvested through open-access fisheries which initially target dense populations with easy access, especially nearshore, shallow environments; stocks are initially underexploited, but the catch keeps on growing and the industry flourishes. As the industry matures, the level of capture becomes constant, but more fishing effort is needed to achieve these levels. As all of the suitable species and size classes are removed from one area, the distribution of fishing effort expands to more remote areas and deeper environments. While this practice may result in extensive areas that are essentially free of harvesting pressure, it also leads to the localized depletion of stocks where fishing has occurred (Ibarra and Soberon, 2002).

Management strategies for holothurian fishery resources have many problems, and in most instances have been reactive in response to dwindling stocks. Some of the issues hindering effective management include 1) a lack of information on the population dynamics of exploited species and on holothurian biology and ecology; 2) few reliable fishery and trade statistics; 3) illegal fishing and export; 4) unregulated or ineffective regulations combined with insufficient enforcement; and 5) difficulties in measuring the effectiveness of management measures. However, it is difficult to identify overarching problems with sea cucumber fisheries, as each fishery is unique. Available information on the resource and the fishery varies by country or area, trade routes are complex and existing fishery, and trade statistics are often insufficient to determine location of fisheries and catch on species by species basis. In addition, monitoring is problematic, particularly in developing countries due to the widespread and often remote nature of the fishery and lacking financial and human resources.

The management of sea cucumbers resources has to be approached on a site by site basis with appropriate controls for each region. The most effective management plans are those that combine multiple controls, such as a minimum size in combination with rotational fishing. In addition to effective fishery management plans and regulations, additional capacity is necessary through training programs and better monitoring efforts for the resource, the fisheries and exports, and enforcement programs must be in place. One way to achieve this is by involving local communities, fishermen and other stakeholders in managing the resource and monitoring fishery impacts. Several countries and regions are already exploring the possibility of developing bêche-de-mer associations to control prices and maximize product quality. These associations are likely to be most effective when they involve partnerships among the fishermen, processors, exporters and other resource users as well as the resource management agencies, with increased involvement in all aspects of resource management and monitoring. In addition, marine park rangers can be trained in dive survey methodology and holothurian taxonomy, and can be encouraged to expand existing monitoring programs to include sea cucumbers. This will provide a constant supply of field data on species presence, temporal and spatial distribution, and growth. Marine parks and no-take reserves could also be sites for sea cucumber research.

Table 5. Examples of fishery management measures in the tropical western Pacific.

Location and species	Permits	Harvest area, species and season	Gear type	Quota
Australia: Great Barrier Reef	Licensing system and logbooks. Quota on number of licenses; 18 active fishermen .	Great Barrier Reef Marine Park Act 1975 closed several reefs to fishing. *H. nobilis* fishery closed in October 1999.		Minimum size: 15 cm; TAC = 500 mt (90% of the estimated yield .
Australia: Torres Strait	Permit system through Island Community Councils.	None?	Hand or hand-held non-mechanical implements only; a ban on SCUBA and hookah gear; 7 m maximum length of Islander dinghies.	Total allowable catch of 260 mt and minimum size limits of 18 cm.
Australia: Northern Territory	6 commercial licenses, 3 per management zone, 4 divers per license	2 management zones; collection restricted to areas covered by water at low tide; no take in marine parks, reserves or sanctuaries and around particular islands and shoals.	Hand collection only by diving.	TAC is 380 mt (127 mt white teatfish and 253 mt of other spp.; minimum sizes.
Fiji	Harvesting and processing restricted to Fiji nationals .	A 5.6 square mile area around Namena Atoll closed to harvest in 2001. No export of *H scabra*.	Use of SCUBA gear prohibited, but hookah was not prohibited.	7.6 cm 3 inch minimum export size.
Papua New Guinea (PNG)	PNG citizens only; license for storing or export.	Open season from 16 Jan-Sep 30. Quota divided into two value groups (high and low). Torres Strait fishery closed in 1992.	Hookah, SCUBA and lights prohibited.	TAC for each province; Minimum sizes for 17 species (live and dried) .
Tonga	Exporters limited to 10 licenses.	Scheduled closed season and closed areas; 10 year moratorium in 1999.	Ban on SCUBA and hookah.	Min size for some species (live and dried).
Solomon Islands		Moratorium in certain areas of Makira in 1994. 1998 ban on collection and sale of sandfish.	Ban on SCUBA and hookah in the Western Province.	

Table 6. Examples of controls and enforcement measures for sea cucumber fisheries in temperate waters.

Location	Licensing	Reporting	Validation
British Columbia Canada	Limited entry; 85 licensed fishers; maximum 5 licenses per vessel.	Fishers use standard logbooks .	All landings are monitored by an independent industry funded firm; dockside landings only at designated ports; license holders pay a fee.
Alaska, USA	Divers registered and permitted.	Dive/harvest logbook with date, location (GPS), depth, bottom time, quantity.	Divers can only obtain permits for urchins or sea cucumbers but not both.
Washington, USA	Limited entry; 190 divers in 2000.	Logbooks with daily reporting of catch to avoid exceeding quota.	Must submit logbooks every month with data on date, depth location and amount (number and weight) collected.
Oregon, USA	Commercial shellfish license was required for dive fishery until 2003, when only 2 permits were issued.	Fish receiving tickets (dock ticket) required from sea cucumber dealers with fishermen's name, location, date and amount.	Cucumbers are listed under Developmental Fisheries species list category B. As of 2004 a permit is no longer required.
California, USA	Separate annual permits for each gear type: 113 dive permits and 36 sea cucumber trawl permits.	Dive and trawl fisheries target different species; all data lumped as sea cucumber landings.	Limit permits by requiring a minimum landing of 50 lbs during the previous year. Trawl fishery declined in 1998-1999 due to prosecution of 16 trawl fishermen that fraudulently obtained sea cucumber permits.
Maine, USA	16 endorsements (only 3 active).	Harvester Logbooks.	Limit licenses to fishermen that landed >250,000 lbs in a previous year. No incidental take allowed, only take through targeted, licensed fishery.

Table 7. Minimum size restrictions for tropical sea cucumbers. Other tropical nations with minimum sizes for sea cucumbers include: 1) Queensland, Australia- 15 cm live minimum size for all species; 2) Fiji- 7.6 cm size dried for all species; 3) Maldives- 15 cm size for *H. atra* only.

		Papua New Guinea		W Australia
Scientific name	Trade name	Live	Dry	Live
Actinopyga lecanora	stone fish	15 cm	10 cm	
H. scabra *H. scabra versicolor*	sandfish	22 cm	10 cm	16 cm
A. miliaris	black fish	15 cm	10 cm	
A. mauritiana	surf red fish	20 cm	8 cm	
H. fuscogilva	white teatfish	35 cm	10 cm	32 cm
S. chloronotus	green fish	20 cm	10 cm	
S. variegates (S. hermanni)	curry fish	25 cm	10 cm	
H. nobilis	black teatfish	22 cm	10 cm	26 cm
Thelenota ananas	prickly redfish	25 cm	15 cm	30 cm
Actinopyga lecanora	stone fish	15 cm	10 cm	
T. anax	amberfish	20 cm	10 cm	
B. argus	leopard (tiger) fish	20 cm	10 cm	
Bohadschia vitiensis	brown sandfish	20 cm	10 cm	
H. edulis	pink fish	25 cm	10 cm	
Holothuria fuscopunctata	elephant trunk fish	45 cm	15 cm	
Halodeima (Holothuria) atra	lolly fish	30 cm	15 cm	15 cm
A. echinites	brownfish (deepwater red fish)	25 cm	15 cm	12 cm
B. marmorata mamorata (B. similes)		25 cm	7 cm	

Appendix I: Current Status of Existing Sea Cucumber Fisheries

Australia. Sea cucumber fisheries date back to the 1700s, with Indonesians most active participants of the fishery until the late 1880s. Increasing interests in the 1980s led to an expansion of fisheries off Queensland, Torres Strait and around the Great Barrier Reef (GBRMP), along with the development of management measures and regulations. In the GBRMP intensive fishing in the mid 1980s-1990s led to depletion of the main target species (H. nobilis) and the fishery on this species was closed in 1998 (Uthicke, 2003). Surveys in GBRMP within fished areas and no-take areas showed that fishing reduced densities of sea cucumbers by about 75%.

British Columbia, Canada: Sea cucumbers have been commercially harvested in British Columbia Canada since 1971, with substantial changes in the management regime over time to address resource declines and to avoid overfishing. The fishery was an open access fishery through 1990. Management measures include: 1) a regional quotas and area closures first introduced in 1986; 2) a reduction in the regional quota in 1989 and 1991; 3) rotational harvest with six months of fishing followed by a two year closure in each defined site between 1993-1996; 4) a license-type limited entry system was introduced in 1991 with individual quotas in 1995; and 5) adaptive management practices were introduced in 1997, with closed areas and areas open to dive fishery, as well as an experimental fishery to assess affects of different harvest levels and determine what is sustainable. In experimental areas resource managers conduct annual pre-harvest surveys, allow take at 0, 2, 4, 8 and 16% of the biomass, and then conduct follow-up surveys to evaluate effects of variable fishing pressure on stocks. Three experimental fisheries are underway in three different habitat types, with annual surveys and experimental fisheries continuing for at least 10 years. At the end of the study management measures will be further refined.

Cook Islands: The only commercially exploitable sea cucumber species in Cook Islands is A. mauritiana, with exports from 2 areas reported in the 1980s and some subsistence use in the southern islands. Recommendations were presented in 1988 that included: 1) establishment of conservative management guidelines; 2) conducting baseline surveys prior to start of fishery; 3) implementation of seasonal closure during breeding seasons; rotational fishing; quotas; minimum sizes; and reserve areas; 4) limited entry and required reporting guidelines; and 5) a ban on the use of SCUBA (Adams, 1993b).

Cuba: A fishery was established in 1999, with over 3 million animals landed during the first two years by one company operating out of 12 boats in the southeast region. The CPUE averaged around 1,153 +/- 630 animals per boat per day, with a decline throughout the year to about 350 animals/boat/day. In the southeastern region, a quota of 611 tons has been established.

Ecuador: In 1989, sea cucumber fishermen from mainland Ecuador began setting up operations in the Galapagos, as the fisheries off the coast of Ecuador were depleted. There was no management plan enacted at this time. Populations of Stichopus fuscus became dramatically reduced almost immediately, prompting a ban on all harvesting of sea cucumbers. Illegal fishing continued, however, and in early 1994, under protest by fisherman and pressure from environmental groups the ban was lifted. In 1996 a consensus based participatory management process was adopted for the sea cucumber fishery, with representatives of various stakeholders. In 1999 Ecuador passed the Galapagos Marine Management Plan and harvesting of sea cucumbers became regulated under a concrete legal and conservation framework. Current management initiatives include a season of 60 consecutive days between March and May; open areas must have minimum observed density; zoning plan with closed areas that correspond with spawning zones; minimum size (20 cm); and a fixed quota (Traffic South America, 2000). In 2002 the Participatory Management Board (PMB) prepared a proposal for the five

year period fishing calendar. This proposal had the agreement from the local sectors (fishing, conservation, tourism and Galapagos National Park) for the management of sea cucumber fisheries. This proposal was approved by the Interinstitutional Management Authority (IMA) on February 25th and established that the fishery would open when the results of a study on the sea cucumber population density was completed. The study was carried out by the fishing sector, the Galapagos National Park and the Charles Darwin Foundation from March 4th to April 10th, 2002 on 6 islands of the archipelago. The results from this joint study indicated that none of the island in the study met the criteria of having a density of 40 sea cucumbers per 100 square meters that were larger than 22 cm.

Egypt: A fishery began in 1998 with catch primarily associated with trawling. Expansion of fishery effort in 2000 led to a ban on sea cucumber fishing in 2001 until baseline stock assessments were completed. The fishery was reopened in 2002, but population surveys indicated resource depletion and a new ban was declared in 2003.

Fiji. Sea cucumbers are harvested for subsistence (sandfish) and export, with the export fishery dating back to the early 1800s, when collection and processing facilities for sea cucumber were established in Fiji primarily to supply Chinese markets (Adams, 1992). Numerous reports of overexploitation of sandfish are associated with the bêche-de-mer boom of the mid 1980s, with exports increasing from less than 15 mt prior to 1982 to 717 mt in 1988. Severe depletion of stocks led to declining exports and a subsequent total ban on export of sandfish; A. miliaris now accounts for up to 95% of the exports. Bêche-de mer Exploitation Guidelines were first published by the Fisheries Division in 1985 with amended regulations in 1988 in response to a 10-20 fold increase in exports (Adams, 1992).

India: Sea cucumbers are taken in a trawl fishery, as bycatch of "thallumadi", a local fishing gear, and by skin diving primarily in the Gulf of Mannar and Palk Bay. H. scabra, H. spinifera and B. marmorata were the most important species over last 1000 years, but fishermen began collecting other species in 1990, in response to high export value and population declines of the preferred species. In 1982, a ban on export of bêche-de-mer below 3 inches was implemented and collection of all sea cucumbers was also banned in Andaman and Nicobar Islands. A fishery exists in Gulf of Manner, Palk Bay, but CPUE and size of specimens has dramatically declined in these areas. Problems with the fishery include an overlap between the peak fishing season and the peak spawning season for H. scabra during July and October; other problems include habitat damage associated with fishing gear. Drag-nets used for sea cucumbers in shallow sea grass beds cause severe destruction of sea grasses. In 2001, all sea cucumbers added to Schedule I list of the Wildlife Protection Act, which bans their collection. However, illegal fishing continues and most stocks are depleted (Nithyanandan, 2003).

Indonesia: Indonesia has the worlds largest sea cucumber fishery with estimated exports increasing from 878 mt in 1981 to over 4600 mt per year from 1987-1990 (Tuwo and Conand, 1992). There are few management measures, although regulations exist in various regions on trawling for sea cucumbers and maximum densities for cage culture of juveniles collected from the wild. Some locations are implementing various voluntary community based conservation measures.

Japan: Sea cucumbers have been consumed locally for centuries, with one species (S. japonicus) harvested in local waters and now also under intense aquaculture. The catch of S. japonicus in Japan declined from 25,000 mt in 1983 to 7000 mt in 1995. Hatchery production increased substantially during this period (Ito and Kitamura, 1998). Japan prohibits fishing between March and November to take into account spawning and seasonal high water temperatures. In addition, area closures are in place in some locations and gear restrictions have been implemented (Arakawa, 1990).

Kenya: Sea cucumbers are collected for export with little or no local consumption. Exports have increased since 1993.Exports increased from 78-86 mt per year between 1989-1991, to 277 mt in 1992, followed by a sharp decline in the next 3 years (14, 41, 55 mt respectively). Fourteen species are exported (Marshall et al., 2001). The only regulations in place are licenses, which are required to collect or trade in sea cucumbers, although most fishermen do not hold licenses.

Madagascar: Export fishery began in 1921, with exports of 50-140 mt annually. Exports increased from 56 mt in 1986 to over 500t in 1991 and 1994. Although it is now illegal to fish with SCUBA, this has been difficult to enforce. Shared management was introduced in 1998, which included a partnership between the Madagascar National Trepang traders group and the government resource managers to administer management and exploitation of trepang (Conand et al., 1998). Madagascar fishers and exporters also formed the National Association of Sea Cucumber Producers (ONET). Some of the proposed initiatives of these associations include: studies of current status of resource; formulation of a monitoring and joint management system using simple assessment methods to evaluate resource and its fluctuation; creation a management manual; and sea farming experiments.

Malaysia. There are three different fisheries for sea cucumbers, including one near Pulua Langkawi with well established trade routes through Thailand; a small artisanal fishery in western Malaysia with a single fisherman, and an expanding fishery along the coast of Sabah in northeast Borneo. In Pulua Langkawi, one target species, S. hermanni, has been depleted and may possibly be extirpated around Langkawi Islands. In Sabah, annual catch was about 400-500 mt, while annual catch in the 1990s has fallen to around 100 mt. Currently there are no countrywide regulations of the sea cucumber fishery (Baine and Sze, 1999).

Maldives. Bêche-de-mer production began around 1986, with three species targeted: *T. ananas, H. nobilis* and *B.marmorata*. Exports increased from 3 mt in 1986 to 740 mt in 1990 (Reichenbach et al., 1998). The only formal regulations are a ban on SCUBA implemented in 1996. The Bay of Bengal programme made recommendations that include a 4-5 yr ban on take of *Thelenota ananas*, a min size of 6 inches for H. atra, and they discourage night fishing.

Mexico: In Baja California, harvesting of the sea cucumber Isostichopus fuscus for export to Asian markets rose very sharply between 1985 and the mid nineties. A permitted commercial dive fishery was established in 1992. In 1994 a closed season was imposed in Baja and size limits for Isostichopus fuscus and P. parvimensis were established; in May of 1994 I. fuscus was declared in danger of extinction by the National Institute of Ecology of Mexico (NOM-059-ECOL-94) with a ban on fishing (Castro, 1995). Illegal fishing continued into 1997, when I. fuscus stocks reached 2% of their original estimated size. In March 200, I. fuscus was placed on a "species under special protection" list, which authorizes scientific research by fishermen and government scientists. Illegal fishing continues (Ibarra and Soberon, 2002).

Micronesia: A small fishery for *A. mauritiana* and *H. whitmaei* occurred in Saipan, CNMI during 1996 and 1997, but was halted in early 1997 due to declining CPUE (Trianni, 2003). The Saltonstall Kennedy grant program funded a five year project in Micronesia (American Samoa, Guam, and FSM) on resource surveys, aquaculture and management with emphasis on three species. The project resulted in a general moratorium on export harvests in Palau and portions of the FSM and the development of a generic sea cucumber Management Plan for Micronesian states (Richmond, 1996).

Mozambique. The sea cucumber fishery targets 11 species, with apreference for *H. scabra, H. nobilis, H. fuscogilva, H. atra, A. echinites* and *A. mauritiana*. Collection occurs in intertidal areas while wading (by women and children) and in deeper areas with snorkel and SCUBA gear (men); some bycatch in trawl and gill-net fisheries is reported. Between 1979-1990 exports fluctuated from about 20-110 mt; during the 1990s exports fluctauated between 17.7-52.4 mt with a drop to 2.9 mt inm 1997 (Marshall et al., 2001). with a high fluctuation in exports. The primary management measure has involved closed seasons, although fishermen continue to exploit the resource during closed periods. The fishery has been closed in one area due to overexploitation.

New Caledonia. The bêche-de-mer fishery dates to the 19th century, with a recent revival in 1983 and harvest of 55-180 mt per year until 1990, when the fishery declined. About 100 fishermen were involved in the fishery in 1993 at the tribal level or in cooperatives on the northeast Coast of Caledonia (Conand and Byrne, 1993). There is no formal management by the government, but local communities have implemented certain conservation measures. In 1992 the people of Arama undertook a voluntary suspension of fishing by during the crab season (April and January). Fishers of Nepoui Poum and Pouebo also established independent minimum size limits.

Panama. Exploitation of sea cucumbers began in an unplanned way, with a permit granted by the government in 1997 for harvesting and processing bêche-de-mar in Bo-cas del Toro. The negative effect of this unmanaged extraction occurred immediately and the permit was revoked 30 days later. An estimated 750 000 sea cucumbers of the three species had been caught during the period, and illegal fishing continues. A recent study comparing population survey data with fishing effort reported severe overfishing and suggested these species will collapse within a year if fishing pressure is maintained or permitted (Guzman and Guevera, 2002). The authors recommend no fishing of *A. multifidus* and *I. badionotus* in the entire archipelago for 3-5 years followed by a tightly controlled harvest for Bo-cas del Toro that includes the creation of no-take areas that are stocked with adult holothurians. They also recommended a fishery for *H. mexicana* with limited access, quotas, season, minimum size and site-based closures in depleted areas that are currently affected by illegal fishing (Guzman and Guevera, 2002).

Palau, Ponphei and Samoa: A number of species are harvested in the Pacific Islands for subsistence use, with some species harvested for their body wall while others are harvested for their gonads and intestines (Lambeth, 2000). Traditional knowledge and resource management practices are commonplace, including collection only during morning hours over four mornings twice per month (Palau), use of a finger to induce evisceration instead of cutting the animal thereby leading to faster regeneration times (Pohnpei), and a requirement that removal of the intestine must be processed on the spot, with animals returned to the water (Samoa).

Philippines. The sea cucumber fishery is a year round activity with a peak season from March to June. Holothurians are collected primarily by women during low tide at night by walking along the intertidal zone, while men snorkel or use hookah gear to collect from deeper areas. Exports of sea cucumbers from the Philippines have occurred for over 300 years, with little or no local consumption (Jun, 2002). Export statistics available since 1970 indicate that the Philippines has emerged as the second largest producer in the world, with catches of around 20,000 mt per year since the mid 1980s (Conand and Byrne, 1993). Exports have been maintained at about 1000 mt, although there has been a decline in high value species compensated for with low value species. There is very little information on the fishery, and there are no management measures specific for sea cucumber fisheries. Many areas stripped of high commercial value species and others of all species (Trinidad-Roa, 1987).

Papua New Guinea (PNG). The fishery dates back to the 18th century, with some local consumption of *H. scabra*. After a period of low activity from 1977-1985, the fishery has been an important source of income for coastal communities (Conand and Byrne, 1993). The primary target in 1989 was H. scabra, leading to establishment of a minimum size in 1996 as a measure to protect stocks. In Torres Strait, problems of illegal fishing in Australian waters led to a closure of the fishery in 1993, which was extended through 1995 (Lokani, 1996). A closed season, licensing and logbook system proposed but not adopted (Lokani et al., 1996). In 2001, a National Bêche-de-mer Fishery Management Plan was adopted. The Plan outlines access, size and catch limits, and storage and export requirements and includes a closed season (Oct 1- Jan 15), total allowable catch by Province and species, and a licensing and logbook system (Polon, 2003). The Plan also encourages provinces in forming Provincial Management and Advisory Committees. The Provincial Fisheries Management Committee made thorough stock assessment in Oct/Nov 2001 throughout Milne Bay and found that most commercial sea cucumber species occur at very low densities. Fisheries data indicate that catch of high value species declined from 36% in early 1990s to 15% in 2002. Although regulations are in place for sea cucumber fisheries, illegal fishing occurs during closed seasons; quotas are often exceeded; and prohibited gear (hookah and lights) is still used (D'Silva, 2001).

Seychelles. A small open access fishery has occurred since the 1950s, with recent increases in harvest of six species mainly for export markets. In 1999 management measures were introduced by the Seychelles Fishing Authority, including The Seychelles Fishing Authority requires licenses for fishing and processingsea cucumber fishermen to be licensed,, with 25 fishing licenses granted per year (Seychelles Nation Online, 2003).Thailand. Sea cucumbers are harvested for local consumption and export with *H. scabra* and *H. atra* being most popular. An export fishery emerged in the late 1970s, with collection primarily by hand during low tide. As resources declined, snorkelling to depths of 5-10 m became popular; use of SCUBA or hookah is not reported. Overexploitation and a shift to less valuable species have been reported. There is currently an absence of management, with recommendations for the establishment of minimum sizes and stock management in marine national parks and sanctuaries (Bussarawit and Thongtham, 1999).

Solomon Islands. The fishery increased from 8 mt in 1985 to 622 mt in 1992, which represented 62% of the countries exports worth $3.4 million USD (Richards et al., 1994). Since 1992, landings have decreased to 240 mt in 2001, with over 75% of the landings derived from species with medium and low commercial value. The South Pacific Commission Inshore Fisheries Research Project 1992 recommended community management, alternate closed seasons of 6-12 months, possible application of size, effort, gear or seasonal limitations that apply to subsistence and commercial fishing, establishment of marine reserves, and monitoring of catch data. None of these recommendations were adopted except for a ban on the use of SCUBA (Adams, 1993). Due to failure of centralized management of the fishery, there is a push to return to customary marine tenure with active participation by fishers and resource owners in implementing management measures (Ramofafia et al., 2003) .

Tanzania. Sea cucumbers are collected by hand-picking, free diving and SCUBA, with a small amount of bycatch associated with commercial trawlers. Collection is year round, with peak periods between March and May and September to November. The fishery targets 7 species, with a lower take of 13 other species. The fishery is currently unregulated (Mmbaga and Mgaya, 2003). Landings increased from 324 mt in 1989 to 1460 mt in 1995, although official exports during the 1990s ranged from 189-565 mt with a peak in 1994 and subsequent declines to about 277-324 mt in subsequent years (Marshall et al., 2001). Separate licenses are required for traders and exporters and exports are taxed.

Tonga. The fishery began in the early 1980s with rapid expansion in the late 1980s and early 1990s with the introduction of assisted underwater breathing apparatus. By 1994, exports exceeded 60 mt. In 1996 a widespread public awareness campaign targeted towards fishermen was initiated to develop the fishery in a more sustainable manner. The government encouraged community management, recommending bêche-de-mer liason officers, closed seasons at the end of each year, and closed areas (Ministry of Fisheries 1996). In 1999, a ban with a ten year moratorium on all species was implemented.

Tuvalu. A small fishery existed between 1979 and 1982. The fishery was revived in 1993, with 871 kg of exports; exports increased four-fold in 1994-1995 (Belhajali, 1997). The fishery is not regulated, but there are recommendations to ban use of SCUBA and hookah gear to harvest sessile organisms including sea cucumbers.

United States. Sea cucumber fisheries in the U.S. are primarily temperate water fisheries with commercial harvest by trawl or dive gear occurring off the east coast (Maine) and west coast (California, Oregon, Washington and Alaska). There is currently little to no harvest in tropical regions. On a state-wide basis, these appear to be sustainably managed, although localized depletions have been reported.

Vanuatu. No fishery in Vanuatu has operated under a formal management plan. The Fisheries (Amendment) Act No. 2 (1989) provides the Minister and the Director with broad discretionary power to manage the country's fish stocks. An annual quota of 40 mt was established by Ministerial order in 1991 and put in place in 1996. Cooperative management was introduced between 1990-1993, in which the government fisheries department provides scientific information and advice, while coastal villages assume the bulk of the responsibility for local management. While bêche-de-mer fishing per se was not being managed, many villages employ total fishing ground closures which constitute de facto bans on bêche-de-mer harvesting.

Venezuela. One year licenses for 200kg/wk were first issued in 1993 and later suspended; four licenses were issued in 1994 for the original site plus a new area (Rodríguez and Marques-Pauls, 1998).

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CITES and Sea Cucumbers

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This paper gives an overview of and highlights issues of relevance to this workshop on the following topics:

1. General background on the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the Appendices and differences between Appendices II and III;

2. The inclusion in Appendix III of *Isostichopus fuscus* by Ecuador;

3. The differences between implementing the provisions of the Convention for species of sea cucumber listed in Appendix II and III; and

4. Non-CITES related institutional measures.

This document expresses the views of TRAFFIC and should not be assumed to reflect the views of the CITES Secretariat. The content of this background paper has been derived from a number of sources, but of particular relevance are Sant (1995), Willock (2002) and Willock *et al*. (in prep.).

Background to CITES and Sea Cucumbers

At its 12th meeting (Santiago, 2002), the Conference of the Parties adopted Decisions 12.60 and 12.61 related to sea cucumbers within the families Holothuridae and Stichopodidae. The CITES Secretariat was mandated through Decision 12.61 to convene a technical workshop on the conservation of sea cucumbers in co-operation with relevant bodies. The outcomes are to be reviewed by the Animals Committee. The CITES Secretariat consulted the Animals Committee in August 2003 concerning the workshop's proposed objectives, agenda, participation and practical arrangements (see document AC19 Doc. 17, and the relevant report from the AC Working Group). The objectives of the workshop were agreed as follows:

a) to review information on the status, catches and bycatches of and trade in specimens of sea cucumbers within the families Holothuridae and Stichopodidae; and on domestic measures for their conservation, including considerations of the adequacy of these measures;

b) to establish conservation priorities and actions to secure the conservation status of sea cucumbers within the families Holothuridae and Stichopodidae, addressing *inter alia* trade monitoring and controls, national legislation and regulations, fisheries management options, conservation management and research, enforcement and capacity building; and

c) to formulate findings and recommendations that can contribute towards the discussion paper on the biological and trade status of sea cucumbers within the families Holothuridae and Stichopodidae to be prepared by the Animals Committee.

Of particular relevance is the entry into force in October 2003 of the inclusion by Ecuador of *Isostichopus fuscus* in Appendix III.

General background to CITES

CITES has three Appendices that list species of wildlife. Each Appendix has different requirements and levels of protection afforded to the species listed in them through the Convention text and Resolutions and Decisions agreed by the Parties to the Convention. A proposal by a Party for a species to be included in Appendix I or Appendix II is discussed and put to a vote at the regular meetings of the Conference of the Parties. Listing proposals may be co-sponsored by other Parties. The criteria to be used for determining whether species should be included in Appendix I or II are contained in Resolution Conf. 9.24 (Rev.

CoP12) on Criteria for amendment of Appendices I and II. In case the proposal concerns a species that occurs in more than one country, proponent Parties have normally to consult with other range States about its proposal. Decisions on amending Appendix I and II require the support from at least two-thirds of Parties present at the meeting of the Conference of the Parties and voting, including decisions to list or de-list a species, or to transfer it between the Appendices. Any Party may enter a reservation on an Appendix I or II listing within 90 days after the adoption by the Conference of the Parties, which results in the Party being treated as a non-Party to the Convention with respect to that species, until the reservation is withdrawn. A Party may unilaterally decide to list a species in Appendix III at any time. A reservation on an Appendix III listing can be taken by a Party at any time and in relation to either the species or certain parts or derivatives thereof.

By including an animal species in Appendix I or II, live and dead specimens, and all readily recognizable parts and derivatives thereof become subject to the provisions of the Convention. The inclusion can concern an entire species, subspecies or geographically separated populations.

The role of each of the three CITES Appendices

Appendix I

An Appendix-I listing offers the highest protection for a species under CITES and includes species that are threatened with extinction and potentially at risk from international trade. Trade in wild-collected specimens of these species must be subject to particularly strict regulation and only authorized in exceptional circumstances (Wijnstekers, 2001). There are nearly 600 animal species and 300 plant species included within Appendix-I.

Appendix II

An Appendix II listing of a species does not necessarily mean that it is currently threatened with extinction nor that trade in that species will be limited, however any such trade must be determined not to be detrimental to the survival of the species in the wild, and should only involve specimens that were obtained in compliance with national laws for the protection of fauna and flora. This means that trade in Appendix-II species should only involve wildlife that was legally acquired and sustainably produced. Appendix II includes species that may become threatened if their trade is not effectively regulated. Through the adoption of listing criteria, the CITES Parties have concluded that Appendix II should include species for which the harvesting of specimens from the wild for international trade has, or may have, a detrimental impact on the species by either exceeding, over an extended period, the level of harvesting that can be continued in perpetuity, or reducing the species to a population level at which its survival would be threatened by other influences.

To ensure that trade in an Appendix II-listed species is non-detrimental, a number of steps must be completed prior to export. First, the Scientific Authority of the State must advise that the export would not be detrimental to the survival of the species. Second, the Management Authority of the State must be satisfied that the specimens were not illegally obtained. The Scientific Authority may also determine that limits should be placed on the export of a species in order to maintain it throughout its range at a level consistent with its role in the ecosystems in which it occurs. Annual quotas are one example of such limits. The Management Authority is ultimately responsible for the issuing of permits.

In relation to importation of Appendix II-listed species, the importing State must require the prior presentation of the export permit or re-export certificate. Some importing states, most notably the members of the European Union, have taken stricter measures and require the prior issuance of an import permit before Appendix-II specimens can be imported. If a species is re-exported, the re-exporting State's Management Authority must be satisfied that the species was imported in accordance with CITES provisions.

The above requirements relate to species that are harvested from areas that are under the jurisdiction of a State. Provisions also exist under CITES for "introduction from the sea" (Art. I (e)) which is defined as "…transportation into a State of specimens of any species which were taken in the marine environment not under the jurisdiction of any State". To date CITES has not formally clarified what constitutes waters under a State's jurisdiction beyond the 12 nautical mile territorial sea.

Appendix III

Appendix III is unique among the three CITES Appendices in that a Party may unilaterally list, and de-list, a species at any time. However, the Parties have developed a recommended process to be followed by Parties wishing to list a species in Appendix III. While still able to submit a species for listing at any time, Resolution Conf. 9.25 on Inclusion of species in Appendix III requests Parties to first consult more widely with any other range States and the Animals Committee before moving to include a species in Appendix III. A listing Party is also requested to ensure that its "…national regulations are adequate to prevent or restrict exploitation and to control trade, for the conservation of the species" and that its "…national enforcement measures are adequate to implement these regulations" (Res. Conf. 9.25).

Despite Appendix III being an integral part of CITES a number of Parties do not have domestic legislation in place enabling them to enforce the listing of a species in that Appendix (Anon., 2003a).

The main purpose of Appendix III is to provide assistance to a Party in the enforcement of its national regulations for a species subject to exploitation for international trade. In practice this circumstance usually arises when there is a significant level of illegal trade that the Party needs the co-operation of other Parties to address. The listing in Appendix III therefore provides for this co-operation through enabling CITES Parties to apply their domestic laws to ensure that trade in the listed species occurs in a manner consistent with the laws of the State of origin for that species (Anon., 2003b; Willock *et al.*, in prep.).

Any country having listed a species in Appendix III must issue an export permit prior to the specimens being exported. An export permit is granted when the Management Authority of the State is satisfied that the specimen was not illegally obtained. Unlike with species listed in Appendix II, Parties issuing export permits for Appendix III specimens are not required to ensure that exports are within sustainable levels, i.e. to make a "non-detriment" finding. Exports from Parties that are range States for the species that have not listed it in Appendix III must be accompanied by a Certificate of Origin. Resolution Conf. 12.3 on Permits and Certificates recommends that

Certificates of Origin follow the format for other CITES permit documents and be issued by the Management Authority. These certificates can be valid for a period of up to 12 months (other documents are generally valid for only six months). Parties re-exporting specimens of the species must issue a Certificate of Re-export, which, as with Certificates of Origin, should be issued by the Management Authority and follow the format for other CITES permit documents.

Parties importing specimens of species listed in Appendix III must confirm that the shipments are accompanied by a Certificate of Origin from a Party that has not listed the species or an export permit where the exporting Party has listed the species. In the case of re-export, a Certificate of Origin from the re-exporting State stating that the specimen was processed in that State or is being re-exported is required upon import. On the basis of this certificate, the importing State decides if the provisions of the Convention have been met. A State may query the validity of a certificate.

Key differences between Appendix II and III

In contrast to Appendix II there are no provisions relating to introduction from the sea under Appendix III. In addition, as noted above, unlike the granting of export permits in relation to species listed in Appendix I and Appendix II, there is no requirement for exporting Parties that list the species in Appendix II to make a non-detriment finding for Appendix III species. Further, Management Authorities issuing Certificates of Origin do not have to 'be satisfied' that specimens to be exported have been obtained in accordance with their national conservation laws, a requirement for exports of Appendix II species.

A further difference is that the provisions of Appendix III only apply to the parts or derivatives specified in the listing. For example, the listing of Big-leaf Mahogany *Swietenia macrophylla* in Appendix III included an annotation designating that only logs, sawn wood and veneer sheets were included under that listing. By contrast, an Appendix II listing for animal species applies to the species as a whole, and no parts or derivatives can be exempted. For plants in Appendix II, however, only whole specimens (live or dead) are covered, with other parts and derivatives only included if specified in accompanying annotations.

Another difference with important implications for marine species is in relation to what are commonly referred to as look-alike species. Article II 2(b) of the Convention allows for species to be included in Appendix II if this is necessary to ensure the effective regulation of trade in species listed in that Appendix owing to trade threats. Resolution Conf. 9.24 requires that this should occur when "…the specimens resemble specimens of a species included in Appendix II under the provisions of Article II, paragraph 2(a), or in Appendix I, such that a non-expert, with reasonable effort, is unlikely to be able to distinguish between them." This is an important provision for marine species as these are often traded in high volumes and in a highly processed state, making some species difficult to distinguish from others. There is no such provision under CITES relating to the listing of look-alike species in Appendix III (Willock *et al.*, in prep.).

A final difference is that in all circumstances personal and household effects are exempt under Appendix III. This means that international movement of products derived from marine species that are considered to be personal or household effects, for example necklaces made from shark tooth, require no CITES documentation.

Table 1: Summary of main differences between Appendix II and Appendix III ***Source:*** **Adapted from Anon. (2003b) and Willock *et al.*(in prep.)**

Provision	Appendix II	Appendix III
Listing process	Proposal requires 2/3 majority support to be accepted; proposals are generally to be decided upon at meetings of the Conference of the Parties	A Party may unilaterally list a species at any time
Introduction from the Sea	Provisions apply	No provision
Non-detriment finding	Required	Not required
Nature of listing	By species; species of fauna cannot be annotated to exempt certain parts and derivatives from the provisions of the convention parts and derivatives (other than whole specimens) must be specifically included by "annotation" for species of flora	By species but may annotated to include only certain parts or derivatives of a species of fauna or flora
Reservation	Only within 90 days of the listing Only in respect to the species as a whole	Can be taken at any time Can be taken in respect to any particular part or derivative
Look-alike species	Look-alike species may also be listed	No provision for the listing of look-alike species
Personal and household effects	Included under certain circumstances	All personal and household effects are exempt

Issues surrounding the listing in Appendix III of *Isostichopus fuscus* by Ecuador[1]

The listing in Appendix III of *Isostichopus fuscus* by Ecuador provides useful background to examining issues associated with management of sea cucumber fisheries, trade in specimens and the implementation of a CITES listing.

Background

The sea cucumber *I. fuscus* is distributed in the Eastern Pacific from Baja California, Mexico to Ecuador, including the Revillagigedo, Cocos and Galapagos Islands (Hickman, 1998). *I. fuscus* has an elongated body, with a soft texture and thick borders. It is dark brown in colour and spotted with orange papillae. It can grow up to 39 cm in length and is sexually mature at around 21 cm, corresponding to 4 to 5 years of age (Herrero-

Perezrul *et al*., 1999). In the Galapagos the species is distributed throughout the archipelago usually in shallow waters (to 39 m depth; but mainly between 5 to 12 m) (Altamirano and Martinez, 2002), therefore it is easily harvested with the use of a hookah[2]. Since 1999 the sea cucumber fishery has been the most important source of income of the Galapagos fishing sector (Murillo *et al*., 2003). The domestic market for sea cucumber in the Galapagos and Ecuador mainland is extremely small and the vast majority of the harvest is exported; for example around 90% of the harvest was exported in 2002. In the Galapagos, the sea cucumber fishery is authorised exclusively by the Inter-Institutional Management Authority (AIM).[3]

Mexico, the only other country that has significantly traded this species, declared it as "threatened" in 1994 and closed the fishery. Since March 2000, the species has been included under a special protection regulation and commercial fishing permits have not been issued for Holothurians since that time.

Despite a range of management measures being in force for the sea cucumber fishery in Ecuador *I. fuscus* has remained the subject of over-harvest and extensive illegal trade from the Galapagos to supply international markets. On 16 October 2003 the Ecuadorian government included *I. fuscus* in CITES Appendix III as a complementary control measure to address international trade of this species.

Commercial fishery

I. fuscus is the only species of sea cucumber commercially harvested in Ecuador's waters. Harvesting commenced in the mainland waters of Ecuador in the late 1980's and within a short time there was a steep increase in the national harvest, from 3 t in 1988 to 29 t in 1991. The resource became over-exploited in mainland waters and the harvest subsequently moved to the Galapagos in 1991 (De Paco *et al*., 1993).

In 1994 the sea cucumber fishery was opened for three months with a maximum quota of 500,000 sea cucumbers. However, around 6 million sea cucumbers were harvested during the first half of the season, which led to the early closure of the fishery. A ban on harvest was subsequently introduced until 1998.

In 1999 AIM authorised the opening of the fishery on an 'experimental' basis, with a decision to be made on whether or not to allow it to continue based on the outcomes from the 1999 season. Since then, a fishery has been authorised every year with that decision based on results from monitoring the sea cucumber populations as well as socio-economic factors.

In addition to the wild capture fishery for *I. fuscus*, attempts to farm the species have recently commenced in abandoned shrimp ponds on mainland Ecuador. By the end of 2003 there had only been success in production

up to the larval stage therefore no trade has taken place. Sea cucumber farming has taken place in several Asian countries (China, Indonesia, India, Philippines and Viet Nam) for restocking and commercial culture as measures to reduce pressure on wild populations. There are two main growing methods for sea cucumbers: monoculture of holothurians in old shrimp ponds, or policulture with shrimp. Both proved to be financially profitable (Chang *et al.*, 2003). It is not known whether farming of *I. fuscus* has commenced in any other country (Hamel *et al.*, 2003).

Table 2: Captures of sea cucumbers in the Galapagos ***Source:*** **Altamirano and Martínez (2002); M. Altamirano, Charles Darwin Research Station, *in litt.* to A. Sancho, TRAFFIC South America, November 2003; M.V. Toral-Granda *in litt.* to A. Sancho, TRAFFIC South America, January 2004**

Year	Quota authorised (units)	Number of sea cucumbers captured (units)	Total green weight (t)	Average green weight of sea cucumbers harvested
1999	4,000,000	4,401,657	1,512	0.344
2000	4,500,000	4,946,947	1,561	0.316
2001	4,000,000	2,672,345	924	0.346
2002	No quota established	8,301,449	1,660	0.200
2003	4,700,000	5,005,574	1,200	0.240

Table 2 shows a decline in the average weight per sea cucumber harvested from 1999 to 2003, with a total decrease of 33% over the five-year period. This is shown most starkly in 2002 when, despite a three-fold increase in the number of sea cucumbers harvested compared to the previous year, the total biomass of the harvest only increased by just over half. The decrease in the weight of sea cucumbers harvested is highlighted by the fact that in the 2003 56% of the harvest was below the 20 cm minimum size limit (Murillo *et al.*, 2003).

Management measures for the Galapagos fishery

There is a comprehensive management regime in place for the sea cucumber fishery in Ecuador covering both the harvesting of the resource and subsequent movement of the product within the country. Management measures in place include the following:

- Minimum size for both dried (6cm) and green (20cm) sea cucumbers
- No-take areas
- Closed seasons
- Limits on the number of licences granted to harvest sea cucumbers
- Annual quota (expressed in numbers of sea cucumbers)
- Chain of custody from harvest to export
- Scientific monitoring of the population
- Carriage of government observers if requested

A significant amount of further work is also currently underway in the Galapagos to improve the existing conservation and management measures within the Galapagos Marine Reserve. Improvements in such areas as monitoring, control and surveillance of commercial fishing vessels are anticipated within the next couple of years, including the implementation of satellite-based vessel monitoring systems.

Trade in I. fuscus *from Ecuador*

From 1990 to 2003, Ecuador exported 554 t of dried sea cucumbers, with an FOB value of almost USD 7.5 million FOB price. Table 3, below, shows recorded exports of dried sea cucumber from Ecuador since 1990 and the FOB price.

Table 3: Ecuadorian exports of dried sea cucumbers in tonnes and FOB value ***Source:*** **Banco Central del Ecuador, 2003.**
[a] until September 2003

Year	Weight (t)	FOB (USD)*
1990	2.93	
1991	8.12	
1992	32.06	121,034
1993	2.01	16,000
1994	23.12	2,493,398
1995	40.20	417,100
1996	7.67	38,361
1997		
1998		
1999	112.64	885,261
2000	110.37	1,212,744
2001	48.48	457,710
2002	116.51	1,072,711
2003	50.01[a]	1,170,698
Total	554.12	7,473,078

Although the sea cucumber fishery was closed during 1993, 1995, 1996, 1997 and 1998 exports of sea cucumbers were recorded in most of those years. A possible explanation for this is that export of dried products can occur at any time. Therefore, products legally acquired in previous years may be exported in a later year due to the long shelf life of the dried product. An alternative explanation is that these exports represent illegally harvested sea cucumber. It is not possible to determine which explanation is correct, or whether the answer lies in a combination of the two.

Comparison of export data with official import data from Taiwan (province of China) and Hong Kong reveals significant discrepancies. From 1998 to 2002, imports of dried sea cucumbers from Ecuador into Hong Kong and Taiwan (province of China) in each year exceeded the reported exports by at least ten per cent and in some years by 25 per cent. In addition to imports of dried sea cucumber, Taiwan (province of China) Customs data also record a total of 211 t of frozen sea cucumbers and 100 t of salted or in brine product as having been imported from Ecuador over that period. On the basis of import figures from Hong Kong and Taiwan (province of China) alone, the Ecuadorian export data would appear to substantially under-record exports of sea cucumbers.

Illegal trade

There have been numerous cases of illegal harvest and trade of sea cucumbers detected by authorities in the Galapagos. These include harvest outside the fishing season, harvest in no-take areas and harvest under the allowed minimum size.

The illegal harvest is taken out of the Galapagos by diverse means, including hidden in ships, probably in larger foreign vessels that illegally enter the Galapagos Marine Reserve (GMR) to pick up illegal cargo of shark fins on their way to non-Ecuadorian ports and in luggage declared to contain personal effects (M. Altamirano, Charles Darwin Research Station, pers. comm. to A. Sancho, TRAFFIC South America, October 2003).

One of the known routes for the laundering of illegal Galapagos sea cucumbers includes final processing in Guayaquil, on the Ecuador mainland, followed by overland transportation to Peruvian ports where it is exported as a local product. The volume of domestic sea cucumber trade in Peru is much larger than in Ecuador, not only because several species are harvested but also because there is a higher local consumption due to a significant population of Asian origin (J. Vizcaíno, Galapagos National Park Service, pers. comm. to A. Sancho, TRAFFIC South America, October 2003).

Within the Galapagos and the Ecuador mainland, a regulated chain of custody has been established for sea cucumbers. However it has not prevented the continuation of illegal harvest for international trade. This is in part due to the fact that the control ends when the product is exported therefore illegally harvested sea cucumbers that circumvent domestic controls may then freely enter international trade.

CITES Appendix III listing of **I. fuscus**

The listing of *I. fuscus* in CITES Appendix III entered into force on 16 October 2003. As of 1 February 2004, no CITES Party had entered a reservation to this listing. This is an important consideration given that a reservation by a major importing country would result in the listing not being implemented by that Party. The regulated chain of custody ceases when the cargo leaves Ecuador and little is known of what happens to it from this point on to the end consumers in international markets. The Appendix-III listing is potentially a useful complementary measure to the current chain of custody requirements as it will require documentation to accompany the sea cucumbers wherever the cargo goes.

Implementation issues relating to the I. fuscus *listing in Appendix III*

Look-alike species

One of the main issues to be addressed for the successful implementation of the listing is that of look-alike species to *I. fuscus*, as many sea cucumber species are very similar when dried or frozen. When processed, most of their external characteristics disappear and only the presence or absence of spikes, which remain after processing, can be used by a non-expert to separate them in these two large groups, each of which include many different species. It is worth noting that Taiwan (province of China) has separate import codes for spiked and non-spiked sea cucumbers (S. Lee, TRAFFIC East Asia, *in litt.* to A. Sancho, TRAFFIC South America, January 2004). More recent research has found that body wall ossicles, unique taxonomic characters to each species of sea cucumber, remain intact after all processing techniques in *I. fuscus*, thus providing a potential tool to be used for identification (Verónica Toral, *in litt*. to A. Sancho, TRAFFIC South America, February 2004).

Some 76 countries and territories are known to have traded sea cucumber species with Hong Kong in the past 10 years (S. Lee, TRAFFIC East Asia, *in litt*. to A. Sancho, TRAFFIC South America, January 2004). Development of an identification guide that allows clear identification of *I. fuscus* from all other sea cucumbers subject to international trade is essential. Given the influential role of major consumers in Asia such as China (including Hong Kong and Taiwan) in the international trade of sea cucumber, it is essential to ensure adequate provisions in these countries to implement the Appendix III listing of *I. fuscus*.

In the absence of the ability to identify *I. fuscus* from other sea cucumber species in trade, it is likely that illegally harvested specimens will not be detected and so will be traded as part of a general group of sea cucumbers of similar appearance. The listing not only includes whole specimens, but all derivatives. This poses extra difficulties with identification.

Range States for I. fuscus

All range States for the species are Parties to CITES[4], however Ecuador is the only country that has included *I. fuscus* in Appendix III thus far. Nevertheless, other potential exporting range States must issue CITES certificates of origin for their exports of this species.

The effectiveness of the implementation of Appendix III in helping close down illegal trade routes would increase significantly if all range States were to list *I. fuscus* in Appendix III. This would then mean that all *I. fuscus* in international trade would be accompanied by export permits determining the legality of the specimens in trade. The absence of the requirement under a Certificate of Origin to make a finding that the specimens have been legally obtained provides for the continuing possibility that products illegally harvested and transshipped to another range State from the Galapagos may enter international trade.

Ecuador's decision to include *I. fuscus* in Appendix III is being viewed as a pilot exercise and other countries are awaiting the results before making any further decisions (S. Lasso, CITES Management Authority, Ministry of Environment of Ecuador, pers. comm. to A. Sancho, TRAFFIC South America, November 2003). Of relevance to the decision of other range States may be the fact that Guzmán *et al*. (2002) state that management and conservation problems in Ecuador has led to traders searching for alternative sources of the product in the region. This has already resulted in the development of unregulated or illegal fisheries for sea cucumbers along the Pacific and Caribbean coasts of countries in tropical America, mainly Venezuela and Mexico.

Trade in specimens from captive breeding[5]

Although there is no trade yet in captive bred *I. fuscus* from Ecuador it is likely to occur in the future. It is worth noting that if the Management Authority is satisfied that the specimens were bred in captivity in compliance with the provisions of the Convention and Resolution Conf. 10.16 (Rev.) on specimens of animal species bred in captivity, a certificate of captive breeding may be issued by the Management Authority in lieu of an export permit. Captive breeding as defined by CITES is distinct and dealt with differently from the situation where specimens are taken from the wild (often as an egg or juvenile) and reared in captivity. This is referred to as "ranching".

***Conclusions drawn from an examination of the Appendix III listing of* I. fuscus**

The Ecuadorian Government has utilized the possibility within CITES to unilaterally include a species in Appendix III with the expectation that the co-operation of other Parties will assist in addressing the illegal harvest of *I. fuscus* for international trade. With the listing only recently entering into force it is unclear the extent to which it will assist in addressing current issues relating to the fishery. However it is likely that, even with effective implementation of the Appendix-III listing, there will remain a need to strengthen national controls and management measures.

A significant amount of work is currently underway in the Galapagos to improve the existing conservation and management measures for the Galapagos Marine Reserve. Improvements in such areas as monitoring, control and surveillance of commercial fishing vessels are anticipated within the next couple of years, including the implementation of satellite-based vessel monitoring systems. Effective implementation of the CITES Appendix III listing of *I. fuscus* would therefore complement efforts being undertaken at a local and national level.

There are a number of areas in which further action may need to be taken in order to ensure the effective implementation of the Appendix III listing of *I. fuscus* including:

- Develop and distribute an identification guide for *I. fuscus* with descriptions of the exported products to enable identification of the species by the authorities of exporting, re-exporting and importing countries.
- Provide training in Appendix-III implementation to management and control authorities, including *I. fuscus* identification and familiarization with CITES export permits. Such training should be undertaken on a regular basis as rotation of control personnel (airports, ports) is high.
- Improve the awareness and understanding of CITES within the fisheries sector in the country by giving short training seminars on CITES including the role of the Appendices and its implementation.
- Maintain a high level of communication with other range States to create awareness of the *I. fuscus* listing and assist in identifying potential illegal imports from Ecuador.
- Urge range States to reconcile harvest of *I. fuscus* within their waters with the export figures to help prevent illegally obtained products from Ecuador being exported from that country.
- The Central Bank of Ecuador should assign species- and product-specific export codes for sea cucumbers in order to improve ability to trace exports of this commodity.

Comparison between Appendix II and III listings of sea cucumber species

Look-alike provisions of the Convention and the recording of species in trade

The Ecuador example above identified the issue of look-alike species as being crucial to the success of the Appendix III listing given the difficulty in identifying individual species of sea cucumber when traded in dried or frozen form beyond generic 'spiked' and 'non-spiked' categories. This issue will arise regardless of whether a sea cucumber species is listed in Appendix II or Appendix III. Given that illegal trade is often a factor in Parties listing or proposing the listing of a species, the possibility of a listed species being traded under a different name, and thus avoiding CITES requirements, is a serious one.

Identification guides are a widely used tool under CITES to assist in differentiating traded specimens at the species level. Such guides have been developed for a range of listed marine species such as corals while a seahorse identification guide is currently in preparation. Further, increasingly sophisticated identification tools are being developed to identify species in trade, including the use of genetic testing and microscopic examination. In the case of sea cucumbers there has not been extensive work to date on readily available means to identify individual species in trade (Bruckner *et al.*, 2003) with the Ecuador listing likely to be the first test of the potential to develop such tools.

As noted, there are unique taxonomic characters to each species of sea cucumber that remain intact after processing. However, as this technique requires the use of fixing agents over a number of hours and the use of microscopic analysis, it is probably an analysis that only an expert would use. This raises the important issue of the appropriateness of different identification techniques, particularly where species are traded in large volumes (for example, in 2003 there were over five million sea cucumbers harvested in Ecuador alone). In some cases, more complex techniques may be most efficiently used to confirm species identification where there is already some suspicion that illegal trade is occurring. In addition, sophisticated tools such as DNA testing or examination of microscopic details may also prove beyond the current capacity of a number of developing countries, from whose waters much of the trade in sea cucumbers originates.

In relation to Appendix II in addition to the potential use of identification tools CITES provides that other species may also be listed in Appendix II in order to ensure effective control over trade in the species of conservation concern. This provision would enable, for example, all species of 'spiked' sea cucumbers in trade to be listed in Appendix II were one such species of sea cucumber listed.

Species listed in Appendix II as look-alike species are subject to the same provisions as those listed due to concerns over their conservation status. Therefore, this approach would not remove the requirement for the exporting Party to ensure that the trade was without detriment to the species. However, experience under CITES with listings of species groupings or orders, such as Antipatharia spp. (black corals) and Scleractinia spp. (stony corals), has shown that this can result in low reliability of trade data for individual species within the listing due to permitting and reporting at taxonomic levels higher than species[6]. In some instances this has led to a reduced confidence that trade is not negatively impacting on a particular species' conservation status. For example if all species in the family Stichopodidae or the genus *Stichopus* were listed, trade data on individual sea cucumber species might still remain elusive if correct permitting and reporting did not occur. In relation to Appendix III, there is no provision under CITES for look-alike species to also be listed in that Appendix. Therefore, unless a Party took the step of unilaterally listing all potential look-alike species, identification problems at species level would require different approaches to be taken cantered on the availability of identification guides and information-sharing about trade routes of legal and illegal product.

Availability of trade data

Regardless of in which Appendix a species is listed, it is important that correct marking of shipments and identification of species is made to not only enable compliance with CITES permitting, but also to ensure that accurate recording is taking place in import and export statistics.

Trade information at the importing level provides export countries with valuable information on what is being exported from their shores. In many cases this may be the only current information available to the exporting country to interpret what level of harvesting of their resources is occurring. Given the importance of this information for the collection of data and for use in relation to helping monitor the implementation of a CITES listing, the need for adequate Customs codes for the reporting of export and import must be one of the highest priorities for action in relation to sea cucumber conservation. This involves the need for countries to have adequate codes to include all commodity types that are being traded. Consideration needs to be given to determining at what minimum taxonomic level trade information should be collected. At a minimum the major importing countries of China, Hong Kong, Singapore and Taiwan (province of China) need to have adequate Customs codes in place as this would then cover the majority of the world's sea cucumber trade. These issues should be addressed regardless of any future listings of sea cucumber species in CITES.

Non-detriment findings

Export of a sea cucumber species listed in Appendix II requires the prior grant by the Party of an export permit. This requires the Scientific Authority of that Party to advise the Management Authority of that Party that the export will not be detrimental to the survival of that species. Appendix III listings do not require the issuing of non-detriment findings prior to granting an export permit or a certificate of origin. This raises the question of the potential basis for non-detriment findings by exporting Parties.

There are currently few countries that actively manage their fisheries for sea cucumbers (Bruckner *et.al*, 2003; Sant, 1995) with notable exceptions such as Ecuador, the United States of America, Australia, Canada and

New Zealand (Anon., in prep.; Bruckner *et al.*, 2003; Willock *et. al.*, in prep.). Further, there is a lack of availability of information on many biological characteristics of sea cucumber species and harvest levels (Bruckner *et al.*, 2003). The lack of active management and information in many range countries on which to base a non-detriment finding for sea cucumber species may be a significant short to medium term impediment to an effective listing in Appendix II. There is a need to collect biological and catch/trade information on sea cucumbers, particularly in the major exporting countries, so that sufficient knowledge can be gained to determine how a non-detriment finding can be made for particular populations of sea cucumber.

Management regimes for fisheries vary in complexity from stock assessment models reliant on extensive catch and monitoring data to the application of relatively simple measures such as closed areas and minimum sizes. Depending on the nature of the resource an effective management regime may not necessarily require the most extensive and complex measures to be applied to support a non-detriment finding. There is, however, a fine balance between allowing harvest at levels that are probably sustainable and being precautionary enough to ensure the survival of the species is not put at risk.

There is no "one fit all" method within CITES that is applied to non-detriment findings and hence it is the responsibility of a Party to decide at which level a harvest is sustainable and how that decision is reached. An important function within CITES exists whereby through the Animals and Plants Committees, species that are being traded at significant levels at what may potentially be of detriment to the species may be subject to review Hence there are provisions within CITES to identify and prevent long-term trade at levels that are not sustainable.

Legality findings

The lack of active management in most range States for sea cucumber species raises a second question in relation to implementation of any future Appendix II listings – the basis for a finding that specimens being exported were legally obtained.

An absence of management measures may make this a relatively straightforward finding in theory, there potentially being no domestic laws that could be contravened. However, a finding by a Management Authority that a specimen had been legally obtained under such circumstances may be incongruous with any attendant non-detriment finding required for an export permit to be granted. In certain circumstances it may be considered that unregulated harvest was not a potential threat to the conservation of the species concerned however in most cases where harvest is stimulated by a demand for trade this is unlikely to be the case. Findings on the legality of the acquisition of specimens for trade may also be complicated by difficulties in identifying individual species if subject to different management regimes. For any future Appendix-II listing two key elements would therefore need to be addressed by exporting countries: first, to implement domestic management regulations for sea cucumbers in support of sustainable harvest of the resource and, second, to ensure the ability exists to determine when these regulations were contravened.

In relation to Appendix III, only the second of these two key elements arises. This is because a listing in Appendix III requires (under Resolution Conf. 9.25) the listing Party to already have in place national regulations relating to the management of the species in question. Range States not having listed the sea cucumber in Appendix III are only required to issue a Certificate of Origin, which does not require a finding that the specimens were legally obtained. With regard to the current listing of *I. fuscus* in Appendix III if any other range State wished to also list the species in that Appendix they would first need to ensure that adequate domestic measures were in place for the species.

Captive Breeding

Captive breeding of sea cucumber species occurs in a range of countries. In some cases the purpose of these operations is the re-seeding of depleted stocks while in other cases it is rearing for the purposes of commercial trade. Consideration needs to be given to the potential conservation impacts of captive breeding and what methods may need to be developed to distinguish individuals sourced from captive breeding facilities and wild-caught individuals.

Whether a sea cucumber is listed on CITES or not there are two particular areas of relevance for the conservation of sea cucumber species. The first is the issue of management at the national level and whether the captive breeding has any impact on the status of the wild population; for example, whether wild harvested parental stock is utilized and whether there is any re-seeding of wild stocks. The second issue is whether captive-bred individuals entering trade should be considered separate from wild harvested individuals for the purposes of, for example, monitoring of quotas.

If wild and captive-bred specimens are to be treated in a different manner this then raises the question of the ability to recognize certain specimens as captive bred, which may require the development of tagging or marking procedures.Under CITES there are specific provisions relating to the treatment of captive bred animals, with the Management Authority needing to be satisfied that specimens have been captive bred. In such circumstances a certificate of captive breeding may be granted in lieu of export permits or other certificates.

Costs and benefits of listing of Sea cucumbers in Appendix II and III

In terms of conservation costs and benefits of listing sea cucumber species in either Appendix II or III of CITES, it is clear that a number of implementation issues would need to be addressed in order for benefit to be derived from such a listing.

Identification of individual species in trade is perhaps of most importance as conservation benefit will be dependent on the ability to ensure that harvest of a species of concern is occurring at a sustainable level. The potential for illegally harvested species of sea cucumber to be traded as non-listed species would also need to be addressed, particularly in relation to Appendix III listings where illegal trade is often the main threat to the conservation of species.

It is possible that a listing in Appendix II or Appendix III of CITES would stimulate management action being taken in range States for sea cucumber species that would improve the conservation status of these species, a situation that may not occur in many countries in the absence of a listing. This could involve management being put in place and/or non-detriment findings being undertaken to ensure that the harvest of sea cucumbers is sustainable. The other main benefit derived from a CITES listing is the checks that occur through the CITES processes such as the significant trade review, mentioned earlier.

The costs, which are primarily financial in nature, are that all the implementation issues such as species identification, issuing of permits, non-detriment findings etc. require a certain level of administrative investment and sufficient investment in science.

Confiscation and disposal of confiscated specimens

Under Article VIII 1(b) Parties are required to implement domestic legislation allowing them to confiscate illegally traded specimens so as to ensure enforcement of the provisions of the Convention.

In relation to trade in sea cucumbers under CITES Appendix II, any dead (e.g., dried, salted or in brine) specimens seized by the Management Authority of a Party may be subsequently sold by that Authority. Resolution Conf. 9.10 (Rev) provides that such confiscated specimens '…be disposed of in the best manner possible to benefit enforcement and administration of the Convention'. No such guidance is given with respect to Appendix-III specimens, with the exception that specimens not be re-exported if there is evidence they were imported in violation of the Convention. Depending on the legislation of individual Parties, the proceeds from the sale of confiscated sea cucumbers could be used to recover costs incurred in the seizure and sale or more generally be attributed to enforcement of CITES by that Party. Subsequent export or re-export of confiscated sea cucumbers would then require a special notation to be made on the export permit that these were confiscated items. The majority of international trade in sea cucumber species is in dead animals, however it is possible that live specimens of species destined for the aquarium trade would be confiscated if CITES provisions were not met. In such cases Parties have identified a decision-making process to determine the best means of disposal of live animals including the possibility of returning the animal to the country of origin, destroying it or maintaining it in captivity.

CITES provisions for Introduction from the Sea

Introduction from the sea is an important provision under the Convention for many off-shore marine species that are harvested from high seas areas. However, while some species of sea cucumbers may occur in high seas areas, harvest occurs from waters under the jurisdiction of a State. It is unlikely that provisions relating to introduction from the sea will be relevant to sea cucumbers under CITES.

Non-CITES related institutional measures

Improved domestic management of sea cucumber fisheries is clearly a precursor to any future complementary use of the provisions under CITES. The identification of minimum requirements for data collection and monitoring of sea cucumbers and their associated fisheries to ensure their conservation is required in support of the development of management measures. Such information is fundamental for the management of fisheries to ensure these stay within sustainable levels, whether or not there are any future listings in CITES.

In Ecuador and in some other fisheries around the world a number of different management tools have been put in place to limit effort within fisheries, assist with the collection of particular fishery dependent catch/trade information and directly protect species at particular biological developmental stages.

Within Article 63 of the United Nations Convention on the Law of the Sea (UNCLOS) Coastal States which are fishing shared stocks from within their EEZ's should either directly through bilateral or multilateral arrangements manage their stocks or through action within sub-regional, regional or international agreements. There are numerous Regional Fisheries Bodies which include all marine resources under their preview, but they vary as to the extent to which they either offer management advice on fisheries or directly manage fisheries. For example the South Pacific Community (SPC) advises its members on scientific and management measures for marine species, but do not directly manage fisheries resources.

Recently the members of the Food and Agriculture Organization (FAO) have agreed on International Plans of Action, one of which being the conservation and management of sharks. Such a plan could possibly be considered by FAO members for sea cucumbers. FAO also provides expert management, marketing and trade advice on many marine species.

Institutions such as these offer opportunity to coordinate management of shared stocks and/or improve national management of sea cucumber fisheries.

For Discussion

This paper discusses the requirements and implications in relation to a listing of sea cucumbers in either Appendices II or III of CITES. This discussion has identified particular issues that would need to be addressed for such listings to be effectively implemented. Regardless of any future listings of sea cucumbers in the CITES Appendices discussion is also required concerning improved management of sea cucumber fisheries and trade at the national and international level.

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FOOTNOTES

[1] The information in this section is adapted from Willock *et al*. in prep

[2] Hookah is the name given to the system whereby an air compressor pumps air to the diver via a length of hose.

[3] AIM is the decision-making body for the Galapagos Marine Reserve.

[4] Range States are, from North to South, Mexico, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Ecuador and possibly Peru.

[5] Captive-bred specimens, for CITES purposes, must be shown to be offspring born or otherwise produced in a controlled environment from parents that reproduced in a controlled environment. A controlled environment is one that humans manipulate for the purpose of producing a species and that has boundaries to prevent the entering or leaving of animals, eggs or gametes. The parental breeding stock must be established in a manner that poses no threat to their wild populations. The stock must also be maintained regularly without augmentation from the wild and managed in a manner designed to maintain the stock indefinitely and which has been demonstrated to be capable of reliably producing second-generation offspring (Sant, 1995). Where an animal has been born in captivity but does not necessarily meet the requirements of captive breeding its source code within CITES records is "F". The source codes for "ranching" is "R", captive breeding is "C" and specimens taken from the wild "W".

[6] Non-detriment findings are required at the species specific level and CITES documents should use species names.

NATIONAL REPORT – CHINA

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1. Information on wild populations

A total of 43 species of sea cucumbers in the families *Holothuridae* and *Stichopedidae* has been described in the Chinese waters, of which 9 are wildly regarded as the edible sea cucumbers and therefore become the major harvest targets (***Appendix I***). These 9 species could be regarded as major commercial species in China. Five of these 9 species belong to the family of *Holothuridae*, and are distributed in the South waters; while the other 4 species belong to the family of *Stichopodidae*, and are also mostly found in the South waters, but *Apostichopus japonicus* (or S*tichopus japonicus*) is mainly found in the coast areas of the Bohai Sea and the Yellow Sea up to the northern China.

Since China is in the dramatic change and fast growing stage in terms of economic reform and development, the situation of the resource of sea cucumber and its administrative conservation is really connected with many various different areas, such as the construction of the system of laws and regulations on the fishery resources, specific national technical standard change and upgraded etc. Although some preliminary investigations and researches on the distribution and species identification of sea cucumbers have been conducted by some institutes for aquatic product sciences, no any intensive and/or comprehensive survey or assessment on the resource of sea cucumbers have been done in China.

2. Nature of sea cucumber fisheries

a. Types of landing & fisheries

China has a long history to harvest the sea cucumber for food; however, no systematic statistics data are available to sketch the sea cucumber fishery situation in China. Based on the incomplete statistics, nationally, a amount of sea cucumber fishery industry is estimated to about 50 tons in 2000, 20 tons in 2001, 10 tons in 2002, and under 5 tons in 2003 (Table 1). Major harvested species are *Stichopus spp. & Apostichopus japonicus*. The above statistics should be regarded as commercial sea cucumber fishery landings. None of other available information could be taken as references to illustrate the scale of sea cucumber landings for the purpose of artisanal or subsistence by local fishermen, but general understanding to the costal area development, the amount of such nature of sea cucumber harvest have less value to be considered while set up the policy for conservation.

Table1. Yearly Natural Harvest Volume

Year	Natural Harvesting (tn.)
2000	50
2001	20
2002	10
2003	5 (lower)

b. Types of harvest methods

The major method to catch the sea cucumber in China is by diving, some of the by diving people directly, and some others use diving boat with about 4 to 5 submarine inside. In the area where the sea bed is quiet flat, small steamboat (also called as sea cucumber harrow) with dragnet could be used for sea cucumber landing, the important condition is that this practice should happen under good weather, as the sea cucumbers normally search for food in upside standing position, it is easier to catch them inside the dragnet.

c. Harvest seasons

The first harvest season comes to the spring, most of days in April and May. The products from this season are normally called Spring-Cumber. Fall, from the beginning of October to the mid of December, is the second harvest season, and the landings from this season are normally called Fall-Cucumber. The quality of Spring-Cucumber is better than that of Fall-Cucumber. The harvest seasons are formed through the history, and further strengthened by the consideration of conservation. It mainly related with breeding season in summer and some sea cucumber species have the habit of aestivation. Another recommendation comes out from the above consideration is to stop the spring harvest if the harvest amount goes down year by year. This can provide more time for sea cucumbers to grow and let more sea cucumbers join the breeding so that the fall harvest could get a balance in term of total landings.

d. Sea cucumber conservation

i) Laws and Regulations

- None of any species of sea cucumbers have been included in the list of species under national key protection, in other words, at the national level, the ***Wild Animal Protection Law (WAPL, 1989)*** have no measure to control either harvest or trade activities of sea cucumbers.

- However, ***the Fishery Act (1986, modified in 2000), Fishery Licences and Permit Administrative Regulation (FLPAR, 2002)*** do require some kinds of limitations on the sea cucumber harvesting. The harvest permit could be applied from the competent fishery department at and above the county level, and in addition to that ***the system of issuing person*** is also established to strengthen the permit administration, it make the permit issuing person some additional obligations to monitor and regulate the fishery activities, and make the units where issuing person gets authority more serious in monitoring the issuing person's behaviours. Whenever the case of exceed authority happened, the unit should get punishment accordingly besides to the punishment on the issuing person himself. But both of these permit and system of issuing person are generally towards to the management of common fishery, there is no special request to the sea cucumber conservation.

In addition to the above, the different types of fishery boats and to where these boats could start fishery production activities are all subject to the permit management system. Fishery department will grant the permit in accordance with indicators previously set up by the competent authority. The net will be used by the boat need to be inspected and subject to separate permit too.

- ***Ocean Environment Protection Law (OEPL, 1982)*** provides some protections on the habitat of the sea cucumbers, although there are no specific provisions towards to protections of sea cucumbers. The general environment protection will benefit all marine species in those waters.

- ***Enforcement Regulations on Aquatic Wildlife Species' Protection (ERAWSP, 1993)*** provides the guidance to local governments to promulgate the more strict measures to protect the sea cucumbers. Hebei

provincial government and Qingdao city government published the local policy to .set up limitations towards to wild sea cucumbers harvest, and encourage wild the sea cucumber harvest only for the use to produce more hatchlings so that eventually could help the development of the farming and culture industry.

- ***Marine Fishery Management Regulation of Qingdao (1997)*** is one of above-mentioned local policy; Article 16 states that to collect the natural resources of sea cucumbers, abalone and agar etc, subject to the approval from competent fishery department and the collection permit should be obtained in prior.

- ***Local key protected wildlife species list*** is the other document mentioned above. *Apostichopus japonicus* was included in this list after 1995. It becomes the species into wildlife and changes the legal status of this species from a major fishery species under the regulation of the Fishery Act into a wildlife species which are mainly managed by the WAPL. All activities like catch in the province, breeding, transportation, exploration etc., shall be under the management set forth for all other key protected wildlife species. To catch this species in Hebei province, the fishery permit issued by the fishery department have to be obtained, other permits for breeding, transportation and utilization are all also required.

ii) Artificial proliferation and releasing program

The Fishery Act (modified in 2000) clearly requests that fishery departments should conduct relevant measures to proliferate the fishery resources. And the following FLPAR issued in 2002 by the Ministry of Agriculture further states that "Encouraging and supporting the practice of proliferation and releasing…"

The practice on the sea cucumber artificial proliferation and set free back to the ocean program started in 1970s in Liaoning province. During the period from 1990 to1995, Shandong province established one demonstration area of sea cucumber artificial proliferation and released them to the ocean. The size of this demonstration area is 23 ha., about 10,000,000 hatchlings with the size around 2-3 cm have been released back to the ocean.

In accordance with relevant statistics, from 1999 to 2002, a total of about 18.5 billion of hatchlings have been released back to the sea. The most recently program was conducted by the Hebei provincial fishery department in July of 2002, and 100 thousands of 2-3 cm hatchlings were released to the sea. Up to now, a total of about more than decades of thousands of hectors have already been selected as areas for the sea cucumber hatching and releasing program, and the proliferation numbers of about 1000 millions could be used to recover the wild population, for a better ecological living environment and also much stronger potentials for fishery activities in the future.

iii) Other conservation measures employed

- **Summer fishery moratorium:** From the year of 1995, China started to conduct summer fishery moratorium policy, and the marine area of the Yellow Sea, East China Sea and South China Sea are all covered in this program. Including sea cucumber catch or harvest, no fishery activities could be allowed in the above sea areas.

- **Zero increase & negative increase program:** Started from the year of 1999, China fishery policy request the zero increase and negative increase in the marine fishery production. This policy seriously decreases the pressure caused by human production activities. It is not only to protect marine resource,

but also to be a sort of measures to encourage marine culture growing up to be one of the major fishery industry types.

- **Fishermen transformation:** This is to encourage the fishermen to change their daily life from marine collection or harvest to the marine culture collection, to connect with local economy's transformation, and to well incorporate the fisherman's future into the whole society transform plan. Some fishermen could be transferred to other professional works, like workers, farmers or even businessman. This program is a kind of support measure to the Zero increase policy described in above.

e. Sea cucumber farming

The sea cucumber farming mainly develops along the costal areas of Bohai Sea and Yellow Sea. The major farmed species are *Apostichopus japonicus* and other *Stichopus* species. There almost are no sea cucumber farming activities along the costal areas of south waters of China. The effort to develop hatchery techniques for the marine-culture on *Apostichopus japonicus* started from 1954, the break through progress achieved in 1985 by the Liaoning Provincial Oceanic & Water Products Research Institute. Around 200-400 thousands hatchlings could be produced in per cubic meters of salt water, almost half of them can survive. For the time being, the hatchery techniques of *Apostichopus japonicus* have started to be used to support the farming industry, and the hatchling field size is about 500 thousands of square meters. According to some incomplete surveys, three provinces including, Liaoning, Shandong and Hebei, produced about 1.2-1.5 billions of commercial hatchlings of 1 cm in length in recent years.

The sea cucumber farming mainly happens in those of cofferdams, shallow beaches and shrimp ponds. The operation cost is pretty low if the risk of diseases and stealing etc. won't be counted.

The major sea cucumber farming activities started from 1980's, along with the break through progress achieved in hatchery techniques, the scale of the farming is growing up steadily. The statistics for these past years could tell something in the direction of the industry (Table 2). The culture area is up to 190,000 mu in the year of 2000 and the sea cucumber yield is 32,000 T; for the year of 2001, the culture area is 280,000 mu and the annual yield is 50,000 T; to the next year of 2002, the area increased to the 400,000 mu and the yield for this year is about 70,000 T.

Table 2. Sea Cucumbers Culture & Natural Harvesting

Year	Sea Cucumber Culture Area (Chinese Acre)	Annual Yielding (tn.)	Natural Harvesting (tn.)
2003			5
2002	400,000	70,000	10
2001	280,000	50,000	20
2000	190,000	32,000	50

* acres devoted to culturing and the annual yield of cultured sea cucumbers increased between 2000-2003, while the levels of wild harvest have declined over this period

The farmed sea cucumber output exceed the natural harvesting, the development in artificial proliferation and culture have step by step to use the cultured specimens to replace the natural harvested specimens for human consumption, it infinitely softens pressures created by human on wild populations of sea cucumbers. In the meantime, fishery departments become very helpful to the local economy by providing the necessary scientific guidance and technical services. Sea cucumber farming already becomes the new economic increase point and it does help both in promotion on life of local fishermen and the conservation of sea cucumbers in the wild. For example, there are more than 100 families are specializing sea cucumbers farming in the small town of Chang Xing Island, WaFangDian city, Liaoning province. More than 3000 people are employed in this industry and the annual income of these families could be high up to 2 million RMB (is about 250,000 USD) ; Another example is WeiHai city of Shandong province, the city promulgated a policy to support the sea cucumber farming industry. It provisions that "any of units or individuals would like to be involved sea cucumber farming in tidal zone shrimp pond and the area bigger than 100 mu, the city will provide additional funds in a certain rate connect with 50% of the total investment to support, and the owner will get some taxes exemption". Till now, in this city, more than 350 families have invested their money and energy into 6000 mu shrimp ponds for sea cucumber culture, the annual production value has reached to about 0.24 billion RMB (30,000,000 USD), and the average of family annual income is about 686,000 RMB (80,000 USD)

f. Preferred markets and most important uses

Domestic markets are major and preferred markets of sea cucumbers in China, among various of use of sea cucumber, more than 85% of sea cucumbers will be used as human's delicacy. For the reason of transportation and reserve, the major part of this type of consumption is mainly from the dried sea cucumbers. Water soaked sea cucumbers with low quality both in species and taste are frequently sold in most of free markets. Fresh sea cucumbers can also be used for dishes, but it is very rare and very difficult to reserve. Other 15% is used as ingredients of medicines, tonic stuff and other products. Again, the dried sea cucumber is the major form being utilized in China.

3. Domestic and international trade

g. Domestic trade

While in the section 2.e., the data on the growing up of farming activities and economy income of operation involved in sea cucumber farming provided a good explanation to the levels of domestic consumption and trade trends. It's almost impossible to give a price list by species, however, the commodity in different type reference price could sketch a little of understandings to the price of sea cucumber and its products (Table 3).

From dried sea cucumbers to other products, all seem very expensive, no matter what origin they are. The foodstuff in the restaurant could be very high but too many factors such as waiter's attitude, cook skill of chef, eating environment etc, involved in that price setting up, the price quoted from restaurant should not be taken as the reference of the marketing price.

Table 3. Price information quoted for reference

Products & Origin	Standard	Price	Units
Dried SC from Cheli	3-7 cm	23.3 USD	Kg
Light dried SC in Shandong	100-160 individuals per kg	3800 RMB (459 USD)	Kg
Half dried SC in Dalian, Liaoning	50 individuals per kg	700 RMB (85 USD)	Kg
Salty SC in Dalian, Liaoning	40 individual per kg	440 RMB (53 USD)	Kg
Branded dried SC in Dalian, Liaoning	No information	Under negotiation	Kg
HaiYanTang in Dalian, Liaoning			
HaiYanTang: SC Nutriment	Fine packing, 18 g	496 RMB (60 USD)	Packing
HaiYanTang: SC Nutriment	Fine packing, 24 g	868 RMB (105 USD)	Packing
HaiYanTang: SC Nutriment	Common packing, 9 g	198 RMB (24 USD)	Packing
HaiYanTang: SC Nutriment	Common packing, 18 g	396 RMB (48 USD)	Packing
HaiYanTang: SC Nutriment	Common packing, 19.2 g	420 RMB (51 USD)	Packing
SC oral liq. in Changdao, Shandong	6 bottles in 1 box	260 RMB (31 USD)	Box
***XinYiDai SC,in Qingdao, Shandong**	1 box, 150 g	106 RMB (13 USD)	Box
Sun Dragon SC can in Qingdao, Shandong	4 can in 1 present packing	168 RMB (20 USD)	Packing
OuShenBao SC living ingredients	In present packing	863 RMB (104 USD)	Packing

*** Using the US techniques produced in Qingdao, Shandong province.**

h. International trade

The information on the international trade of sea cucumbers (rock, dried, salted) could provide some hints to the degree or the level of the international trade of these species. From the data showing in the below tables and charts, ggenerally, China is a country import more sea cucumbers than its export, no matter we use the volume or the value as the factor to make analysis. From the data listed below, there is not a clear trend in directions, but for the importation, the cost seems going up steadily and the volume seems going up for a long term. There is not a trend could be referred from the data for these years. The reason for the difficulties while to analysis could be lack of enough information; the following studies will provide more information for this area.

Table 4. Sea Cucumbers Import and Export

Year	Import			Export		
	Volume (kg)	Value (usd)	Average (usd/kg)	Volume (kg)	Value (usd)	Average (usd/kg)
1999	139,152	265,306	1.91	87,919	208,872	2.38
2000	186,234	793,045	4.26	298,479	612,301	2.05
2001	2,058,574	1,229,090	0.60	653,487	845,137	1.29
2002	481,092	1,281,770	2.66	581,237	519,203	0.89
2003	1,619,079	3,459,259	2.14	152,323	243,976	1.60
Total	4,484,131	7,028,470		1,773,445	2,429,489	

Chart 1: The Sea Cucumber importation

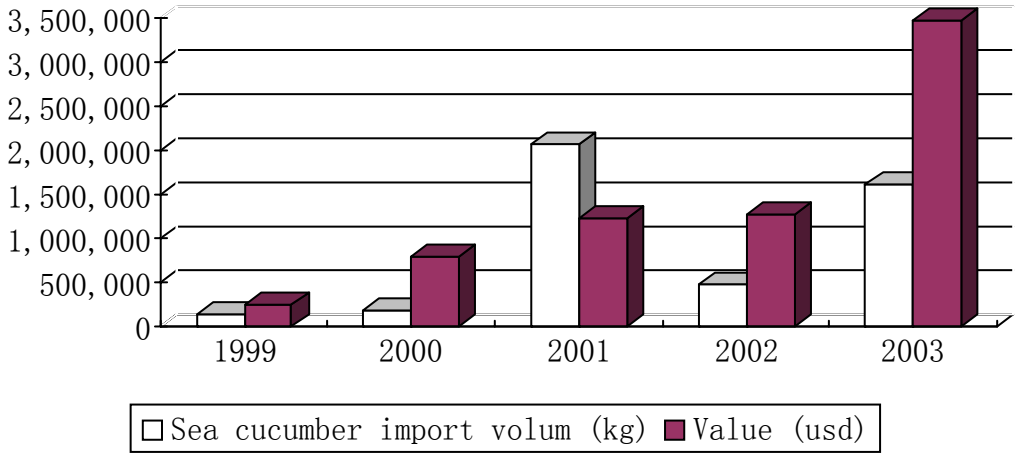
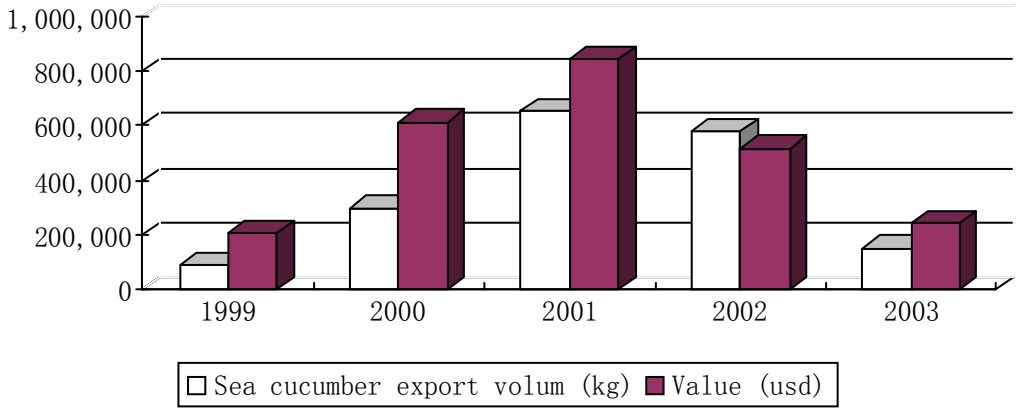


Chart 1 &2 on the importation and exportation of sea cucumbers showing some results that is a little confused to us generally. The potential reason could be the change of price in the international market, the trend in Chart 1 seems support this explanation, but the chart 2 does not. Other reasons will be too many even need to review the validity of the information kept in the Customs.

Chart 2 The Sea Cucumber exportation



From the Appendix II and III, the list of county of origins included 34 counties and/or territories, while the destined countries and/or territories for the export of sea cucumber are only about 15 countries. From which, the data of import and export have been included at the annual bases for reference.

I. Others

The information requested in this section is normally for those species already listed in the CITES appendices. The sea cucumber species have not been listed into the CITES and have not been included in the wildlife protection list of China. Mainly regulated by the Fishery Act, having very little connection with wild animal protection law, therefor, the information provided in this section is mostly based on the personal analysis, more substantial information collected through formal governmental channels will be provided in the future.

- There is no any trade controls at all, since no limitation nationally applied towards to the trade of sea cucumbers, there is no need to establish a team or to use the existed enforcement power to regulate the trade of these resources.

- The identification of specimens in trade is not for regulation, but to tell the difference for the inspection of products. There is not a comprehensive identification manual at all, mostly based on the common knowledge to the commerce, the relation established between the commerce and species normally is based on the area and its common production either by wild caught or from the sea cucumbers farming operations.

- Information regarding the illegal trade of sea cucumbers in China is currently not available. The reasons could be various, such as lack of understanding to the limitations set up by the authority, lack of power to check fisherman with sea cucumbers whether they get permit or not, sea cucumber species will not encounter any law enforcement (except for Hebei province) problems as if the authority cannot stop the illegal catch around the costal line; there is no any control on the sales in markets and to the restaurant. All of possible reasons are personal analysis; none of them could be confirmed by any sense at this time.

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Annex I: Species List of Sea Cucumbers in the families of *Holothuridae* & *Stichopus* In China

Latin Name	**Distribution area**
Bohadschia marmorata Jaeger *B. bivittata, B. koellikeri*	Dazhou island of Hainan, Xisha & Nansha
Bohadschia argus Jaeger	Xisha, Nansha islands
Bohadschia graeffei (Semper)	Nansha islands
Actinopyga lecanora (Jaeger)	Xisha, Nansha islands
Actinopyga echinites (Jaeger)	Sanya, Xisha, Baoan and Aotou county of Guangdong
Actinopyga mauritiana (Quoy et Gaimard)	South of Hainan, Xisha & Nansha
Actinopyga miliaris (Quoy et Gaimard)	Xisha
Labidodemas semperianum Selenka	YongXing island of Xisha & Nansha
Holothuria moebi Ludwig	Middle and south costal area of Guangdong & south of Hainan
Holothuria cinerascens (Brandt) *Halodeima atra*	YongXing island of Xisha & Hainan
Holothuria flavomaculata Semper	Tidle zone of Sanya, Hainan
Holothuria atra Jaeger *Halodeima atra*	Hainan, Xisha & Nansha
Holothuria edulis Lesson *Halodeima edulis*	South of Hainan
Holothuria dicrepans Semper	Yongxing island of Xisha
Holothuria olivacea Ludwig	Yongxing island of Xisha
Holothuria difficilis Semper *Microthele difficilis*	Xisha, south of Hainan, Taiwan & Nansha
Holothuria impatiens (Forskaal)	Xisha, Hainan & Nansha
Holothuria arenicola Semper	Xisha
Holothuria gracilis Semper	South of Hainan
Holothuria hilla Lesson *Holothuria monacaria*	Xisha, Nansha & Hainan
Holothuria leucospilota (Brandt) *Holothuria vagabunda*	Xisha, Hainan & Guangdong
Holothuria fuscocinerea Jaeger	Xisha, Hainan; Baoan county & Daya Bay of Guangdong
Holothuria pervicax Selenka	Xisha, south of Hainan
Holothuria dietrichi Ludwig	HongKong
Holothuria pardalis Selenka	Xisha, Hainan
Holothuria verrucosa Selenka	Xisha
Holothuria multipilula Liao	Xisha
Holothuria rigida Selenka	Yongxing island of Xisha
Holothuria inhabilis Selenka	Xisha
Holothuria spinifera Théel	Xisha
Holothuria ocellata Jaeger	Northern bay, south of Hainan, Nansha & peral river estuary

Annex I (continued)

Latin Name	**Distribution area**
Holothuria scabra Jaeger	Xisha, Hainan, west coast of Guangdong
Holothuria albiventer Semper	South of Hainan
Holothuria martensi Semper	Northern bay
Holothuria nobilis (Selenka)	Xisha & south of Hainan
Microthele nobilis	
Holothuria axiologa H.L. Clark	Xisha
***STICHOPODIDAE* – 7 Species**	
Latin Name	**Distribution area**
Stichopus chloronotus Brandt	Xisha & south of Hainan, edible
Stichopus variegatus Semper	Northern bay, Xisha, Nansha, Hainan & Leizhou peninsular. Edible
Stichopus horrens Selenka	Xisha, Nansha & Hainan
Stichopus flaccus Liao	Middle and west part of Northern bay
Apostichopus japonicus (Selenka)	Costal area of Bohai Sea & Yellow Sea, the best of edible
stichopus japonicus	cucumber
Thelenota ananas (Jaeger)	Xisha & Nansha, high quality edible cucumber
Thelenota anax H.L. Clark	Xisha

Annex II: List of Country & territory of origin - annual import volume & value (total 34)

Year	Country / territory	import volume (kg)	import value (usd)
1999	Australia	58	294
2000		629	4,403
2002		1,209	2,053
2001	Belgium	15	67
1999	Burma	2,000	2,892
1999	Canda	14,630	22,107
2000		28,426	81,361
2001		17,541	41,385
2002		16,629	114,008
2003		142,359	515,489
2001	Chile	1,200	720
2002		5,904	3,554
2000	Cuba	1,881	41,382
2003		700	13,300
1999	Ecuador	91	525
2001		1,160	11,258
2002		8,465	108,089
2003		8,430	123,176
2003	Egypt	210	4,213
2001	Guinea	624	4,992
1999	HongKong SAR	50,187	154,001
2000		13,760	54,509
2001		13,500	11,369
2002		2,600	6,208
2003		17,680	21,536
1999	Indonesia	9,120	4,766
2000		44,062	84,846
2001		1,145,943	487,793
2002		279,758	499,035
2003		605,589	677,791
1999	Japan	14,275	19,795
2001		20	1,023
2002		256	5,232
2003		29,637	389,732
1999	Madagascar	7,189	13,793
2000		10,581	24,031
2001		940	2,560
2002		5,575	18,422
2002	Malaysia	595	14,862
2003	Maldives	505	8,392
2002	New Zeland	11,475	11,475
2003		10,625	14,391

Year	Country / territory	import volume (kg)	import value (usd)
1999	North Korea	55	1,300
2001		234	2,808
2002		537	11,782
2003		25	750
2002	Pakistan	302	1,363
2001	Papua New Guinea	225	1,327
2002	Peru	700	4,332
2003		5,520	4,429
1999	Philippines	28,803	23,599
2000		45,017	348,241
2001		791,482	489,250
2002		63,371	251,969
2003		142,765	254,990
1999	Russia Federation	500	7,500
2000		850	8,500
2001		1,200	6,000
2003		5,169	265,652
1999	Singapore	568	1,776
2000		905	2,940
2002		80	967
2001	South Africa	1,076	1,642
2002		10,211	10,211
2000	South Korea	12,340	76,766
2001		21,096	107,840
2002		6,470	32,448
2003		5,900	29,589
1999	Spain	2,190	2,609
2002		8,496	16,994
2003	Sri Lanka	324	7,376
2002	Taiwan province	1,496	3,106
2003		567,809	690,700
2000	Tanzania	200	154
2002		10,805	10,633
2003		22,565	27,530
2001	Thailand	55,910	18,780
2002		4,050	1,557
2002	Turkey	2,100	10,532
2003		1,800	9,000
1999	USA	9,473	10,293
2000		27,172	65,397
2001		6,408	40,276
2002		37,533	140,463
2003		46,282	389,602
2000	Viet Nam	200	346
2002		2,475	2,475
2003		5,185	11,621
2000	Fiji	211	169

Annex III: List of destined countries/territories - annual export volume & value (total 15)

Year	Country/territory	Import volume (kg)	import value (usd)
2002	Australia	885	3,275
2003		3,660	3,660
2001	Belgium	750	1,906
1999	Canada	5,100	27,550
2000		629	5,032
2002	Finland	60	300
1999	HongKong SAR	22,330	64,442
2000		26,342	82,148
2001		13,039	54,958
2002		12,077	49,038
2003		7,588	23,533
1999	Japan	1,235	3,266
2000		200	6,750
2001		131	327
2002		48	244
2003		181	25,855
2003	Macao SAR	280	564
2000	Malaysia	15	114
2003		-	28
2001	Russian Federation	168	393
2002		150	600
2003		230	820
1999	Singapore	10	400
2000		80	103
2003		5	10
1999	South Korea	59,234	113,134
2000		265,951	511,650
2001		639,359	785,345
2002		567,817	455,280
2003		140,115	177,712
2001	Sudan	40	2,208
2002		200	10,466
2003		200	11,494
2000	Taiwan province	5,252	6,303
2003		64	300
1999	USA	10	80
2000	Zimbabwe	10	201

NATIONAL REPORT – HONG KONG SPECIAL ADMINISTRATIVE REGION, CHINA

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1. Information on wild populations

Distribution and abundance of sea cucumber (also known as Bêche-de-mer) species are not well documented in Hong Kong. However, at least, the following species have been recorded in Hong Kong waters:

Holothuria leucospilota (previous known as *Holothuria vagabunda*) [1, 2, 3, 4, 5]
Holothuria arenicola [3]
Holothuria insignis [1]
Holothuria fuscocinerea [1]
Holothuria cinerascens [1]
Holothuria dietrichi [4]
Holothuria impatiens [5]
Polycheira rufescens [1,2,3,5]
Colochirus quadrangularis [1]
Pseudocolochirus violaceus [1,4]
Afrocucumis africana [1]
Acaudina molpadioides [1]
Protankyra bidentata [1]
Thyone papuensis [1]
Havelockia sp. [1]
Stichopus sp. [3]

2. Nature of sea cucumber fisheries

No sea cucumber fishery is observed in Hong Kong waters.

3.Domestic and International trade

Hong Kong is reported as one of the major importers and re-exporters of sea cucumber [6]. Among abalone, sharkfin and fish maw, sea cucumber is regarded as a food delicacy in Chinese tradition. In Hong Kong, sea cucumbers are mainly imported in dried form [7] even though it was also reported that specialized products are also produced from the gonad, respiratory trees and viscera of sea cucumber [8]. Sea cucumber is also traded in aquarium trade but the trade volume and pattern are not known.

The customs data from 1999-2003 (annex 1) showed that Hong Kong imported sea cucumber from more than 70 countries and territories all around the world. Indonesia, Philippines and Papua New Guinea were the major exporting countries in terms of volume. The total import volume varied from 2, 992 to 4, 759 tonnes annually.

The export data (annex 1) shows that Hong Kong export dried sea cucumber to 46 different countries and territories. Mainland China, Vietnam, Taiwan, USA and Thailand was the top 5 destination in the year 2003.

The most expensive sea cucumbers observed are the ones from Japan (presumably *Stichopus japonicus*) and their import price ranged from HKD 910 -1482 per kilogram while the average price of the rest sea cucumber imported ranged from HKD 67-75 per kilogram. The retail price observed in the market in 2002 ranged from HKD 260 -620 per catty and that of *Stichopus japonicus* from Japan was over HKD 2000 per catty.

Many of the sea cucumbers imported were later on re-exported elsewhere. Table 1 shows that more than a half of the sea cucumbers were not consumed in Hong Kong. It also shows an apparent trend of declining re-export ratio from 1999-2003. This may indicate the local consumption of sea cucumber is increasing but more precise trade studies should be carried out to verify this interpretation.

Table 1: Import and re-export volume of sea cucumber from 1999-2003

	1999	2000	2001	2002	2003
Total import (kg)	2,922,332	4,758,719	4,382,272	4,417,354	4,655,496
Total re-export (kg)	2,657,502	4,221,073	3,866,623	2,943,878	2,528,543
Re-export ratio	91%	89%	88%	69%	54%

Legislations:

(1) Marine Parks Ordinance, Cap. 476

The Marine Parks Ordinance (Cap. 476) was enacted in 1995 to provide for the designation, control and management of marine parks and marine reserves in Hong Kong. To date, there are 4 marine parks and 1 marine reserve designated in Hong Kong waters. Unauthorized fishing, hunting, collecting or possessing any wild animals or plants, or their parts are strictly prohibited within marine parks and marine reserves. Anyone contravenes this ordinance may lead to a fine of HKD 25, 000 and 1 year imprisonment.

(2) Animals and plants (Protection of Endangered Species) Ordinance, Cap 187

The Animals and Plants (Protection of Endangered Species) Ordinance, Cap 187 is the local legislation that gives effect to CITES. The Schedules to the Ordinance have recently been amended to effect the changes to CITES Appendices as adopted at the 12th Conference of the Parties to CITES. The amended Schedules, which include the listing of *Isostichopus fuscus*, will take effect from mid 2004. Since then, import of *Isostichopus fuscus* from Ecuador would require a CITES export permit and import from elsewhere would require a certificate of origin. An export licence would also be required for its re-export. The maximum penalty is HKD 500, 000, 1 years of imprisonment and mandatory forfeiture of the concerned specimens.

(3) Customs declaration

The commodity code of sea cucumber (Beche-de-mer, dried, salted or in brine) is 0307 9930 under the Hong Kong Harmonized System [9]. Under the Import and Export (Registration) Regulations, every person who imports or exports any article other than an exempted article is required to lodge an accurate and complete import or export/re-export declaration within 14 days after the importation or exportation. Prosecution may be initiated against any person who fails to lodge the required declaration, or knowingly or recklessly lodges any declaration that is inaccurate in any material particular.

Feasibility of enforcement:

There are potential problems in enforcement work of trade control of sea cucumber. Firstly, there are a lot of sea cucumber species. There are approximately 1200 species of sea cucumber in the world and about 300 of these can be utilized in the dried sea cucumber trade [6]. It is impossible to enforce the trade regulation if there is no user-friendly identification method available.

Secondly, most of the sea cucumbers are traded in dried form. Some of the diagnostic characteristics would have been destroyed in the drying process. This may make it impossible to identify the specimens to the species level.

Lastly, specialized products produced from the gonad, respiratory trees and viscera of sea cucumber are also traded internationally. Thus far, their trade is not yet clear and their identification is still unavailable. In light of the above problems, it is recommended more studies should be carried out in order to sort out the above matters. In order to generate real conservation benefits, it is recommended any regulations, including CITES listing proposals, should consider the feasibility of enforcement thoroughly before they are imposed.

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Remarks:

USD 1 = HKD 7.78
1 catty = 600 gram

Table 2. Imports of sea cucumbers.

Import	**1999**		**2000**		**2001**		**2002**		**2003**	
Country/Territory	HKD	Quantity	HKD '000	Quantity	HKD '000	Quantity	HKD	Quantity	HKD '000	Quantity
Indonesia	31,341	762,707	42,938	1,041,559	35,252	1,068,768	33,548	1,010,698	29,900	977,893
Philippines	31,608	591,092	63,830	1,070,154	39,697	737,232	40,845	802,023	33,306	666,841
Papua N Guinea	28,817	350,321	45,482	524,101	41,165	54,122	40,344	380,595	41,146	447,632
Singapore R	10,715	165,911	18,531	284,804	16,583	249,278	20,092	284,657	21,414	409,315
Fiji	15,048	168,264	28,149	364,369	22,893	291,093	18,313	235,503	16,150	264,253
Solomon Is	2,641	49,737	7,646	149,115	14,896	259,727	12,027	248,751	7,438	222,763
Madagascar	18,729	166,364	17,745	178,392	17,529	194,129	14,217	193,551	8,821	216,354
Japan	53,879	58,343	81,952	75,528	100,602	110,558	147,874	137,999	305,792	206,359
Malaysia	1,471	19,854	4,617	67,975	4,090	73,158	10,276	144,754	10,657	147,523
Djibouti	0	0	0	0	0	1	567	4,133	5,012	134,999
Yemen R	256	3,287	0	0	798	4,848	10,454	102,414	15,266	134,919
Australia	25,206	125,289	43,646	146,524	41,282	185,952	30,964	124,665	35,416	118,827
USA	5,684	112,283	8,311	170,423	4,964	88,816	10,251	154,837	9,074	113,119
Thailand	3,410	60,331	12,492	133,858	9,695	101,020	7,329	78,528	4,552	69,207
Tanzania	5,989	41,352	8,930	118,166	4,676	56,382	5,462	91,672	3,662	67,555
Sri Lanka	2,008	21,381	3,647	53,867	1,964	33,288	3,610	54,523	3,836	64,972
Mozambique	76	500	40	109	197	853	3,307	37,000	5,210	63,363
Canada	623	4,883	2,242	13,837	3,332	58,541	1,363	17,861	4,533	60,506
Maldives R	229	4,170	2,780	53,915	1,563	27,928	1,080	37,829	2,451	49,013
South Africa R	649	10,149	2,188	27,876	1,274	30,178	1,119	53,792	620	37,800
Taiwan	6,164	40,958	6,606	37,830	6,360	40,143	5,545	40,800	5,187	34,570
The Mainland of	1,680	25,020	2,395	14,946	451	4,031	898	37,400	1,830	30,657
Kenya	148	1,707	3,377	51,580	1,407	39,444	1,873	20,429	4,235	22,658
Aust & Oceania	5737	32294	3822	24227	6515	37574	4300	22558	4456	21256
African Nes	0	0	0	0	0	0	144	2,340	1,417	19,977
Egypt Arab R	0	0	102	677	0	0	961	6,510	2,496	17,220
Seychelles	0	0	1,309	7,121	2,142	15,678	681	5,662	3,412	13,028
Tunisia	0	0	0	0	0	0	0	0	622	11,300
Haiti	0	0	0	0	0	0	242	1,000	2,362	9,680
Vanuatu	286	7,966	1,315	28,467	936	16,647	460	8,363	352	9,001
Peru	879	4,170	1,450	7,331	1,364	3,881	185	1,828	798	8,354
Cuba	570	2,920	3,593	19,023	3,042	13,941	904	3,800	1,862	7,648
India	928	6,610	454	1,906	930	9,810	356	2,391	1,622	5,655
Kiribati R	737	6,523	683	9,073	1,556	22,774	883	8,561	694	5,528
Vietnam	957	34,093	186	600	950	3,274	142	756	637	5,415
U A Emirates	5	140	983	9,100	13	256	1,159	17,141	1,065	4,508
Mauritius	12	300	271	3,185	0	0	131	667	768	3,682
New Zealand	186	530	1,664	7,583	115	317	276	1,440	305	3,471
Ecuador	1,274	24,567	5,769	15,285	384	991	3,983	10,130	1,414	3,026
Marshall Islands	0	0	0	0	0	0	0	0	757	2,739
Micronesia FS &	0	0	0	0	0	0	335	6,368	123	2,252
Turkey	0	0	0	0	0	0	68	1,290	106	1,995
Mexico	0	0	68	150	758	1,818	1,339	3,302	477	1,270
Hong Kong SAR	0	0	0	0	0	0	0	0	66	874
Chile	0	0	486	22,318	200	7,599	85	2,906	137	527

Table 2. Imports of sea cucumbers (continued).

Import	**1999**		**2000**		**2001**		**2002**		**2003**	
Country/Territory	HKD	Quantity	HKD '000	Quantity	HKD '000	Quantity	HKD	Quantity	HKD '000	Quantity
Korea R	0	0	0	0	0	0	29	651	45	510
Tonga	0	0	0	0	0	0	0	0	180	296
Korea Dem P R	0	0	0	0	0	0	0	0	373	284
Nicaragua	0	0	0	0	0	0	0	0	111	252
Sao Tome And	0	0	0	0	0	0	0	0	23	202
Asian Nes	0	0	0	0	0	0	0	0	20	96
Dominican R	0	0	0	0	0	0	54	2,562	4	45
Costa Rica	29	108	254	664	41	325	0	0	4	7
Yugoslavia F R	0	0	0	0	0	0	80	200	0	0
Netherlands	0	0	0	0	2	8	0	0	0	0
France	0	0	0	0	20	155	0	0	0	0
Brazil	0	0	0	0	42	444	10	50	0	0
Spain	0	0	211	1,000	0	0	0	0	0	0
Colombia	0	0	0	0	35	540	0	0	0	0
Puerto Rico	0	0	0	0	0	0	56	1,300	0	0
Oman	60	180	146	960	93	490	161	507	0	0
Saudi Arabia	72	782	0	0			5	30	0	0
Macao	0	0	0	0	20	1,200	0	0	0	0
Morocco	0	0	0	0	447	7,438	205	1,932	0	0
Somali Dem R	0	0	0	0	0	0	702	3,835	0	0
Comoros	0	0	62	600	0	0	0	0	0	0
Mauitania	0	0	0	0	0	0	146	1,860	0	0
Senegal	0	0	0	0	0	0	189	3,000	0	0
Swaziland	0	0	83	354	0	0	0	0	0	0
US Oceania	1,789	11,528	1,935	17,623	3,019	40,622	0	0	0	0
W Samoa	533	5,718	0	0	0	0	0	0	0	0
Total	260,422	2,922,332	432,666	4,758,719	393,292	4,382,272	439,628	4,417,354	602,212	4,655,496

Table 3. Reexports HS code: 0307 9930 Beche-de-mer, dried, salted or in brine (KG)

Re-export	**1999**		**2000**		**2001**		**2002**		**2003**	
Country/Territory of consignment	HKD '000	Quantity (kg)	HKD '000	Quantity (kg)	HKD '000	Quantity (kg)	HKD '000	Quantity (kg)	HKD '000	Quantity (kg)
China	78,159	2,268,382	176,034	3,770,695	141,171	3,542,713	73,903	2,126,617	56,700	2,034,399
Vietnam	0	0	0	0	0	0	13,097	439,233	8,695	240,870
Taiwan	15,479	158,408	25,164	208,791	9,927	117,081	16,662	152,440	9,229	81,761
USA	2,544	16,775	2,880	22,677	2,750	37,799	6,409	105,765	13,847	72,138
Thailand	5,265	31,025	6,005	29,864	6,555	39,652	7,656	39,798	5,482	25,173
Korea R	4,780	50,178	7,102	81,900	4,294	62,211	2,703	35,728	1,886	23,788
Canada	2,722	16,362	2,717	12,960	3,395	27,210	3,906	14,491	3,116	21,543
Singapore R	12,293	80,820	9,854	70,054	6,122	28,474	4,253	18,820	4,457	19,457
Malaysia	2,550	21,918	2,866	21,347	667	5,583	1,046	5,839	956	4,545
Australia	288	2,559	79	570	359	1,920	203	1,506	258	2,902
Sri Lanka	0	0	0	0	0	0	38	808	91	1,403
Japan	46	147	711	833	325	521	213	1,243	530	519
Korea Dem P R	644	750	0	0	94	50	0	0	10	20
Spain	0	0	0	0	46	1,026	0	0	21	15
Trinidad & Tobago	0	0	0	0	0	0	0	0	1	10
Switzerland	0	0	13	15	39	16	0	0	0	0
Portugal	0	0	42	19	28	10	56	20	0	0
Germany F R	3	4	6	8	0	0	67	25	0	0
France	0	1	0	0	28	10	0	0	0	0
Italy	28	10	28	12	39	14	0	0	0	0
Rep of Ireland	0	0	0	0	27	60	0	0	0	0
Macedonia R	0	0	0	0	0	0	14	5	0	0
Kazakhstan R	0	0	0	0	28	10	28	29	0	0
Ukraine	0	0	0	0	0	0	28	20	0	0
Brazil	0	0	0	0	70	250	63	25	0	0
Panama R	0	0	0	0	9	23	0	0	0	0
Venezuela	0	0	0	0	126	45	0	0	0	0
Syrian Arab R	0	0	0	0	28	10	0	0	0	0
Romania	0	0	54	60	0	0	0	0	0	0
Russian f	0	0	11	12	0	0	0	0	0	0
Costa Rica	0	0	26	478	0	0	0	0	0	0
Turkey	8	42	0	0	0	0	0	0	0	0
Poland	22	24	0	0	0	0	0	0	0	0
Israel	13	6	14	5	0	0	0	0	0	0
Indonesia	236	10,080	13	129	0	0	0	0	0	0
Macao	0	0	188	594	586	1,905	7	8	0	0
Philippines	0	0	0	0	0	0	150	1,428	0	0
Pakistan	0	0	1	1	0	0	0	0	0	0
India	0	0	56	38	0	0	0	0	0	0
Brunei	0	0	0	0	38	15	0	0	0	0
Bangladesh	0	0	0	0			45	20	0	0
Mali	0	0	0	0	28	10	0	0	0	0
Algeria	0	0	10	5	0	0	0	0	0	0
Djibouti	0	0	11	6	0	0	0	0	0	0
New Zealand	19	11	0	0	0	0	0	0	0	0
Nepal	0	0	0	0	13	5	28	10		
TOTAL	125,098	2,657,502	233,886	4,221,073	176,789	3,866,623	130,574	2,943,878	105,280	2,528,543

NATIONAL REPORT – CUBA

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1. Information on wild populations

a) Commercial Species:

STICHOPODIDAE

There are 32 species of sea cucumber reported on Cuban waters but only one of these *Isostichopus badionotus* has been commercially fished in Cuba from 1999.

Non-commercial species:

STICHOPODIDAE

Astichopus multifidus

HOLOTHURIIDAE

Actinopyga agassizii
H. floridana
H. mexicana
H. cubana
H. grisea
H. thomasi
H. impatiens
H. princeps
H. glaberrima
H. arenicola
H. surinamensis

b) Area of distribution and habitats.

- *I. badionotus* is distributed all around the Cuban shelf in mouth-sandy and sand-slushy bottoms.
- *A. agassizii*, *H. floridana* and *H. grisea* (under stones, the last) are distributed in north central coast of Cuba. They are also present but scarce at southern region.
- *H. mexicana* and *A. multifidus*, are well distributed around the island.
- *H. thomasi* is reported only for the south western region, located on sandy bottom.
- *H. arenicola* (under stones) highest abundance at south-central Cuban region.

c) Abundance

I. badionotus, The highest abundances (0 up to 8 800 /ha) are located at southeastern region and also in some bays of the northeastern region of the island. *A. agassizi* (to 1 800/ha), *H. floridana* (to 2 800/ha) in the north central Cuban region. *H. mexicana* (to 17 000/ha) and *A. multifidus* (to 6 300/ ha). *H.grisea* (under stones, the last) with few local abundances and the rest of the species, are very scarce in Cuba.

2. Nature of sea cucumber fisheries

a) Commercial, artisanal, subsistence : Commercial

b) Estimated number of fishers: 28 fishers and 18 proccesors

c) Type of fishing methods and gear equipment used:

Each speedboat is provided with compressed air tanks for use by the divers and four "on board tanks" with recycled water to hold the sea cucumbers. The divers use a "narquilex" or ¨hookas¨ system with a hose (95 m long) coupled to the compressor tank with the other end fitted with a mouthpiece. An air regulator system is used to supply air and allow longer time under the water. The fishery is carried out at depths between 3 to 15 meters.

d) Licensing/permitting requirements: Yes

To date *I. badionotus* has been captured from quotes recommended and assigned by fishery localities, for the Fishery Research Centre, after a potential population's assessment. A rational catch plans by the authorities PESCACUBA, who has the control trough the OPIP (Inspection Fishery Office) from the Fishery Industry Ministry.

e) Sea cucumber farming, if any:

Studies are underway to detemrine the feasibility of a pilot land-based hatchery

f) Preferred markets (live vs. dried):

The product is sold to NENEKA c.a., a Korean company who export this product to Hong Kong. The average live vs. dried has been approximately 20:1.

g) Identification of the most important uses of sea cucumbers. Commercial.

To date the principal use is for commercial export. Since 2002 research has been underway to use fishery by-products, mainly gonads and the boiled freshwater from processing, for bioactive extracts and medicines against certain illnesses and other uses.

h) Landing data (species, by catch, kg, sizes, etc), if available:

Average 48 pieces/kg and 6 cm/pieces.

i) Conservation measures (minimum harvesting size, closed areas, closed seasons, etc):

Fishery regulations were established to protect the population since mid-2000, enforced by the National Office of Fishery Inspection. The regulations also established catch's quota for each locality, an effort limited by each fishing campaign, a minimal legal size of 22 cm., a seasonal restriction recently extended (June-October) to protect the reproductive season. A rule is to prevent more than 60 sea cucumbers collected in the bag by immersion, and the maintenance of covered "on board tanks" to protect the sea cucumbers from the sun light.

3. Domestic and International Trade

a) Information on value, retail, wholesale prices and trends.

Around dry weight 89 104 kg., have been sold. Prices have steadily increased during this period from US$13.5/kg dry product ¨Class A¨ in 1999-2001, US$18.0 in 2001-2002 to US$20.0/kg during December 2002 to March 2003, and US$22.0/kg during April 2003 to date as a result of improved ¨Class A¨ and ¨Class B¨ product quality. The variability in ¨Class B¨ quality prize has fluctuated between US $6.00/kg.to US $10.00/kg on depending of others pay off.

b) Export volumes:

Year	Export volumes (kg dry weight)	Value (Cuba) ($ usd)	Clase A (%)
1999	5510	71 630	17
2000	31796	341 718	70
2001	18234	306 708	80
2002	8642	133 186	81
2003	8242	148 634	83
2004	5140	81 529	85
Totals	**77564**	**1 083 405**	

c) Information on key sea cucumber trading countries and territories:

All the production dehydrated-salted is sold to NENEKA c.a. a Korean company.

d) Trade controls and enforcement, including identification of specimens in trade:

Authorities emit a sanitary certificate with a product quantity's and qualities, by a customs officer before the product send to Hong Kong.

e) Information on illegal, unreported and unregulated trade:

No illegal fishery.

g) Levels of domestic consumption, trends and trade.

No domestic consumption.

NATIONAL REPORT: ECUADOR

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1. Information on wild populations

a) Species of non-commercial and commercial sea cucumbers in your country's waters: There are 38 species of sea cucumbers in the Galápagos islands (Maluf 1991) out of which only one species *Isostichopus fuscus* is commercially harvested. In mainland Ecuador the populations are overexploited and the only viable populations are found in the Galapagos Marine Reserve (GMR).

b) Area of distribution, and habitats if known: *I. fuscus* can be found in the eastern Pacific, from Baja California, México to Ecuador, including Cocos Island (Costa Rica), Socorro Island (México) and the Galápagos Islands (Ecuador) (Deichman 1958, Maluf 1991). In the Galápagos islands *I. fuscus* can be found in all islands in rocky bottoms down to 39 m depth (Maluf 1991).

c) Abundance (including anecdotal information): Please refer to Martínez & Toral (2004).

2. Nature of sea cucumber fisheries

a) Commercial, artisanal, subsistence: There is an artisanal fishery with all catches for commercial exportation to oriental markets.

b) Estimated number of fishers: 845 fishers and 313 fishing vessels were active in the 2003 season (Murillo et al. 2003).

c) Type of fishing methods and gear equipment used: Hookah diving and hand collecting. All animals collected are placed in a diving bag where kept until brought to the surface.

d) Licensing/permitting requirements: Any fishing activity within the Galápagos Marine Reserve (GMR) must be done by a fishermen with a PARMA fishing license. No other specific licence or permit required to partipate in a sea cucumber fishing season.

e) Sea cucumber farming, if any. None in the Galápagos islands, however studies are being undertaken in mainland Ecuador to use abandoned shrimp farms to start rearing *I. fuscus*.

f) Preferred markets (live vs. dried): Dried in the final destination; however, the produce leaves Galápagos in brine.

g) Identification of the most important uses of sea cucumbers.

h) Landing data (species, bycatch, kg, sizes, etc), if available: Only *I. fuscus* is commercially harvested in the Galápagos islands. No bycatch species have been recognised.

i) Conservation measures (minimum harvesting size, closed areas, closed seasons, etc).

Table 1. Percentage of catches per fishing macrozone of *I. fuscus* in the fishing seasons since 1999 until 2003 (Murillo et al. 2003).

Fishing macrozone	1999	2000	2001	2002	2003
Isabela Oeste	37.3	52.9	64.9	65.0	61.0
Fernandina	3.9		23.4	9.1	14.7
Santa Cruz	10.8	14.5	3.3		6.8
Isabela Sur	2.2	2.4	2.7	3.4	9.7
San Cristóbal	26.4	12.6	2.0		2.4
Isabela Norte y Este	6.4	7.6	2.0	18.7	5.4
Floreana	1.8	4.8	1.8	2.8	
Española	11.1	5.2	0.0	1.0	
TOTAL (%)	100	100	100	100	100
Total number of individuals harvested	4 401 657	4 946 947	2 672 345	8 301 449	5 005 574
Average landing size (live) (cm)	25.2	22.2	22.8	22.4	20.9

Table 3. Technical criteria used for the management of the sea cucumber (*Isostichopus fuscus*) fishery in the Galápagos Marine Reserve since 1999 (Altamirano et al. 2004).

Technical Criteria	Fishing Season				
	1999	2000	2001	2002	2003
Two-Month season	1	1	1	1	1
Total Allowable Catch (TAC)	1	1	1	–	1
Individual TAC	–	–	1	–	–
Fisheries Monitoring	1	1	1	1	1
Minimum Landing Size	–	–	1	1	1
Technical Criteria	Fishing Season				
	1999	2000	2001	2002	2003
Coastal Zoning	–	–	1	1	1
Closure of nursery grounds	–	–	1	1	1
Technical Criteria	Fishing Season				
	1999	2000	2001	2002	2003
Closure of islands	–	–	–	1	1
Population density evaluation	1	1	1	1	1
Catch Per Unit of Effort (CPUE)	–	–	–	–	1
TOTAL	4	4	8	7	9

3. Domestic and International Trade: From Altamirano et al. 2004

a) Information on value, retail, wholesale prices and trends: To date, sea cucumber fishery is the most lucrative fishing activity in the GMR (Murillo et al. 2003). From 1999 to 2003, a total of 25 327 972 sea cucumbers were harvested. This equals 6856.41 tonnes fresh weight whole. After processing, this species losses approximately 90% of its weight, giving approximately 671.2 tonnes dry weight.

   This fishing activity has yielded a gross income of US$14 436 589 to the local artisanal fishing sector.

   The market price per kg of individuals in brine in Galápagos was US$ 22.88 in 1999, $US 24.1 in 2000, US$ 12.32 in 2001, US$ 14.96 in 2002 and US$ 22.88 in 2003 (Murillo et al. 2003).

   According to Ecuadorian Export Statistics, Taiwan is the most important importer (73% of the total), followed by USA and Hong Kong.

b) Export volumes, values and trends; import volumes, values and trends. N/A import data.

c) Information on key sea cucumber trading countries and territories.

d) Trade controls and enforcement, including identification of specimens in trade. The calcareous ossicles (spicules) (taxonomic character for ID) remain untouched through the processing stages, thus validating the use of this tool for identifying this species in the major importing countries.

e) Information on illegal, unreported and unregulated trade: Illegal fishing activities take place all year round in the GMR, despite great effort from the Galapagos National Park Service. Most of the illegal catches are shipped to mainland Ecuador, where it is transported by land to Peru where it is exported to Hong Kong and other oriental markets.

f) Levels of domestic consumption, trends and trade: No domestic consumption in Ecuador.

NATIONAL REPORT – FIJI

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1. Background

The harvesting, processing and export of sea cucumbers dates back to 1882, which was the beginning of commercial exploitation of marine resources in Fiji waters. Since then, this fishery has fluctuated from very extreme to almost non-existent. Lately, the sea cucumber fisheries have seen an increase in exploitation due to various contributing factors, which are discussed below.

2. Information on wild populations

Table 1: A list of the commercial species of sea cucumbers in Fiji waters. Note: in the family column, H = Holothuridae, S = Stichopodidae.

Common name	Scientific name	Family	Value
White teatfish	*Microthele fuscogilva*	H	High
Black teatfish	*M. versicolor*	H	High
Prickly redfish	*Thelenota ananas*	S	High
Sandfish	*Holothuria scabra*	H	Med/high
Sandfish	*H. versicolor*	H	Med/high
Deepwater redfish	*Actinopyga echinitus*	H	Med
Stonefish	*A. lecanora*	H	Med
Surf redfish	*A. Mauritania*	H	Med
Blackfish	*A. miliaris*	H	Med
Greenfish	*Stichopus cholonotus*	S	Med
Lollyfish	*Holothuria atra*	H	Low
Elephant trunkfish	*H. fuscopunctata*	H	Low
Curryfish	*Stichopus variegatus*	S	Low
Amberfish	*Thelenota anax*	S	Low
Brown sandfish	*Bohadshia marmorata*	H	Low
Tigerfish	*B. argus*	H	Low
Leopard fish	*B. anaes*	H	Low
Pinkfish	*Holothuria edulis*	H	Low

Two non-commercial species in the wild are:

i) *Bohadschia geoffreyi* (Holothuridae)
ii) *B. graeffei* (Holothuridae)

These sea cucumbers are distributed throughout all the inshore coastal waters of the islands of Fiji, their habitats ranging from shallow sea grass beds and sandy bottoms (sandfish), deep lagoons (Blackfish), reef flats (leopardfish), backreef slopes (surf redfish) to very deep parts of the backreef (white teatfish).

However, the abundance of individual species vary greatly from one coastal water to another, due to the following factors:

a) Environmental factors – which might favour one species over another;
b) Traditional beliefs – some tribes have certain species of sea cucumbers as their totem thus protect it more than others;
c) Religious practice – some religions ban the consumption of sea cucumbers and in some cases in Fiji a whole clan (which could be one 3-4 villages) along the coast might observe this ritual;
d) Degree of isolation – if the reefs are very far from the main urban centres, than it won't be under high fishing pressure; and
e) Habitat destruction.

3. Nature of sea cucumber fisheries

Commercial harvesting is the greatest threat to this marine resource, and has a huge impact on artisanal and subsistence fisheries as well. Licensed companies not only buy from artisanal fishers, but also send out diving teams (15-30 divers/team) who use UBA to gather for sea cucumbers from deeper waters. The use of SCUBA (both scuba or hookah) is illegal for any fishing activity unless approved by "special exemption" of the minister concerned, and most diving teams have had their request denied but use UBA anyway. All stakeholders (Fisheries Dept, Police and local communities) work together in trying to eradicate this illegal activity.

Artisanal and subsistence fisheries almost always occur together but at present, it is becoming more frequent because of the presence of 'commercial traders' or agents of licensed companies. These agents are located at strategic positions amongst the coastal villages, even on isolated island that have only 2-3 villages. This factor has really accelerated the gleaning rate of sea cucumbers, and especially when the companies are willing to buy it live because it is cheaper for them, while the fishers favour it because it involves less work, no risks and quick cash.

Any Fijian can indulge in artisanal and subsistence a fishery of sea cucumbers without a licence, provided it is done within their customary fishing grounds, so practically everyone gleans. From the list of companies in table 2, one can deduce the number of agents they have and how many fishers are out there for them

Table 2: List of approved BDM exporters as of 10/02/04.

COMPANY	OPERATION STATUS
1. Gold Hold Co. Ltd	Active
2. Kung Wah Trading Co. Ltd	Active
3. Star Dragon General Trading Co.	Active
4. Golden Dove Investment Ltd	Active
5. C&J Enterprise	Active
6. Tuvu seafood (Fiji) Ltd	Active

There are 7 more approved companies who are under the 'yet to operate' status, so when they are active, the total number of companies would be 13.

The main fishing methods for sea cucumbers are:

a) Gleaning – occurs during low tide
b) Free dive – occurs in deeper waters during low and high tides
c) Bomb – a spear head partly embedded in concrete is dropped on target species at location too far down for diver to free dive
d) SCUBA – scuba or hooker is used to access depths where free diving is impossible for prolonged periods. This is illegal but is becoming more frequently employed by divers.

At present there is no sea cucumber farming by any private entrepreneur, but it is part of the Fisheries Department's ongoing trial at it's Makogai Research Station.

Apart from it's economic value, only 2 species (*Holothuria scabra* & *H. versicolor*) are frequently used as food.

4. Management and conservation

Government is concerned about the current status of the sea cucumber fisheries, thus it has taken the following steps:

a) Working in collaboration with NGOs, research institutions and concerned communities in over fished areas to set up management plans where such tools as 'Closed Areas', or 'reduction of licence issued' are employed

b) The formation of a BDM council by all companies concerned with Fisheries Department. The council is working on a set of guidelines that will protect the industry and ensure the sustainability of the sea cucumber fisheries

c) In 1984, Government approved the 'BDM exploitation guidelines' that clearly states who should harvest and process BDM, which species are banned from exporting, the size limitations for harvesting (3 inches), and which gears are banned for sea cucumber harvesting. Most of these regulations need education / awareness campaigns and tighter enforcement of the law but for size limitation, government is looking into the 'one size fits all' issue which are continually being raised by researcher and industry members.

However, one of the major hindrance to the effectiveness of the Fisheries Department's role in regards to the policing, enforcement and research of sea cucumber issues is funding.

5. Domestic and international trade

Out of all the sea cucumbers species in Fiji, only 18 are of commercial importance. Sea cucumbers processed into BDM products are traded internationally to Asian and American markets. An increase in market demand has led to the harvesting and processing of more quantities of low value species, irrespective of size limitations. The export markets have now extended to the European countries of Italy and Spain, Asian markets of Hong Kong, China, Korea, Singapore and Taiwan, American markets in the USA and Canada.

The commercial exploitation of sea cucumbers began in the 18th century; however, export volumes recorded over the last century revealed that BDM had never exceeded 50 tonnes per annum. Yet, the industry have expanded and diversified into isolated areas in the last 20 years due to improved transportation infrastructure, and harvesting effort has intensified to meet the market demand. This has led to an increase in fishing pressure at new fishing grounds and isolated reefs, increase in number of fishers and extensive use of UBA's.

Unfortunately, the production volume still remains low despite an increase in fishing effort. The production of 800,000 Kg with a value of $15m peaked in the early 1990's; however, it continually declined after that (refer table 3).

Table 3: Export weight and value of BDM

YEAR	WEIGHT (Kg)	VALUE (FJD$)
Early 1990	800,000.00	15,000,000.00
1998	369,261.50	9,785,918.00
1999	140,695.00	3,585,618.00
2000	246,001.50	6,659,532.00
2001	244,971.00	6,468,610.50

The data clearly indicates that the resource is under pressure, and if no proactive measures are enforced, than there will be a catastrophic effect on the - industry, economy, recovery period for the resource in the wild, inshore coastal marine ecosystem, employment opportunity and readily available food source in disastrous times.

NATIONAL REPORT – INDONESIA

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1. Introduction

Sea cucumbers or holothurians are sausage-shaped marine animals commonly observed on sand bottoms. They are harvested for food such as a base for soups in Asia (Allen, 1996). Sea cucumber known as *teripang* is one of alternative-valuable marine resources for local fishermen in Indonesia. Habitat distributions of sea cucumbers are widespread over the country, perhaps potentially in middle to eastern parts such as Sulawesi and Maluku. Practices of sea cucumber harvest have been running for years especially in a difficult season during extreme west and east monsoon. Sea cucumber is relatively easy to be collected by local inhabitants because its habitat is in shallow seashore water generally adjacent to villages. Collected sea cucumbers are sun dried for a few days before being sold to traders.

2. Conservation and trade

Harvesting on sea cucumbers by local people is under authority of the Ministry of Marine and Fishery, and regulated under the Act of Fishery (number 9, year 1985). There is lack of information concerning a number of sea cucumbers in trade as sea cucumbers are a non-target commodity of marine resources. The large number of fisheries still concentrate in their activities to catch fishes which is abundance over the country, besides the domestic market are not familiar to consume sea cucumbers. Neglecting to understand the biology of the species within high market demand would be endangered of the species in the near future. The cultivation of sea cucumbers that has been initiated is focused to fulfill a potential overseas-market, especially to the countries such as Hongkong and Taiwan (personal communication with a staff of the Ministry of Marine and Fishery).

Action to be designed in Year 2004-2005

- Setting a management and conservation of sea cucumbers for short, middle, and long terms.
- Identifying habitat distribution and status population of sea cucumbers in selected locations.
- Recording sea cucumbers in trade in selected landing ports.

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NATIONAL REPORT – JAMAICA, WEST INDIES

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1. Information on wild populations

a) Species

The species of the Class Holothuroidea, families Holothuroidae and Stichiopidae thought to be occurring in Jamaican waters include the following. Table 1 also provides an assessment of potential commercial use based mainly on size.

Table 1. Species of sea cucumbers known from Jamaican and adjacent waters with assessment of potential commercial importance (Adapted from Humann, 1992; Kaplan, 1982 ; Colin, 1978).

Scientific name	**Common name**	**Potential commercial use (size range or max. size, cm)**	**Non-commercial species**
Astichopus multifidus	Furry sea cucumber	* (to 45 cm) but deep (see Table 2)	
Actinopygia agassizii	Five-Toothed Sea Cucumber	* 20 – 30 cm)	
Isostichopus badionotus	Three-rowed sea cucumber	*(20 – 45 cm)	
Eostichopus amesoni	Conical Sea Cucumber	*(20 – 40 cm)	
Holothuria mexicana	Donkey Dung Sea Cucumber	* (25 - 40 cm)	
Holothuria surinamensis	Surinam sea cucumber	* (to 20 cm)	
Holothuria arenicola	Burrowing sea cucumber	*(10 - 25 cm)	
Holothuria impatiens	Slender Sea Cucumber	* (20 – 30 cm)	
Holothuria thomasi	Tiger Tail Sea Cucumber	*(90 – 180 cm)	
Holothuria glaberrima	Brown rock sea cucumber	*(10 -15 cm)	
Holothuria grisea	Grey sea cucumber	*(to 20 cm)	
Holothuria floridana	Florida sea cucumber	*(to 20 cm)	
Euapta lappa	Beaded sea cucumber	* (22 - 90 cm)	
Holothuria parvula	Golden sea cucumber		*(3.5 cm)
Pentacta pygmea	Pygmy sea cucumber		*(to 10 cm)

b) <u>Area of distribution, habitats & abundance</u>

Preliminary data of the species listed in Table 1 is summarized in Table 2 below.

Table 2. Distribution, habitat preferences and abundance of species of sea cucumbers from Jamaica (adapted from Humann, 1992; Kaplan, 1982; Colin, 1978).

SPECIES	DISTRIBUTION	HABITAT	ABUNDANCE IN JAMAICA
Astichopus multifidus	Florida, Bahamas, Caribbean, Jamaica	Deep sandy areas around reefs.	Occasional but deep
Actinopygia agassizii	Florida, Bahamas, Caribbean, Jamaica.	Sea grass beds and sandy around reefs.	Occasional
Isostichopus badionotus	Florida, Bahamas, Caribbean incl. Jamaica.	Sea grass beds, shallow reef rubble patches, sandy areas around reefs.	Common
Eostichopus amesoni	Caribbean incl. Jamaica.	Reef rubble patches and sandy areas around reefs.	Uncommon
Holothuria mexicana	Caribbean incl. Jamaica; Bahamas, not in Florida.	Sea grass beds and sandy areas around reefs.	Common
Holothuria surinamensis	Bermuda, Florida Jamaica, Antigua.	Among algal tufts, among finger-coral colonies	Common
Holothuria arenicola	Bermuda to Brazil (incl. Jamaica)	Coral debris, sand flats	Occasional
Holothuria impatiens	Florida, Bahamas, Caribbean incl. Jamaica, also circumtropical.	Under rocks, crevices in reefs, reef rubble and in open water.	Uncommon
Holothuria thomasi	Florida, Bahamas, Caribbean incl. Jamaica.	Lagoons, protected water with rubble bottoms.	Occasional
Holothuria glaberrima	Caribbean incl. Jamaica, not in Florida	On & under rocks in surf zone	Occasional
Holothuria grisea	Caribbean incl. Jamaica, Florida, not in Bermuda	Young among rock or coral debris, adults in Turtle grass	Common
Holothuria floridana	Florida, Jamaica, western Caribbean, Dutch Antilles	Near mangrove swamps, turtle grass beds	Common
Euapta lappa	South Florida, Bahamas, Caribbean incl. Jamaica	Hide under coral slabs, rubble and in recesses during the day.	Occasional
Holothuria parvula	Bermuda , Caribbean, (Jamaica?	Under rocks in reef flat, shallow water and tide pools	Unknown
Pentacta pygmea	Florida Gulf Coast, Puerto Rico, Trinidad, Brazil, (Jamaica)?	Shallow rocky bottoms, turtle grass beds	Unknown

Abundance notes

Generally, little is known of the relative abundance of the species of sea cucumbers in Jamaica's waters. What little exists is summarized in the preceding tables and is based on identification texts and personal observations during 30 years of diving and marine field trips and research in coastal waters.

Certain species may have apparently changed in their abundance. For example, the large species *Holothuria mexicana*, donkey dung sea cucumber, between 1980 and 1988 was relatively abundant around the University of the West Indies Discovery Bay Marine Laboratory precincts, which is located almost exactly in the middle of the north coastline. They were readily observed in the shallows around the lab and near the adjoining back reef lagoon. For the last few years their number is relatively few. What factor(s) might have brought about this apparent significant decline in abundance is unknown. It must, however, be mentioned that there were two major hurricanes (tropical cyclones) in 1980 and the other in 1988 which seriously impacted the reefs in the area. Combined with coral diseases, sea urchin die-offs and sea surface temperature increases over the same time, one or more or all of these factors may be related to or responsible for this change.

2. Nature of sea cumber fisheries

a) Sea cucumbers are not consumed in Jamaica and historically never were consumed by the population. Thus, there is no traditional fishery for or interest of any kind in them. There are a very few anecdotal stories of Japanese embassy staff asking for marine biology students to deliver any sea cucumbers collected to them for consumption in the late 1980's (M. Jones-Williams, pers. comm.. 2004).

b) Estimated number of fishers: None

c) Type of fishing methods and gear: None

d) Licensing/permitting: None

e) Sea cucumber farming: None

f) Preferred market(s): None, although in 1991 a small team of Chinese businessmen asked a local fishing business to organise an assessment of the sea cucumber stock in local waters. This was done, but the results are unknown. Importantly, no directed fishery for sea cucumbers was known to have developed after this survey.

g) Identification of most important uses of sea cucumbers: No sea cucumber species is caught or consumed.

h) Landing data: None are landed.

i) Conservation measures: As no sea cucumbers are landed, none is in place. If a market were to develop, the species would be protected under the new Fisheries Bill which is shortly to be introduced. This Bill replaces the older Fishing Industry Act of 1976. They would also be included under parts of the Wildlife Protection Act which is administered by the National Environmental Planning Agency (NEPA).

3. Domestic and international trade

There is no landing of seas cucumbers in Jamaica, so there is no trade. The only known interest from outside Jamaica in possibly exporting Jamaican sea cucumbers, took place in 1991. Though a small survey was done, nothing apparently came of this effort by a Chinese business enterprise.

4. Summary

It would appear that there is a great lack of detailed relevant, basic biological and ecological information on the members of the Order Holothuroidea in Jamaican waters. Even information on the identification of the species that actually occur in Jamaica is uncertain and poor at the time of writing. Data included in this present paper would represent the first known compilation. Therefore, there is considerable need for the investigation into these biological aspects, and an assessment of the status of the several species occurring, prior to any conservation measures that may be suggested and/or introduced. Any potential decisions on international trade enquiries must be based on sound recent scientific data on local species of sea cucumbers, of which there is almost none at present. The University of the West Indies, Life Sciences Department, Mona campus, is thus presently seeking funding a proposal for baseline biological research into Jamaican sea cucumber species. Such research when completed, could form the basis of preliminary conservation and management regulations for the species should they be necessary.

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NATIONAL REPORT – JAPAN

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INTRODUCTION

More than 100 species of sea cucumbers are found in Japan. Among sea cucumbers belonging to the families Holothuridae and Stichopodidae, the species mainly harvested and used commercially is *Apostichopus japonicus*. Historically, descriptions on the use of sea cucumbers in Japan are found in the writings of early 8th century. Further, since the end of the 17th century, dried sea cucumber, called "iriko", had been exported to China (then Qing dynasty), constituting Japan's major export item. At present, most of *Apostichopus japonicus* harvested in Japan are distributed in the domestic market. It is eaten raw with soy sauce and vinegar, and salted fermented products (shiokara) of digestive organs called "konowata" and dried gonad called "konoko" are cherished as delicacies and high-grade food materials.

In sea cucumber fishery in Japan, diverse resource management measures adapted to the regional situation are taken, such as regulations on fishing gear, fishing methods, fishing season and size limitation as well as larvae release. Thus sea cucumbers are used in a sustainable way. Further, as the bulk of the harvest is used for domestic consumption, it is considered that international trade in this species has little or no impact on the population. Therefore, management under the Convention for Trade in Endangered Species of Wild Fauna and Flora (CITES) is not an appropriate approach.

In order to discuss conservation and management regarding sea cucumbers, it should be emphasized that each country and the United Nations Food and Agriculture Organization (FAO) need to collect and collate on a preliminary basis the basic data such as the state of the sea cucumber resources, situation of the catch, and actual state of utilization. If each country and FAO implement fisheries management based on such basic data, it will be possible to ensure sustainable utilization of sea cucumbers in the world. Japan expects that its experience in the management of sea cucumber fisheries will contribute to the realization of sustainable utilization of sea cucumbers in the world.

1. Information on wild populations

a) Species of non-commercial and commercial sea cucumbers in your country´s waters

In Japan, many species of temperate and tropical sea cucumbers are found. Subjected to harvesting among them are *Apostichopus japonicus*, *Thelenota ananas*, *Stichopus chloronotus* belonging to Stichopidea family, and *Holothuria (Halodeima) arta*, *H.scabra* belonging to Holothuriidae family. The species harvested for commercial purpose is mostly *Apostichopus japonicus*. The list of sea cucumber found in Japan is shown in Attachment 1.

2. Nature of sea cucumber fisheries

a) Commercial, artisanal, subsistence.

Most of the fisheries targeting sea cucumbers are commercial operation targeting temperate-zone *Apostichopus japonicus*, and the catch is distributed as live products in the domestic market. In some part of Okinawa, artisanal fisheries targeting tropical sea cucumbers are practiced.

b) Estimated number of fishers

The number of people engaged in coastal fisheries in Japan is about 215,000. In many cases, sea cucumber fisheries are conducted seasonally by coastal fishermen, and the number of fishing enterprises engaging in sea cucumber fisheries is estimated to be at least over 10,000. Therefore the number of fishers engaging in this fishery is estimated at several tens of thousand.

c) Type of fishing methods and gear equipment used

Sea cucumbers are harvested mainly by trawling using small-size engine-powered fishing vessels (sea cucumber dredge net fisheries) and fisheries using diving equipment. It is also harvested by diving, spear and ring nets.

d) Licensing/permitting requirements

In order to promote protection of breeding habitat and rational utilization of sea cucumbers, the Japanese government is adopting fishery license and fishery right systems, as in the following, based on fisheries-related laws. Any person engaging in violation relating to the fisheries license and fishery rights is subjected, as juridical penalties, to imprisonment and/or fines and other administrative proceedings.

Fisheries license: The government is placing the types of fisheries having high-level capability to harvest sea cucumbers (e.g. bottom trawl fisheries) under the license system in all areas of Japan. Further, prefecture governors are placing under the license system the fisheries capable of harvesting sea cucumbers exceeding certain quantities (bottom trawl fisheries using small-size engine-powered fishing vessels (sea cucumber dredge net fisheries) and fisheries using diving equipment).

Fishery right: Besides the fisheries license, the prefecture governors confer, based of the fisheries-related laws, the responsibility to conserve resources to fishermen's groups utilizing and depending on sea cucumber resources historically and socio-economically, by granting them the right to harvest sea cucumbers exclusively in certain areas of sea. Prefecture governors implement protection of sea cucumber resources by establishing limitations and conditions to the fishery right in case fishermen's groups do not take appropriate resource conservation measures for sea cucumbers.

e) Sea cucumber farming, if any

No aquaculture of sea cucumbers is carried out, but farming of *Apostichopus japonicus* is widely practiced. Full-scale development of artificial larvae production technology has been promoted since 1977, and in 2001, a total of 1,877,000 artificial larvae were produced at 10 larvae production centers in Japan. Also, natural larvae harvesting has been conducted to collect juvenile sea cucumbers attached to oyster shells, etc. in the natural sea environment. The number of larvae released for both types of culture in 2001 was 3,648,000.

f) Preferred markets (live vs. dried)

g) Identification of the most important uses of sea cucumbers

At present, most of *Apostichopus japonicus* harvested in Japan are distributed as live products in the domestic market, and are consumed raw with soy sauce and vinegar. Salted fermented products of digestive organs called "konowata" and dried gonads called "konoko" are cherised as delicacies and high-grade food materials. Some sea cucumbers are processed into dried products and are exported.

h) Landing data (species, bycatch, kg, sizes, etc), if available

The catch volume in 2001 was 7,229 tons, worth about 4.1 billion yen, all of them being *Apostichopus japonicus*. *Apostichopus japonicus* is harvested by fisheries mainly targeting this species, and there is little or no bycatch by other fisheries nor are there bycatches of other species of sea cucumbers.

i) Conservation measures (minimum harvesting size, closed areas, closed seasons, etc)

Regarding conservation and management of sea cucumber fisheries, sustainable utilization is ensured with detailed region-to-region regulations, including obligatory and voluntary measures. Major conservation and management measures include the establishment of closed seasons (protection during the spawning seasons), limitations on the number of licensed fishing vessels, vessel tonnage, fishing gear, fishing seasons, fishing hours, fishing areas, size and weight, and catch volume and value. As an example, a specific case of conservation and management measures implemented in Hokkaido, the most producing prefecture, is presented in Attachment 2.

Further, in addition to management measures, improvement of fishing ground, which serve as resting habitat and reproduction area of sea cucumber, by accumulating rocks and establishing reefs for sea cucumber in order to ensure increase of the population.

3. Domestic and International Trade

a) Information on value, retail, wholesale prices and trends

The prices of fresh *Apostichopus japonicus* distributed in Japan differ from season to season. (Prices are highest in the New Year season when demand is high.) The average wholesale price per kilogram is about 500 yen, with retail prices standing at 1,500 yen to 5,000 yen. "Konowata"(salted fermented products of digestive organs), which is a delicacy fetches 2,500 yen per 80g container, and "konoko" (dried gonad) is about 4,000 yen per 20g.

b) Export volumes, values and trends; import volumes, values and trends

The only sea cucumber product being exported is dried sea cucumber, and a small amount of frozen and salted dried products are imported.

Exports: There is no export statistic item of dried sea cucumber in Japan, and the products are included in the category of "Other mollusk and aquatic non-vertebrate animals." Exports in 2002 were about 90 tons, with export value of about 1.7 billion yen, of which a substantial part is taken by dried sea cucumbers.

Imports: A total of 270kg of frozen products worth 800,000 yen, and 1.2 tons of salted dried products worth 4 million yen were imported in the same year.

c) Information on key sea cucumber trading countries and territories

Dried sea cucumbers from Japan are being exported to China, Hong Kong, and Taiwan.

d) Trade controls and enforcement, including identification of specimens in trade

Effective from January 2004, "dried sea cucumber" was added to Japan's export statistic item, and exports volume came to be accurately grasped by the customs office. However, accurate species-to-species identification is not possible even by experts. Unless species-to-species trade enforcement method is established, it would not be possible to control trade properly.

e) Information on illegal, unreported and unregulated trade: None

f) Levels of domestic consumption, trends and trade

At present, a dominant portion of *Apostichopus japonicus* harvested in Japan are distributed in Japan as live products, and consumed raw with soy sauce and vinegar. Salted fermented products of digestive tube called "konowata" and dried gonads called "konoko" are cherished as delicacies and high-grade food materials

Sea cucumbers belonging to the families Stichopodidae and Holothuriidae found in Japan

Family Stichopodidae

Apostichopus japonicus (Liao, 1980):
Commonly sighted in various parts of Japan (from Hokkaido to Kyushu). Found in the boulder stone zone in the shallow sea area. It is an important edible species. "Iriko"(dried sea cucumber) is used in the Chinese cuisine, and salted fermented products of internal organs is cherished as "konowata".

Thelenota anax (H.L.Clark, 1912):
Distributed in Japan (shallow sea south of Okinawa), Madagascar, Australia, New Caledonia, Guam, and China.

Parastichopus nigripunctatus (Augstin, 1908):
Japan (found at the sea depth of 20-600m from Hokkaido to Kyushu)

P. multidentis (Imaoka, 1991):
Japan (East China Sea (136m), off Koshiki island (330-380m))

Thelenota ananas (Jager, 1833):
Japan (found on the coral sand filter in the shallow sea of south of the main Okinawa Island), Australia, Fiji, New Caledonia, Indonesia, Guam, China, and Taiwan. Dried products of this species are called "gajimaru" in Okinawa, and "bai-ka-san" in China. They are both high-graded products.

Stichopus chloronotus (Brandt, 1835):
Japan (found in the reef zone in the shallow sea south of the Amami Oshima Islands). Distributed extensively from the Indian Ocean to western Pacific (New Caledonia, Australia, Guam, the Philippines, Hawaii, and China).

Stichopus ohshimae (Mitsukuri, 1912):
Japan (found in reef zone of the shallow sea south of Izu Peninsula).

Stichopus horrens (Selenka, 1867):
Japan (Kakeroma Island in the Amami Oshima Islands), Maldive, Australia, New Caledonia, New Guinnea, the Philippines, Guam, Hawaii, China, and Taiwan.

Stichopus pseudhorrens (Cherbonnier, 1967):
Japan (Kurosaki in Amami Oshima Islands, Okinawa), and New Caledonia.

Stichopus hermanni (Semper, 1868):
Japan (found in the sandy area of the reef area, south of Okinawa), Australia, the Philippines, and Sumatra.

Stichopus variegatus (Semper, 1868):
Japan (Okinawa), Red Sea, Australia, New Caledonia, Indonesia, the Philippines, Palau, China, and Taiwan.

Sea cucumbers belonging to the families Stichopodidae and Holothuriidae found in Japan

Family Holothuriidae

Actinopyga lecanora (Jager, 1833):
Southeastern Asia south of Japan (Okinawa, Ogasawara Islands), South Pacific.

A. miliaris (Quoy et Gaimard, 1833):
Japan (south of Amami Oshima Islands, Ogasawara Islands)

Bohadschina marmorata (Jager, 1833):
Southeast Asia south of Japan (coral reefs in the shallow sea south of Okinawa), and South Pacific.

Holothuria (Platyperona) macteari (Bell, 1884):
Southeastern Asia south of Japan (Okinawa, Ogasawara Islands), and South Pacific

H. (Lessonothuria) isuga (Mitsukuri, 1912):
Southeast Asia south of Japan (Chinenzaki on the main Okinawa Island), and South Pacific.

Actinopyga mauritiana (Quoy et Gaimard, 1833):
Japan (Ogasawara Islands, reef zone south of Amami Oshima Islands), Fiji, New Caledonia, Samoa, Tahiti, Australia, Guam, China, and Taiwan.

Actinopyga echinites (Jager, 1833):
Japan (found in sand filter zone at the sea depth of 0-30m in Okinawa), Sri Lanka, Celebes, Fiji, Australia, New Caledonia, China, and Taiwan.

Actinopyga sp.:
Japan (Kahi Island and Kuroshima Island in the Okinawa Islands; found in the coral sand filter zone in the shallow sea).

Bohadschia graeffei (Semper, 1876):
Japan (found in the sand filter and reef zones at the sea depth of 5-20m in southern Okinawa), Red Sea, Maldive, Australia, New Caledonia, Indonesia, the Philippines, Guam, Papua New Guinnea, China, and Taiwan.

Bohadschia vitiensis (Semper, 1867):
Japan (found in the sandy zone of shallow sea south of Amami Oshima Islands), New Caledonia, Fiji, Samoa, and Java.

Bohadschia bivittata (Mitsukuri, 1912):
Japan (found in the shallow sea of Okinawa)

Bohadschia argus (Jager, 1833)
Japan (found in the shallow sea of Amami Oshima Islands), Sri Lanka, Timor, Celebes, Fiji, Samoa, Tahiti, the Philippines, New Caledonia, Guam, Indonesia, Malaysia, Australia, China, and Taiwan.

Bohadschia sp.:
Japan (found in the coral sand filter zone in Kuroshima in Okinawa Islands).

Holothuria (Selenkothuria) moebii (Ludwig, 1883):
Japan (found in the sand filter on the beaches from Boso Peninsula to Okinawa), China, and Taiwan.

Holothuria (Semperothuria) cinerascens (Brandt, 1835):
Japan (southern Kii Peninsula, Makurazaki, Okinawa, Ogasawara Islands. Found in the dent of rocks near low-tide zone).

H. (Halodeima) edulis (Lesson, 1830):
Japan (found in the shallow sea south of Amami Oshima Islands), Red Sea, Sri Lanka, Timor, New Caledonia, Guam, Celebes, Fiji, Tahiti, Hawaii, and China.

H. (Platyperona) difficilis (Semper, 1868):
Japan (Kushimoto, Amami Oshima Islands, Ogasawara Islands. Small individuals are found in the tide pools and under rolling rocks in the low-tide area while large individuals are found in the boulder stone zone at the sea depth of several meters), Samoa, Australia, Guam, China, and Taiwan.

Sea cucumbers belonging to the families Stichopodidae and Holothuriidae found in Japan

H. (Thymiosycia) hilla (Lesson, 1830):
Japan (found in reef zone in Okinawa Islands), Red Sea, Australia, New Caledonia, Guam, Hawaii, Panama, China, and Taiwan
H. (Thymiosycia) arenicola (Semper, 1868):
Japan (coral sand filter zones in Okinawa Islands), Australia, Guam, the Philippines, China, and Taiwan.
H. (Thymiosycia) impatiens (Forskal, 1775):
Japan (Kuroshima in the Okinawa Islands. Found from reef to sand filter zones in the shallow sea.), the Mediterranean Sea, Red Sea, Sri Lanka, Timor, the Philippines, Australia, Samoa, Tonga, Tahiti, New Caledonia, Guam, Hawaii, Panama, Florida, China, and Taiwan
Holothuria (Thymiosycia) decorata (von Marenzeller, 1882):
Japan (Miura Misaki, Kominato, Shirahama, Awaji Island, Iki Island, Bungo, Kochi. Found at the sea depth of 0-200m. In the shallow water, found in the sand filter zone). Host to pearl fish.
H. (Halodeima) arta (Jager, 1833):
Japan (found reef zone south of Tokara Archipelago), Red Sea, Sri Lanka, Timor, New Caledonia, Guam, Celebes, the Philippines, Australia, Tonga, Tahiti, Samoa, Hawaii, Florida, Jamaica, China, and Taiwan. Large individuals of over 50cm are found in the tropical region. "Iriko" is produced.
H. (Mertensiothuria) leucospirota (Brandt, 1835):
Japan (south of Izu Peninsula; reef zone of the shallow sea), Sri Lanka, Australia, Fiji, the Philippines, Samoa, Tahiti, New Caledonia, Guam, Hawaii, China, and Taiwan. Poisonous with Cuvierian tubles.
H. (Mertensiothuria) pervicax (Selenka, 1967):
Japan (south of Miura Peninsula; found in the reef and boulder stone zones in the shallow sea), Red Sea, the Philippines, Australia, Samoa, New Caledonia, Guam, China, and Taiwan
H. (Mertensiothuria) fuscocinera (Jager, 1833):
Japan (Kuroshima of the Okinawa Islands; found in the sandy zone of coral reef or in sand filters), New Caledonia, Australia, China, and Taiwan
H. (Mertensiothuria) sp.:
Japan (Taira Bay of the main Okinawa Island; found in the sand of reef)
H. (Lessonothuria) pardalis (Selenka, 1867) :
Japan (South of Izu Peninsula; somewhat buried in the sand filter under the boulder stones around low-tide zone, or found among boulder stones), Red Sea, Sri Lanka, Samoa, Australia, the Philippines, New Caledonia, Guam, Hawaii, China, and Taiwan
H. (Metriatyla) scabra (Jager, 1833)Japan (south of Amami Oshima Islands; found in coral sand in the shallow sea), India, Solomon Islands, Indonesia, Red Sea, Sri Lanka, Singapore, Celebes, the Philippines, Fiji, New Caledonia, and China.
H. (Microthele) nobilis (Selenka, 1867) : Distributed in Japan (found in the coral sand filter in the shallow sea of Okinawa Islands), New Caledonia, Australia, Guam, China, and Taiwan.

Management measures for sea cucumber fishery in Hokkaido

Contents of regulations	Regulations, etc.
# License system for fisheries - trawl fishery using small-type engine-powered boats (sea cucumber dredge net) - Diving fishery	Hokkaido marine fisheries adjustment regulation Article 5 *All require approval for implementation based on fishery right
# Establishment of closed season (protection of spawning season) - May 1-June 15--Offshore area of Ishikari, Shiribeshi, Abashiri, Soya and Rumoi Districts - June 21-August 20--Offshore area of Hiyama, Watarijima and Iburi Districts - July11-September 20--Offshore area of Hidaka, Tokachi, Kushiro and Nemuro Districts	Hokkaido marine fishery adjustment regulation Article 39
(i) Limitation on the number of license and the number of operating vessels [entire Hokkaido]	Regulation on the exercise of fishery right
(ii) Limitation on tonnage of fishing vessels used - Hamamasu: less than 5 tons; Atsuta: less than 10 tons [Ishikari] - Rausu: less than 5 tons; Notsuke, Betsuumi, mid part of Nemuro Bay, Nemuro, Habomai, Ochiisi: less than 10 tons; Shibetsu: less than 15 tons [Nemuro]	Regulation on the exercise of fishery right
- Oumu: outboard motor; Monbetsu: spoon net: less than 3 tons; Saruru, Monbetsu: diving equipment; Shari, Utoro: less than 5 tons; Yuubetsu: less than 10 tons; Oumu, Saroma, Tokoro: less than 15 tons [Abashiri]	voluntary regulation
- Esashi: less than 7 tons [Soya]	Regulation on the exercise of fishery right
(iii) Limitation on fishing gear used # Limitation on fishing methods, etc. - dredge net, Rausu diving equipment, Notsuke spoon net fishery [Nemuro]	Regulation on the exercise of fishery right
- dredge net, spoon net or diving equipment, gaff or diving equipment [Abashiri] - dredge net: up to 2; Tomamai-Haboro: gaff 2-3; Yagishiri: spoon net: up to 2 [Rumoi]	voluntary regulation
# Limitation on the scale of fishing gear - Length of nets: up to 280cm [Ishikari]	Regulation on the exercise of fishery right
- Sawara-Otoshibe: dredge net mesh size: 75mm or larger [Watarijima]	voluntary regulation
- dredge net mesh size: 45.45-75mm; dredge length: 3.18m-4m [Abashiri]	
(iv)Limitation on fishing season - Yoichi: July 16-March 30; voluntary halt of operation [Shiribeshi]	
- Esashi, Kaminokuni area: December, January: harvesting prohibited Otobe area: November, December: harvesting prohibited Taisei(Kaitorima) area: November 21-April 9: harvesting prohibited Sedana area: January-March: harvesting prohibited [Hiyama]	voluntary regulation
- Operation season: Yakumo: November 1-March 31 [Watarijima]	voluntary regulation

(i) Limitation on the number of license and the number of operating vessels [entire Hokkaido]	Regulation on the exercise of fishery right
(ii) Limitation on tonnage of fishing vessels used	Regulation on the exercise of fishery right
- Hamamasu: less than 5 tons; Atsuta: less than 10 tons [Ishikari]	
- Rausu: less than 5 tons; Notsuke, Betsuumi, mid part of Nemuro Bay, Nemuro, Habomai, Ochiisi: less than 10 tons; Shibetsu: less than 15 tons [Nemuro]	
- Oumu: outboard motor; Monbetsu: spoon net: less than 3 tons; Saruru, Monbetsu: diving equipment; Shari, Utoro: less than 5 tons; Yuubetsu: less than 10 tons; Oumu, Saroma, Tokoro: less than 15 tons [Abashiri]	voluntary regulation
- Esashi: less than 7 tons [Soya]	Regulation on the exercise of fishery right
(iii) Limitation on fishing gear used	
# Limitation on fishing methods, etc.	
- dredge net, Rausu diving equipment, Notsuke spoon net fishery [Nemuro]	Regulation on the exercise of fishery right
- dredge net, spoon net or diving equipment, gaff or diving equipment [Abashiri]	
- dredge net: up to 2; Tomamai-Haboro: gaff 2-3; Yagishiri: spoon net: up to 2 [Rumoi]	voluntary regulation
# Limitation on the scale of fishing gear	Regulation on the exercise of fishery right
- Length of nets: up to 280cm [Ishikari]	
- Sawara-Otoshibe: dredge net mesh size: 75mm or larger [Watarijima]	voluntary regulation
- dredge net mesh size: 45.45-75mm; dredge length: 3.18m-4m [Abashiri]	
(iv)Limitation on fishing season	
- Yoichi: July 16-March 30; voluntary halt of operation [Shiribeshi]	
- Esashi, Kaminokuni area: December, January: harvesting prohibited Otobe area: November, December: harvesting prohibited Taisei(Kaitorima) area: November 21-April 9: harvesting prohibited Sedana area: January-March: harvesting prohibited [Hiyama]	voluntary regulation
- Operation season: Yakumo: November 1-March 31 [Watarijima]	voluntary regulation
- January-May, July-December; voluntary halt of operation [Hidaka]	
- Period for use of dredge net: Wakkanai: March 10-April 30, June 16-September 20; Tombetsu: June 16-August 31; Rirei area: August 1-September 30, Funadomari: November 20-March 31; Kabuka: November 1-April 30 [Soya]	Regulation on the exercise of fishery right voluntary regulation
- Fishing season: Shosanbetsu: July-October; Haboro, Teuri, Yagishiri, Tomamae: July-August; Onishika: July 1-August 15 [Rumoi]	voluntary regulation
(v) Limitation on operating hours	
- Yakumo: 6:30-noon [Watarijima]	
- Soya: until 4: 00 p.m.; Esashi-Wakkanai: return to port by 3: 00 p.m. [Soya]	
- Rumoi: no operation every Saturday, operation hour: 9-17 [Rumoi]	voluntary regulation
(vi) Limitation on operation area	
- Suttsu: 10 fathoms or shallower: Harvesting prohibited	

NATIONAL REPORT – MEXICO

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1. Information on wild populations

a) Species of non-commercial and commercial sea cucumbers in your country´s waters

In México, *Isostichopus fuscus* is the main target of holothurian fishery in the Gulf of California since the late 80's. Another sea cucumber, *Parastichopus parvimensis* is also exploited in the west coast of the Peninsula of Baja California.

b) Area of distribution, and habitats if known.

Isostichopus fuscus is distributed in shallow waters (0.5 to 40 m depth) from the northern Gulf of California (30 °N) to Ecuador and the Galápagos Islands, with a Panamic distribution. This holothurian is found in rocky bottoms and associated to corals, mostly *Pocillopora* and *Porites* spp.

c) Abundance.

The abundances of this holothurian range from 0.3 to 0.7 ind/m^2 in the Gulf of California and in the Mexican Pacific from 0.25 to 0.40 ind/m^2

2. Nature of sea cucumber fisheries

a) Commercial, artisanal, subsistence.

Isostichopus fuscus is exploited by artisanal fishery, and all the production is exported.

b) Estimated number of fishers

There are currently 8 UMA's (management units for wild life conservation), which are the only way to extract the resource. Each UMA works with 3-6 motorized boats (21 feet long). Each boat is operated by the driver and one or two divers. There can not be more than two divers per boat.

c) Type of fishing methods and gear equipment used

Fishermen use Hookas, (air compressor) and basic dive equipment for the extraction of Isostichopus fuscus, which are collected by hand and using a net for carrying them to the boat.

d) Licensing and permitting requirements

To date, in Mexico, permits for extraction are denominated UMA (management units for wild life conservation), on which a management plan is developed for a designated area. After an assessment of the potential populations, a rational extraction rate is assigned by the authorities (SEMARNAT, Environment and natural resources secretariat). The license holders must present periodic reports on the activities that enable to control the appropriate use of the resource. The management plan for this fishery establishes catch quotas in number of individuals per season rather than weight quotas.

e) Sea cucumber farming

There have been several attempts to develop larvae in controlled conditions in the lab, unfortunately they have not been successful, although we have described the first stages of embryonic development (two cells to early gastrula).

f) Preferred markets (live vs dried)

All the production is exported to USA and then re-exported to Asian countries. The product is exported dried after being boiled for two hours approximately for food and traditional medicine

g) Identification of the most important uses of sea cucumbers.

In Mexico holothurian fishery is not a traditional activity and *Isostichopus fuscus* is not consumed in the country. However in Ecuador, this sea cucumber is used locally as medicine for respiratory problems, and pain killers.

h) Landing data (species, bycatch, kg, sizes, etc)

There are two species for export: *Isostichopus fuscus* and *Parastichopus parvimensis*.

In 1991, *I. fuscus* catch reached its maximum peak (about 2,000 metric tones), and then diminished drastically to 395 mt in 1993 (Table 1). Because of this, the Mexican government banned the fishery in1994 and the holothurian was considered as an endangered species. This drastic solution had no scientific background, and in the year 2000 its *status* changed to a protected species and special permits were emitted. This permits changed in 2002 to UMA's, because populations are recovering (at least in the Gulf of California) to allow rational levels of exploitation. *I. fuscus* is a large holothurian and they are generally fished between 350 and 450 g and 19 and 25 cm. Since length is highly variable, weight is used to delimit minimum harvesting size, which is 400 g for this species in the Gulf of California.

On the other hand, *Parastichopus parvimensis* has been exploited since the early 1990's, in the west coast of the Peninsula of Baja California reaching its maximum peak in 1995 (about 600 mt). Despite the fact that this sea cucumber was exploited with the same intensity as *I. fuscus*, its populations have remained stable until the last couple of years, when it is beginning to decline. This situation could be controlled by the establishment of a management plan, including reproductive bans, which currently is the catch season for this species. There are no regulations for this fishery at all.

i) Conservation measures (minimum harvesting size, closed areas, closed season, etc)

Isostichopus fuscus is currently considered under special protection in Mexican legislation (NOM-059—ECOL-2001), but is still extracted on the UMA's frame. There is a reproductive ban during summer (July to September), a minimum harvesting size of 400 g, a limited quota in number of individuals. As a precautionary measure, areas where the smallest specimens were found were closed for extraction, these areas are characterized by small reefs of *Pocillopora* and *Porites* spp and sometimes associated with algae. Ecuador also exploits *I. fuscus* and they have already included this holothurian in CITES appendix III.

Table 1. Commercial catch of *Isostichopus fuscus* in Baja California, Mexico.

Año	Golfo de California (*I. fuscus*)	Pacífico Occidental (*P. parvimensis*)
1989	336	-----
1990	623	169
1991	1767	339
1992	646	469
1993	395	294
1994	419	519
1995	219	421
1996	58	530
1997	129	371
1998	24	247
1999	36	175
2000	43	358
2001	120	286
2002	20	59

3. Domestic and International trade

a) Information on value, retail, wholesale prices and trends.

In the early 1990's sea cucumbers were sold either fresh, boiled or dried. Fresh holothurians were sold at USD $ 0.65 per kg, boiled (two hours) at USD $30.00 per kg and the dried product was the most expensive, at USD $60.00 per kg. To this date, the product is sold almost entirely boiled at around USD $12.00 per kg. All the production is exported to USA, and then re-exported to Asian countries.

b) Export and import volumes, values and trends

As it was mentioned, all the production was and is still exported to foreign countries, but there are no official data. Mexico does not import sea cucumbers.

c) Information on key sea cucumber trading countries and territories

All the production is exported to USA and then re-exported to Asian countries, mostly Japan, Hong Kong and Korea. The product is exported dried after being boiled for two hours approximately.

d) Trade controls and enforcement, including identification of specimens in trade.

Authorities emitting export permits (DGVS wild life general administration, SEMARNAT) corroborate that the catch was legal and under the UMA's frame and they register all information regarding catch and exports.

There are no ID manuals to help identify the exportation product, both species are traded as sea cucumber.

e) Information on illegal, unreported and unregulated trade

Illegal fishery has existed previous to the emission of permits for *Isostichopus fuscus*. This activity continues to date, this information is presented in Table 2

f) Levels of domestic consumption, trends and trade.

Holothurian fishery is not a traditional activity and all production is exported; there is recent evidence that some of the product from the UMA's is being sold locally to restaurants, at an unknown price.

NATIONAL REPORT – MALAYSIA

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Introduction

Sea cucumber in Malaysia is known with various terminology for example gamat, balat and timun laut. On the west coast of Peninsular Malaysia, the term gamat is used to refer to a specific species of sea cucumber which is the *Stichopus horrens*. In Malaysia sea cucumber is used in many ways, the Malays used it in traditional medicine and the Chinese exploit it as delicacies. Sea cucumber was accepted to be highly beneficial in pharmaceutical industries and studies being done on the chemical components of the sea cucumber especially the *Stichopus horrens*. Extraction of the pharmaceutical substances was done from various types of sea cucumbers found. Samples used were collected from similar morphological body type and from the same area as the species utilized by the traditional collectors (Figure 1a,b and c).

Collection is still done in Pulau Langkawi as a part time activity for personal consumption during low tides without using special apparatus in the shallow intertidal reef flats (Baine and Choo, 1999). The sea cucumber is collected from under dead corals, and rocks by turning it over while wading. The collectors may catch up from several individuals to a few hundreds normally small fresh sea cucumbers. Collection from wild is the main and only source of sea cucumber for the industry in Malaysia. Aquaculture, mainly raising wild stock to marketable size has been tried in some part of Malaysia for example in Sabah and Pulau Pangkor (Yusnizar *et al*. 1995). Production of sea cucumber has yet to be tried and succeed in Malaysia.

The main problem faced by the industry is over exploitation, which led to resource depletion. In other part of the world, over exploitation was the major problem followed by destruction of natural area by pollution from the development (Erdman, 1995; Kelso, 1996).

Research and Biodiversity

Research on sea cucumber in Malaysia was carried out mainly by Department of Fisheries and the local universities. Past reports focuses on species density and usage. A short study was carried out by the Fisheries Research Institute on the possibility of translocation of *Stichopus horrens* from Pulau Pangkor to Pulau Singa of Langkawi (Pers. comm.). The study proved successful in techniques utilized for transporting the sea cucumber. A study was also carried out on the density of *Acaudina* sp. in the waters of Penang Island and found a high density area of this species on muddy coastal sea bed of southern Penang (Zaidnuddin, 2001).

Identification of the sea cucumber species is challenging, as there were lack of scientific guide for most of the sea cucumber (Forbes & Zaidnuddin, 1999). Identification was done from physical body appearance but problem arises as in certain area the same species may have body taxonomy that is slightly different. A number of *Stichopus* sp. found around Malaysian waters were still unidentified to species level but most have been used for food or medicine (Siti Zaama *et al*. 1999). On the West Coast of Peninsular Malaysia sea cucumbers (*S. horrens*) were collected for traditional medicine and food from Port Dickson, Pulau Sembilan and Pulauangkor. However in Pulau Langkawi, even though known as one of the producers of sea cucumber medicine,natural stock of sea cucumber has diminished. Here the sea cucumber supply was imported from other places.

Figure 1a: *Stichopus* sp. at Mersing Johor Marine Park.

Figure 1b: The red variant of *Stichopus horrens* at Pulau Payar Marine Park

Figure 1c: Sea cucumber wholesaler

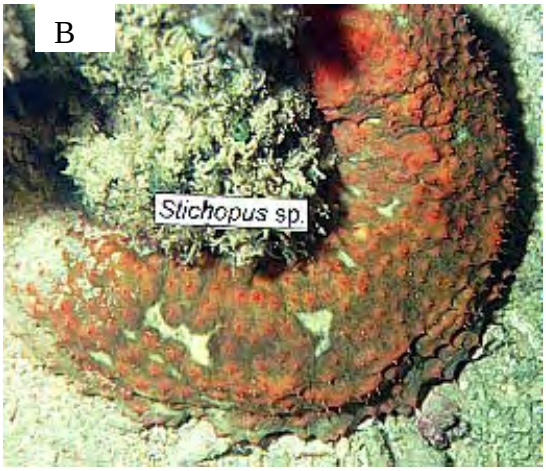

Figure 2: Peninsular Malaysia and Sabah surveyed sites

In the year 1999 a conference on "Conservation of sea cucumbers in Malaysia, their Taxonomy, Ecology and Trade" was held at the Department of Fisheries Malaysia to present a comprehensive summary of the research undertook by the Heriot-Watt University and the Fisheries Research Institute of Malaysia as part of the Darwin Initiative for the Survival of Species. It also provided an opportunity for other Malaysian Universities and fisheries managers to present their results of research projects. It was emphasized that the problems facing the industry in Malaysia are common to many countries exploiting sea cucumbers (Baine & Choo, 1999). Through the workshop much progress has been achieved in the three years project promoting a better understanding of the taxonomy, ecology, fishery and trade of holothurians in Malaysia. Information on the Malaysian sea cucumber has started to increased through compilation of the research work done by local and foreign expert.

The Department of Fisheries Malaysia in collaboration with the University of Heriot-Watt has carried out sea cucumber surveys at Marine Park islands, Sabah and non-marine park islands (Figure 2). From these survey, distribution of major species was identified. Other studies for example seasonal density variation and gonadal index were also carried out by other DOF researchers. Seasonal variation of selected species was studied at two places which were at Pulau Payar and Pulau Tioman. The result shows the fluctuation of the number of sea cucumber recorded along a permanent transect at Pulau Payar in 1998 (Figure 3). Spawning behaviour of *Stichopus chloronotus* was determine using gonad index method showing the spawning behaviour of the species (Figure 4)

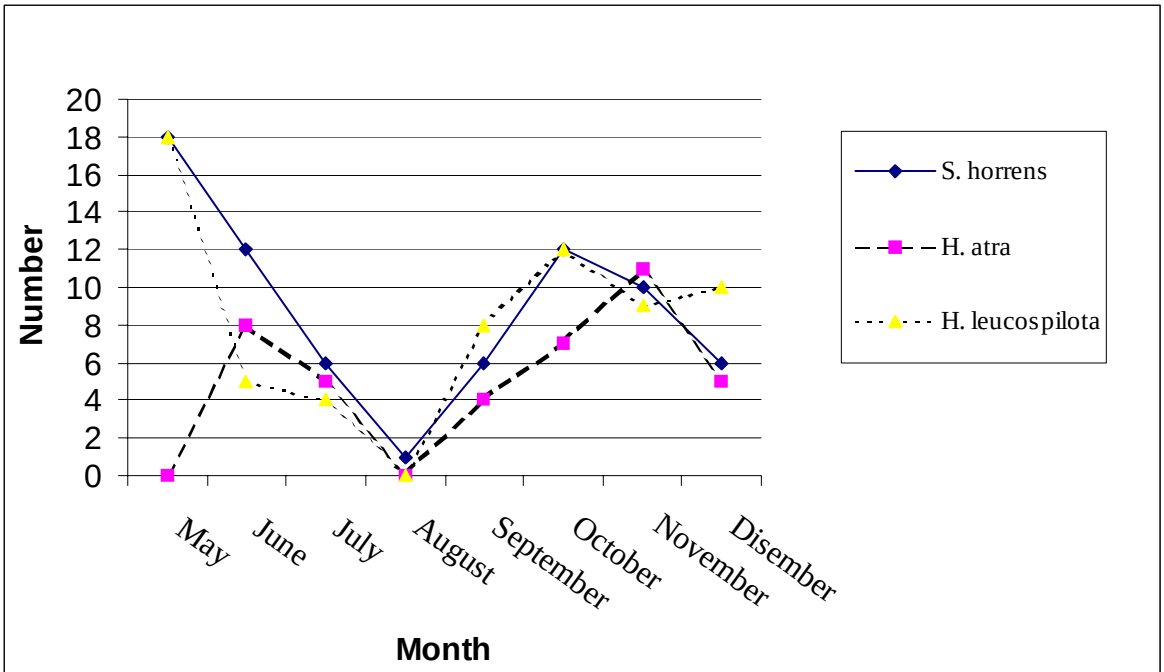

Figure 3: Total number of selected species of Sea cucumber along a permanent transect at Pulau Payar in 1998

Major progress has been made on the taxonomy and ecology of sea cucumbers in Malaysia. At the end of the 1999 sea cucumber project, some 37 species have been identified, and a few others still remain to be described as they appear to be new species to science (Table 1)(Forbes *et al.*, 1999). Underwater photographs of the sea cucumbers and their characteristic habitats have also been compiled. The importance of the sea cucumber has been overlook for sometimes with the evidence that it has not yet comprehensively describe eventhough sea cucumber has many large and conspicuous species living in shallow waters.

To enhance research and management activities of marine organisms and protecting it, the Department of Fisheries has set up a research center for conservation of marine ecosystem named TUMEC, Turtle and Marine Ecosystem Center in the state of Terengganu. TUMEC functions as a center for marine biodiversity and conservation. The center was given the task to help the department in conservation and protection of endangered species.

3. Domestic and international trade

Worldwide trends in fisheries and trade indicate that the number of countries producing beche-de-mer has recently increased, both in tropical and temperate regions (Conand, 1999). Nevertheless the records for many countries are incomplete and in some case inaccurate (Baine and Choo, 1999). The situation in Malaysia appears to be particularly difficult, the country being simultaneously an importer, consumer, producer and exporter (Baine and Choo, 1999). Nevertheless data is collected by the Department of Fisheries and produced in the annual fisheries statistic. Recent data shows that the import of sea cucumber for Malaysia exceeded the export quantity (Figure 5). It will be important to collect and standardize the statistics at the different levels of the "holothurian system". It is also vital to emphasize the importance of correct processing methods, to discourage

Table 1: The sea cucumber species list (Forbes et al. 1999)

SPECIES	
Stichopus chloronotus	*Colochirus robustus*
S. horrens	*Neothynodium violaceus*
S. variegatus	*Cucumaria* sp.
S. noctivagus	*Euapta godeffroyi*
S. pseudohorrens	*Synapta maculata*
Stichopus hermanni	*Synaptula media*
Stichopus vastus	*S. lamperti*
Thelenota ananas	*Synaptidae sp.indet*
T. anax	*Actinopyga echinites*
Holothuria coluber	*A. leconora*
H. atra	*A. miliaris*
H. edulis	*A. obesa*
H. pardalis	*Bohadschia argus*
H. verrucosa	*B. graeffei*
H. leucospilota	*B. marmorata*
H. parvicax	*B. paradoxa*
H. scabra	
H. nobilis	
H. fuscopuntata	
H. fuscogilva	
H. hilla	
H. impatiens	

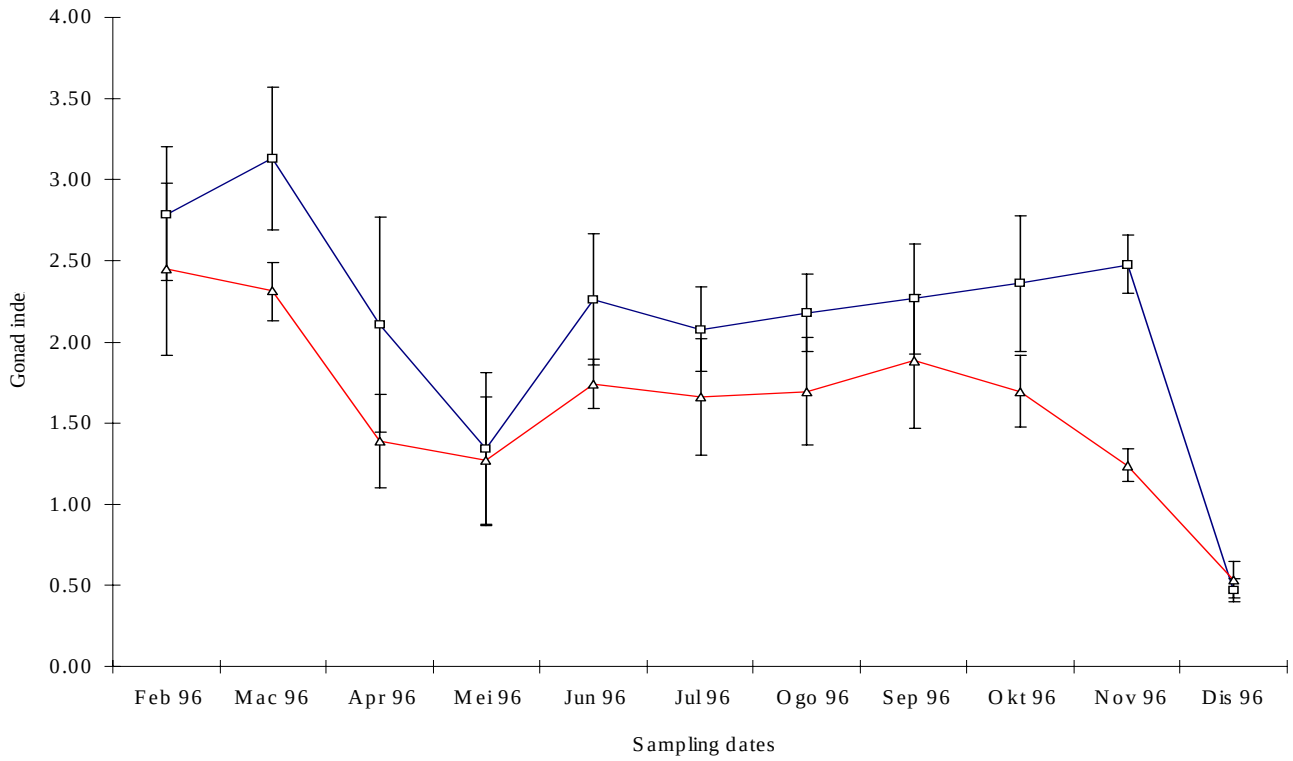

Figure 4: Gonad index of *Stichopus chloronotus* at Pulau Payar in 1996

wastage and improve the profitability of the declining catches. The recent conflicts appearing within or between, several countries in the region might be interpreted as further signs of overexploitation of the resource, and of a high level of demand.

Examination of the total import and export of sea cucumber from Malaysia shows that the import of sea cucumber into Malaysia was always high between 172.53 tonnes to 958.85 tonnes (DOF Statistic 1986-2001). Nevertheless there are no proves showing the increase in sea cucumber production either from natural harvesting or aquaculture. Further analysis of the data also shows that the import of sea cucumber is declining but the export shows an increasing pattern. The export of sea cucumber was low, in 1993 through 1997 less than 25 tonnes of sea cucumber exported. The import of sea cucumber was high with an average of 565.69 tonnes between 1996 and 2001.

In the year 2001, sea cucumber was imported from various countries mainly Hong Kong (100.2 tonnes), Japan (151.26 tonnes), Korea, Singapore, Taiwan and Thailand (DOF, 2001)(Figure 6). This gave Malaysia a total expenditure of RM 4.9 million from a total import of 403.27 tonnes of sea cucumber. On the other hand the export of sea cucumber from Malaysia was 158.41 tonnes with a total of RM 1.9 million revenue (DOF, 2001).

The management of sea cucumber resources has to be approached on locality basis and appropriate controls should be put in place for each region. Development of fishery regulations should focus on stocks consisting monitoring and effective enforcement. The threats on stocks of sea cucumbers in Malaysia were confined to the *Stichopus horrens* of Pulau Langkawi and the west coast of Peninsular Malaysia while in Sabah the targeted species were the larger size sea cucumbers. Other more abundant species for example the *Holothuria atra, Stichopus chloronotus* and *H. leucospilota* were not targeted in Malaysia. Better and proper management strategies should be focused on these targeted species. At present the use of sea cucumber is not limited to traditional medicine but also processed in scientific ways to produce food supplement (Figure 7)

The problems facing the Malaysian sea cucumber industry are complex. Development of a regional network, dealing with the same set of fisheries problems, species and management controls is a desirable need. Broadercommunication between parties can be of benefit to the environment and industry. It would help disseminate the information on the issues an also help others to avoid making the same mistakes, promote research and recovery of stocks.

There is a growing concern, surrounding trade between bordering country for example Malaysia, Thailand, Indonesia and Phillipine, that requires a concerted collaborative effort from Malaysia and the neighbouring country (Baine and Choo, 1999). The potential for overfishing in Thailand waters is high, given the evidence of levels of trade to Pulau Langkawi combined with observations on the widening geographical focus of Thai fishers within their own territory to meet the demand within Pulau Langkawi. The potential for overfishing and subsequent possible domino effects in Malaysia, such as the development of an intensive fishery in the waters off the west coast of peninsular Malaysia (for example Pulau Pangkor) in order to meet the demand can be detrimental. This situation should be addressed appropriately and requires immediate attention.

In Pulau Langkawi and Sabah an extensive infrastructure has developed (fishers, processor and traders) (Figure 8)around holothurian fisheries (Baine and Choo, 1999). Although this may not contribute significantly to the country's economy, there are important source of income for small coastal and island communities which cannot be ignored. In the Pulau Langkawi for example, there are more than 100 local families involved in sea cucumber medicine production line from producer to trader on which some depend on it as a main source of income.

4. Conservation effort

Effort to conserve the resources started due to the depletion of the natural resources in some part of Malaysia. The Department of Fisheries has started a study on *S. horrens* in early 1993 and also tried a translocation program. Nevertheless it was clear that further studies were needed on different aspects of the sustainable exploitation of sea cucumbers in Malaysia. For that purpose a study was also carried out to identify the sea cucumber species was carried out by DOF in collaboration with a local university in 1994. This was then followed by a three years collaboration project with Heriot Watt University under the Darwin Initiative funding. These studies mainly focus on biology and ecology of the species in Malaysia and also the possibility of aquaculture production.

The sustainable exploitation of sea cucumbers from the area will be dependent on a better understanding of the resources available in the country and it threats. Unfortunately, the life-history traits and the population ecology of many of the commercial species have not yet been intensively studied in the region. Worldwide there is very little data available on recruitment, growth and mortality for most species. In general, it appears that many commercial species are slow-growing and very vulnerable to over exploitation. Research into population dynamics and stock assessments are also needed, even though the resource seems to be already severely depleted in some areas. The variable nature of the fishery indicates that management solutions will differ between areas depending on the degree of over-exploitation. There may be future cause for concern for a fishery that targets juveniles. On the other hand the situation in Pulau Langkawi and Sabah, demands immediate mobilization of Department of Fisheries resources.

Research, education and extensive knowledge are needed for the best conservation effort. Action for example total prohibition of specific species, creating sanctuaries for sea cucumber, aquaculture production and restocking the wild are some of the actions to be considered. One of the appealing management options is restocking sea cucumbers stock with juveniles produced in hatcheries. Hatchery production techniques are now available for only one tropical species, the high value sandfish, *Holothuria scabra* (Battaglene, 1999). Restocking sandfish and potentially enhancing stocks above historical harvest levels is a priority area for research but does not currently offer an immediate solution to the declining stocks of the most commonly exploited species in Malaysia. Other action for example farming of sea cucumbers is practiced in China, Indonesia and India but not yet in Malaysia. Grow-out of cultured sandfish in cages or enclosures may be another alternative way for fishermen to provide product for processors. It may also elevate pressure on natural stocks.

Research on culture aspects of *Stichopus horrens* should be emphasized as this is the target species for local consumption, industrially produced food supplement and traditional medicine. Success in production of these species will be of benefit to the local public and the conservation of threatens sea cucumber species.

There is growing interest in the potential for culture and restocking of juveniles holothurians. This should be approached with cautions, as this is not the ultimate answer to all holothurian's management problems, indeed there is still considerable research to be undertaken into refining basic premises behind their rearing and stocking.

5. Monitoring and Enforcement

Enforcement of sea cucumber conservation strategies require good data and proper authority for this is the marine park section of the Department of Fisheries and the research section. Proper training of the staffs prior to the collection of the data and monitoring is vital. Staffs have to be trained in diving survey methodology and holothurian's taxonomy. The knowledge should be utilised to the full in the monitoring surveys within the conservation area and other area under the jurisdiction of the Department of Fisheries. This will result in a constant supply of extensive field data on species presence, their temporal and spatial distribution, and growth (length and weight analyses). This will enable future research to interpret comprehensive information available in the form of a well established database on stock dynamics. At present, the research wing of the Department of Fisheries carries out monitoring and study of the marine organism. The marine park islands provide ideal areas for future research on other aspects of holothurian reproductive biology and ecology. Trained marine park personnel can also be utilized within such research and they can be trained in SCUBA, survey and taxonomy techniques (Forbes and Zaidnuddin, 1999).

Holothurian taxonomy is currently in confusion with many reviews going on. It is important that the monitoring programme maintain adequate photographic and morphological records. The monitoring should also incorporate examination of spicule distribution and composition within different holothurian species and at varying stages of their life cycle.

An integrated approach to holothurian fisheries management in Malaysia should be carried out not only in research and regulation but in its widening of scope to involve other countries in SE Asia with a view to approach a common problem that already sees a maze of existing international trade links.

6. Legal and Fisheries Act

At present the Fisheries act gazetted 25 species of marine organisms; Dugong, whale, dolphin, whale shark and giant clams as endangered and protected (Control of endangered fish species, DOF, Fisheries Act P.U.(A) 1985) . Legally the sea cucumber in Malaysia is not protected specifically under Fisheries Act or Marine Park act. The sea cucumber species within the boundary of Marine Park is protected but harvesting outside of the park is legal.

Promoting the fisheries act to protect the sea cucumber species in Malaysia is possible now as there are strong indications of high exploitation of resource and probable case of stock depletion. There are many potential approaches to the problems and opportunities unearthed by past research. Possible options for direct management of sea cucumber might be the application procedures adopted elsewhere including the setting of minimum landing sizes, establishing closed areas and seasons and even complete prohibition of fishing. Sabah state is the area that may most require such regulation, but the following points must be considered (Baine and Choo, 1999):

- Preparation of baseline data for the fishery;
- Determining associated political and social repercussions that may arise;
- The lack of resources within the Fisheries Department to enforce regulations in a fishery which is not seen as priority for internal management.

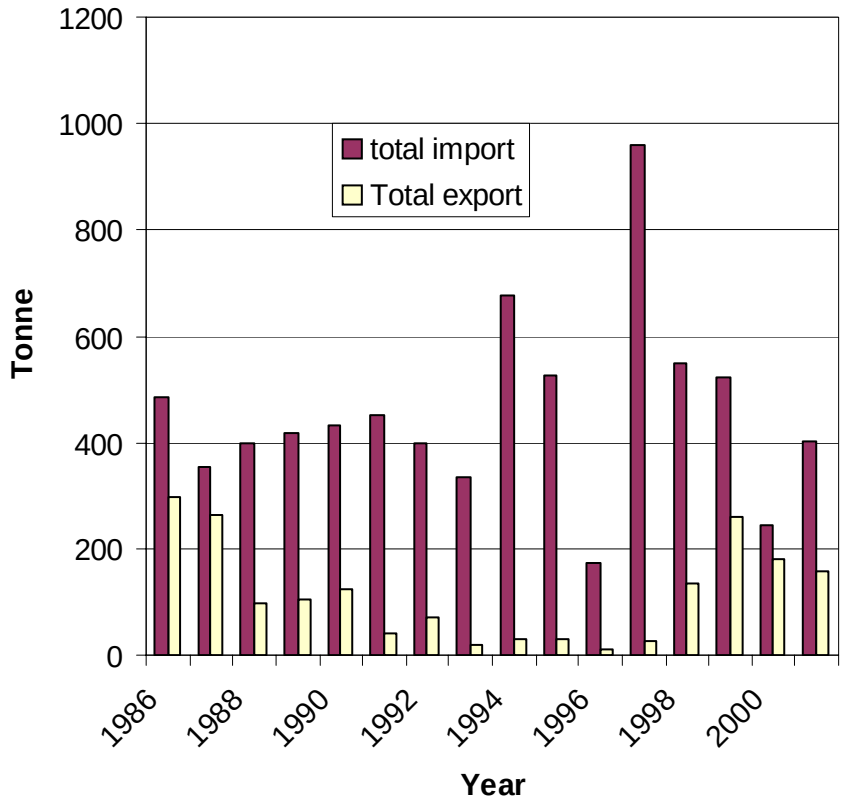

Figure 5: Total import and export of sea cucumber from Malaysia in various forms (Source Baine & Choo, 1999; Department of Fisheries Malaysia 1986-2001 Statistics

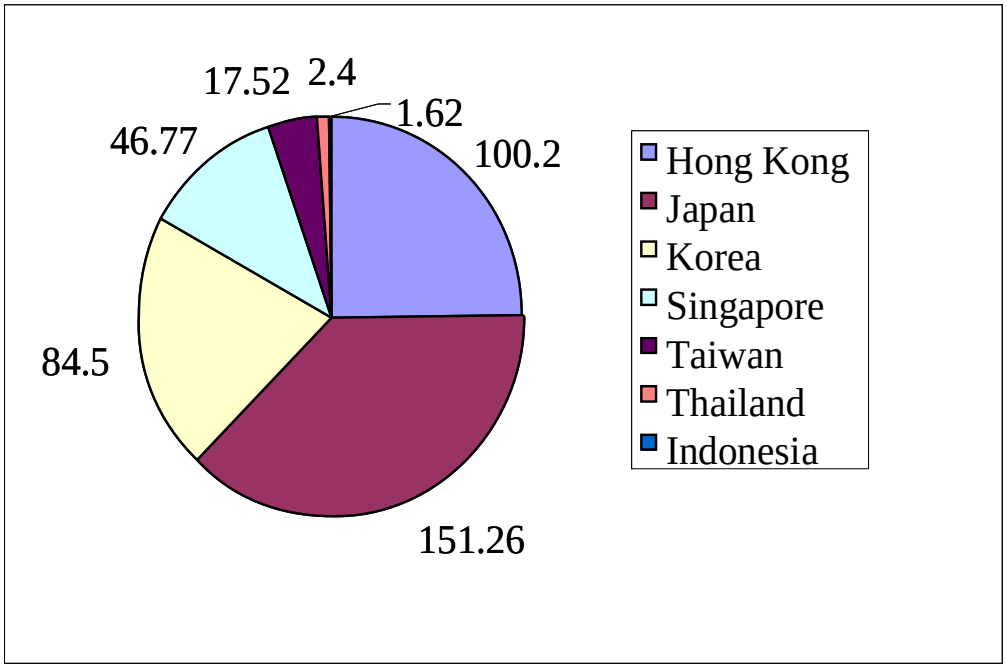

Figure 6: Countries exporting sea cucumber to Malaysia (DOF 2001) value in tonne

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The authors would like to thank the Director General of Fisheries Malaysia, Darwin Initiative, The Marine Park Division, Director of Research and others who help make this paper come through.

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Figure 7: New product from sea cucumber (*Stichopus horrens*)

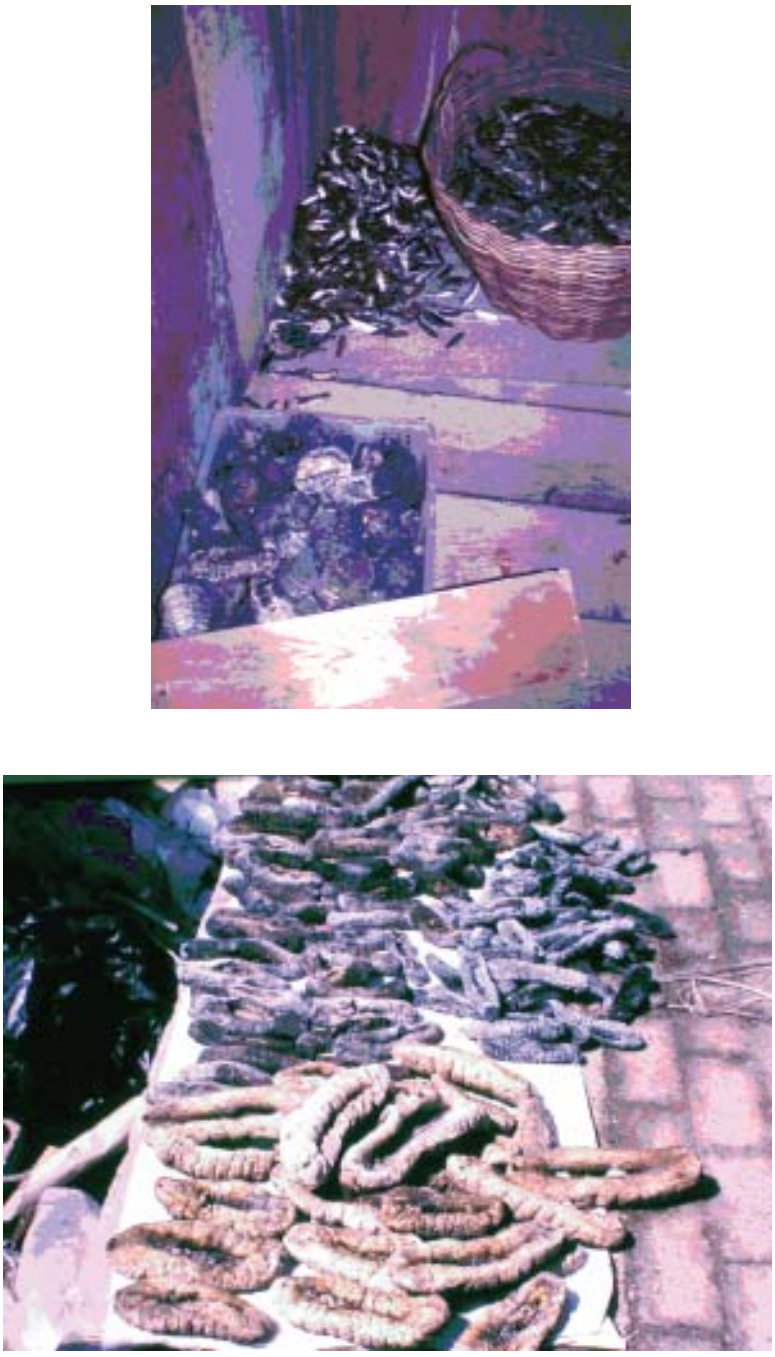

Figure 8: Processing sea cucumber before selling

NATIONAL REPORT – THE PHILIPPINES

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1. Information on wild populations

a. Non-commercial and commercial species, distribution and habitats.

The holothurians (Echinodermata: Holothuroidea), commonly known as sea cucumbers, once abound in nearly all the shallow-water reef areas of the Philippines (Clark and Rowe, 1971; Schoppe, 2000) (Fig. 1). Of the approximately 1400 described species worldwide, about 100 species of Philippine holothurians have been recorded by past distribution and taxonomic accounts. Recent surveys have accounted 41 species belonging to five families around the provinces of Pangasinan, northern Luzon; Batangas, Mindoro and Palawan in southern Luzon; Bohol and Negros Occidental in central Visayas; Leyte, eastern Visayas and Zamboanga, northern Mindanao (Colin and Arneson, 1995; Gosliner, et al., 1996; Carpenter and Niem, 1998; Schoppe, et al., 1998; Schoppe, 2000). They abound in all habitat types: sandy, mudflats, reef flats and lagoons (Table 1). Colin and Arneson (1996) recorded the world's largest sea cucumber, *Stichopus variegatus* measuring 39 x 9.5 inches from the Philippines. About 30 commercial species in the families Holothuriidae and Stichopodidae are being utilized as food source for domestic and international markets (Roa, 1987, Ferrer, 2001) (Table 2).

b. Information on abundance.

The present status of the resource is unknown due to the absence of statistical monitoring in the once rich areas of the country (Schoppe, 2000; Gamboa, et al., 2003). The increasing depletion of natural stocks is obvious based on these reports, the available fisheries data and anecdotal accounts. Collection sizes of commercial species are reportedly getting smaller and the collection sites, which were for many years within the littoral zone, have now moved to deeper waters (Roa, 1987; Schoppe, 2000). The accessibility of the collection sites of commercial species and the high demand for the products particularly in the world markets make the resource vulnerable to over-exploitation. There is a current move by the research staff of the National Fisheries Research and Development Institute (NFRDI), which is the research arm of the Bureau of Fisheries and Aquatic Resources (BFAR) to conduct studies on the natural population and catch statistics of sea cucumbers for conservation and management purposes.

2. Nature of sea cucumber fisheries

a. Artisanal fisheries.

The advent of sea cucumber fisheries in the Philippines dates back to c1911 (Roa, 1987). The methods of collection and equipment used remained the same through the years as reported by various authors. In 1995, this author had the personal experience of observing holothurian collection and processing in an island village in Bohol, central Visayas. The commercial species in the families Holothuriidae and Stichopodidae are heavily collected by gleaning during low tide by members of fishing families in coastal villages all over the country. The deep-water species are collected by diving from small boats by divers using improvised air compressor or "hookah" (Table 1). These species are known by various local names based on the distinctive external characteristic of the animal (Table 2). The works of Alcala and Alcazar (1984), Roa (1987) and Schoppe (2000) gave glimpses on the status of sea cucumber fisheries in selected areas. The frequently collected species are *Holothuria scabra, Bohadschia marmorata, Actinopyga lecanora, Holothuria fuscocinerea, Holothuria atra and Stichopus hermanni* (Schoppe, 2000).

Table 1. Commercial and non-commercial species of sea cucumbers in Philippine waters and methods of collection of commercial species. (Source: Colin & Arneson (1995); Gosliner, Behrens & Williams (1996); Carpenter & Niem (1998); Schoppe (2000).

SCIENTIFIC NAME	ENGLISH NAME	DISTRIBUTION	METHOD OF COLLECTION
HOLOTHURIIDAE			
Actinopyga lecanora (Jaeger, 1833)		East Africa; Madagascar to Australia; New Caledonia; Indonesia; Philippines; southern Japan	gleaning
Actinopyga echinites (Jaeger, 1833) *	Deep-water redfish	Indo-West Pacific from Zanzibar east to southern China; the Ryukyu Islands; Philippines; East Indies; Fiji and northern Australia	gleaning
Actinopyga mauritiana (Quoy & Gaimard, 1833) *	Surf redfish	Widespread in the tropical Indo-Pacific	gleaning
Actinopyga miliaris (Quoy & Gaimard, 1833) *	Hairy blackfish	Widespread in the propical Indo-Pacific including the Red Sea but excluding the Persian Gulf and Hawaii	gleaning
Actinopyga obesa (Selenka, 1867)		Solomon Islands; Philippines; China and Hawaiian Islands	
Bohadschia argus Jaeger, 1833	Leopard fish	Seychelles to Australia; New Caledonia; Indonesia; Malaysia; Philippines and northern Japan	diving
Bohadschia graeffei (Semper, 1868)		Red Sea; Maldives to Australia; New Caledonia; New Guinea; Indonesia and Philippines; Madang; PNG	
Bohadschia marmorata Jaeger, 1833	Chalky sea cucumber	Throughout the Indo-West Pacific excluding the Hawaiian Islands	diving
Bohadschia paradoxa (Selenka, 1867)		Australia; Philippines to Hawaiian Islands (Maui)	
Bohadschia vitiensis (Semper, 1867)	Brown sandfish	Widespread in the tropical Indo-Pacific	gleaning/diving
*Pearsonothuria graeffei (*Semper, 1868)	Blackspotted sea cucumber	Widespread in the tropical Indo-Pacific, excluding the Persian Gulf & Hawaii	diving
Holothuria (Halodeima) atra Jaeger, 1833	lollyfish	Throughout the tropical Indo-west Pacific	gleaning/diving
Holothuria (Halodeima) edulis Lesson, 1830	Pinkfish	Widespread in the tropical Indo-Pacific; excluding Hawaii	gleaning
Holothuria (Halodeima) pulla		East Africa and Madagascar; East Indies; Philippines and the South Pacific Islands	
Holothuria (Acanthotrapeza) coluber Semper, 1868	Snake fish	Widespread in the tropical Pacific, excluding Hawaii; not recorded in the Indian Ocean	gleaning/diving

SCIENTIFIC NAME	ENGLISH NAME	DISTRIBUTION	METHOD OF COLLECTION
Holothuria (Microthele) fuscogilva Cherbonnier, 1980	White teatfish	Widespread in the tropical Indo-Pacific	diving
Holothuria (Microthele) fuscopunctata Jaeger, 1833	Elephant trunkfish	Australia; New Caledonia; New Guinea; Belau; the Mariana Islands; Philippines	diving
Holothuria (Microthele) nobilis (Selenka, 1867)	White teatfish	Widespread in the tropical Indo-West Pacific	gleaning/diving
Holothuria (Microthele) whitmae	Teatfish; mammy blackfish	Throughout the tropical indo-West Pacific	
Holothuria (Thymiosycia) hilla Lesson, 1830		Throughout the Indo-West Pacific	gleaning
Holothuria (Thymiosycia) impatiens (Forskal, 1775)		East Africa; Red Sea to the Hawaiian Islands; tropical Atlantic; Mediterranean	gleaning
Holothuria (Mertensiothuria) leucospilota (Brandt, 1835)	White threadfish	Western Indian Ocean and Red Sea; western Pacific to the Hawaiian Islands (Cook Islands)	gleaning/diving
Holothuria (Cystipus) inhabilis		SE Arabia; China; Philippines; East Indies; Pacific Islands; Australia	gleaning/diving
Holothuria (Cystipus) rigida (Selenka, 1867)		East Africa to Hawaii; western coast of North America; Panamanian Region; Galapagos and the West Indies	
Holothuria (Metriatyla) scabra Jaeger, 1833	Sandfish	Widespread in the Indo-Pacific excluding Hawaii	gleaning
Holothuria (Metriatyla) scabra var. versicolor (Conand, 1986)	Sandfish	Widespread in the tropical Pacific, excluding coral reef islands	gleaning
STICHOPODIDAE			
Stichopus chloronotus Brandt, 1835	Greenfish	Widespread in the tropical Indo-Pacific excluding the Persian Gulf	gleaning/diving
Stichopus hermanni	Curryfish	Throughout the tropical Indo-West Pacific except the Hawaiian Islands	gleaning/diving
Stichopus horrens Selenka, 1835	Selenka's sea cucumber	Widespread in the tropical Indo-Pacific	gleaning/diiving
Stichopus noctivagus Cherbonnier, 1980		New Caledonia; New Guinea; Philippines and Hawaiian Islands	

Table 1. Continued

SCIENTIFIC NAME	ENGLISH NAME	DISTRIBUTION	METHOD OF COLLECTION
Stichopus variegatus Semper, 1868	Curryfish	Widespread in the tropical Indo-Pacific excluding Hawaii	gleaning
Thelenota ananas (Jaeger, 1833)	Prickly redfish; pineapple sea cucumber	Widespread in the tropical Indo-Pacific, excluding Hawaii	diving
Thelenota anax Clark, 1921	Amberfish; giant beche-de-mer	In the tropical Indian Ocean; in the tropical Pacific; from northern Australia to Enewok, Guam, China Sea and Ryukyu Islands southwards to New Caledonia, Fiji and the Society Islands	diving
Thelenota rubralineata Massin & Lane, 1991		New Guinea; Solomon Islands; Guam; Banda Islands; New Caledonia; Philippines; Indonesia; SCS; Fiji & Palau	diving
CUCUMARIDAE			
Colochirus robustus Ostergren, 1898		Indonesia; Belau and Philippines	
Cucumaria miniata		Indonesia; Palau; Philippines (Pamilacan Is)	
Neothyonidium magnum (Ludwig, 1882)		Western Pacific; New Caledonia; New Guinea; Indonesia; Philippines	
Pseudocolochirus violaceus (Theel, 1886)		India; northern Australia and Philippines	
SYNAPTIDAE			
Euapta godeffroyi (Semper, 1868)	Sticky snake sea cucumber	Throughout the Indo-West Pacific	
Opheodesoma grisea (Semper, 1868)	Serpent synaptid	East Africa and the Red Sea to Hainan Island; Philippines; the East Indies and Hawaiian Islands	
Synapta maculata (Chamisso & Eysenhardt, 1821)	Maculated synaptid	Throughout the Indo-West Pacific excluding the Hawaiian Islands	
Synaptula media Cherbonnier & Feral, 1985		New Caledonia; New Guinea; Micronesia and Philippines	

b.Number of fishermen and landing data

Due to the scarcity of fisheries data, the number of fishermen who depend on sea cucumber fisheries for livelihood is unavailable. However, historical data on sea cucumber production based on landed catches from artisanal fisheries are on hand until 1997. The usefulness of these historical catch data in conservation and management initiatives is diminished by the inability of field workers to identify the landed catch and processed products to species level. The latest available data shows fluctuating annual landed catch from as high as 3109 metric tons in 1993 to a low 1191 metric tons in 1997 (Figure 2). Ferrer (2001) conducted a study of artisanal fisheries in Danao, Misamis Occidental on the island of Mindanao. Based on data collected from the fishers and historical catches in Danao Bay, the fishers could only collect 0.5 kg of live weight per hour in 1997, compared to 100 kg/hr in 1960s and 1980s.

c. Licensing and permitting requirements

In most municipal waters, there is the so-called "open access" in the utilization of marine resources. In some areas, however, the local government unit, which has jurisdiction over the coastal waters, issues a "license or permit to collect" with validity of three years to the fisherfolks engaged in the collection or stakeholders. This permitting requirement is not in any way a form of regulation or control in the use of the resource as the license/ permit is issued to all applicants. Moreover, not all local government units in the country require the stakeholders to secure such license/permit (BFAR-FRQD, pers. comm.)

d. Sea cucumber farming

Sea cucumber culture in the Philippines is still in its infancy with initiatives coming from academic institutions. Grow-out culture and seedstock production of the highly valued *Holothuria scabra* is being done at the marine laboratory of the University of the Philippines Marine Science Institute with the primary purpose of reseeding marine protected areas (MPAs) (Gamboa, et al., 2003). It is hoped that commercial quantities of seedstock will become available in the future for interested entrepreneurs and relieve the pressure on natural population.

e. Most important uses of sea cucumbers

Besides being high value commodity as food source, the pharmaceutical potential and other commercial uses of sea cucumbers are being discovered. The processed products were found to have curative powers for ailments like high blood pressure and muscular disorders. Cuvierian tubules are being used as crude plaster for minor wounds (Roa, 1987). The scientists from the University of the Philippines in Los Banos, Laguna have found the chloroform extracts called lectins from *Holothuria nobilis, H. axiologa, Bohadschia marmorata* and *Stichopus chloronatus* as having promising anticancer and antibacterial activity (Mojica, et al., 2003).

f. Conservation measures

Philippine sea cucumber fishery depends solely on natural stocks. At present, there are no laws governing the exploitation and utilization of the commercial species. The local government units have the authority to draft and pass conservation measures, e.g. limited access, closed seasons, and closed areas, minimum harvestable size, in the form of municipal ordinance with or without scientific bases for such measures. The dearth of best available data on their population and ecological status in Philippine waters is primarily due to budget constraints on scientific research, while the "precautionary approach" to conservation seems not a popular option in the absence of scientific bases.

Table 2. Prices of sea cucumber species (US$1.00 = PHP 56.00) (Source: modified from Schoppe, 2000)

SCIENTIFIC NAME	LOCAL NAME	PRICE/kg (US$)
Actinopyga echinites **	brown beauty; khaki	20.5
Actinopyga lecanora ***	buli-buli; monang/manang	37.00
Actinopyga mauritiana ***	bakungan	31.00
Actinopyga miliaris **	khaki	26.00
Bohadschia argus **	leopard; matang itik	23.50
Bohadschia marmorata **	lawayan; pulutan	22.50
Holothuria atra **	black beauty	21.00
Holothuria edulis **	red beauty	21.00
Holothuria coluber *	patola white; tambor	16.50
Holothuria fuscocinerea *	labuyo	17.38
Holothuria fuscogilva *	patola	16.76
Holothuria fuscopunctata *	sapatos	18.00
Holothuria leucospilota **	patola	20.75
Holothuria nobilis ***	susuan	41.00
Holothuria inhabilis *	batunan	local consumption
Holothuria pulla **	patola red	21.00
Holothuria rigida *	batunan	local consumption
Holothuria scabra ***	kurtido; putian	41.00
Holothuria scabra var. versicolor *	kurtido bato	16.50
Holothuria whitmae ***	susuan	41.00
Pearsonothuria graeffei *	pina; hanginan; mani-mani	17.75
Stichopus hermanni ***	hanginan	37.25
Stichopus horrens ***	hanginan	37.25
Stichopus variegatus **	hanginan; gadul	20.20
Thelenota ananas **	talipan; taripan	28.50
Thelenota anax **	legs	20.25

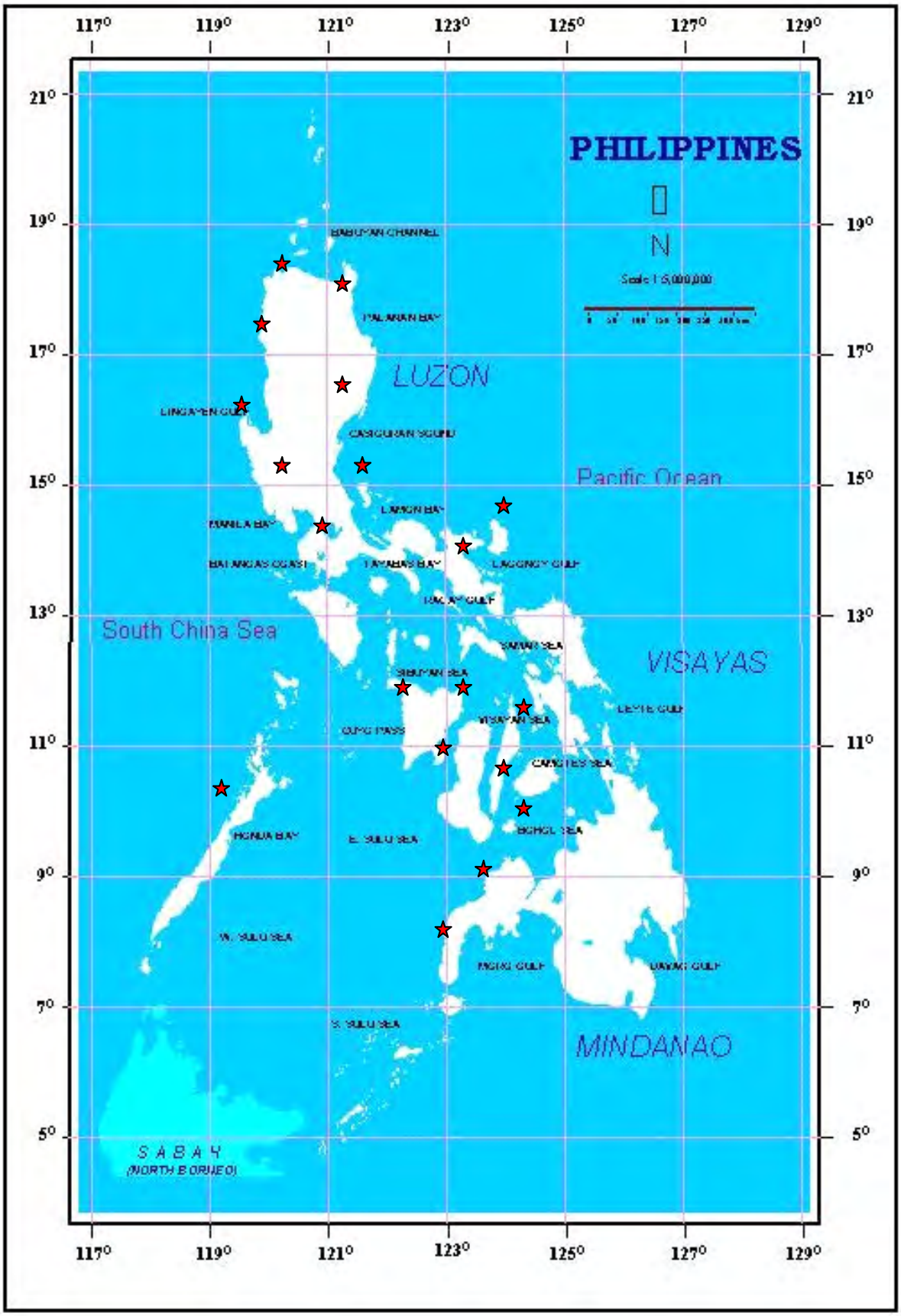

Figure 1. Philippine map showing the sea cucumber collection and processing areas

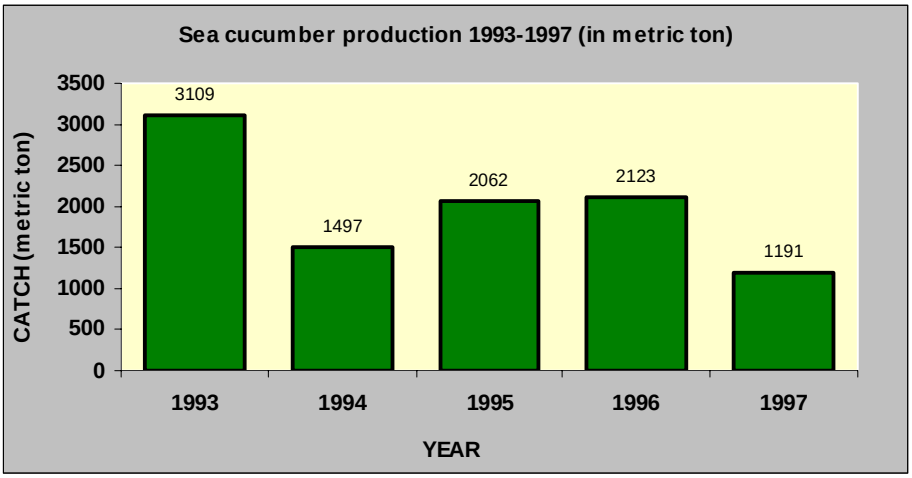

Figure 2. Municipal production of sea cucumbers, 1993-1997 (MT)

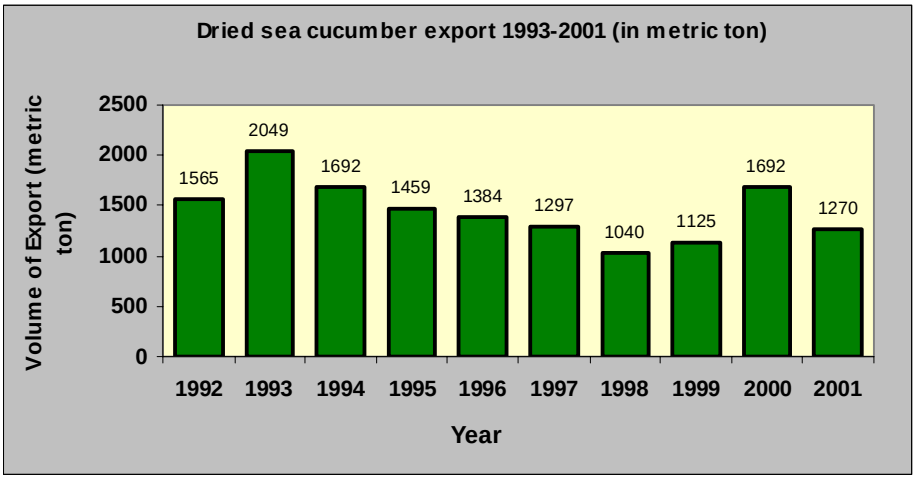

Figure 3. Export volume of dried sea cucumbers 1992-2001 (MT)

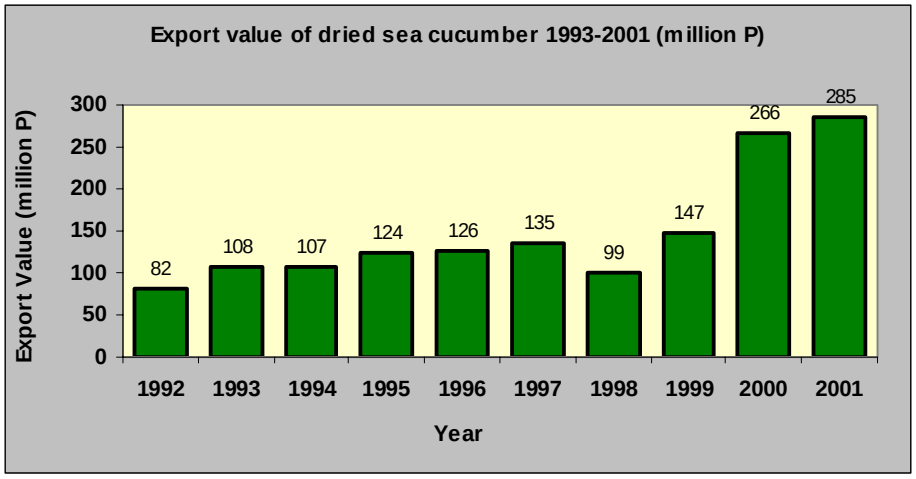

Figure 4. Export value of dried sea cucumbers 1992-2001 (millionP)

3. Domestic and international trade

a. Domestic trade

In the Philippines, the trade in sea cucumbers involves the fisherfolks, middlemen and exporters as key players. After collection, the cleaning and processing of gutted sea cucumbers into fresh/frozen, dried and smoked products are carried out by the collectors themselves or brought to processors in their respective areas. The processed products are deposited in designated trading places within the community until a commercial volume is reached (BFAR FRQD, pers. comm.). The existence of sea cucumber fisheries and processing has been confirmed in northern Luzon provinces of Pangasinan, La Union and Cagayan; eastern Luzon province of Zambales; southern Luzon provinces of Quezon, Batangas and Palawan; central Visayas provinces of Cebu, Bohol and Negros Occidental; The middlemen from different parts of the country have the knowledge of the trading season in each locality and have complete control over domestic prices. The prices of processed products depend on the size (small, medium, large) or grade (class A, B, C). From the fisherfolk collectors to middlemen, trading shifts hands from the middlemen to local businessmen who are engaged in the supermarket, hotel, restaurant and export businesses (Gamboa, et al., 2003). The prevailing domestic price of sea cucumbers is unavailable.

b. International trade: export volume and trends

The international market is dominated by dried sea cucumber products with the Philippines as the 2nd major producer and exporter. From 1997 to 2001, dried sea cucumbers ranked 8th in the country's top 10 major export commodities (BAS, 2002). The markets in Asia receive the bulk of dried products from all exporting countries. Philippine export statistics show a decline in export volume from 2049 tons in 1993 to 1125 in 1999 with slight increase in 2000 (1692 tons), and then dropped to 1270 tons in 2001 (Fig. 3). The decline in the volume of export may be the result of the Asian economic crisis in the late 1990s or low supply from exporting countries due to over-exploitation of high priced species such as *Holothuria scabra, Stichopus spp., Holothuria nobilis, H. whitmae* and *Actinopyga lecanora* (Roa, 1987; Schoppe, 2000).

c. Export values

Despite the recession and low supply of commercial species, there is a steady increase in prices of processed products. The exported dried sea cucumber in 1992 was valued at PHP 82 million and increased to PHP 285 million in 2001 (Fig. 4). The most recent trading prices from the traders in Palawan, southern Luzon was obtained from Schoppe (2000). The prices of high value species ranged from US$ 8.75 to 25.00 per kg of dry weight with exchange rate of PHP 40.00 to US$ 1.00. These figures increased by more than 71% with the current exchange rate of PHP 56.00 to US$ 1.00 (Table 2).

d. Trading countries and territories

Asia is still the biggest market for dried sea cucumber from the Philippines. At least five exporters are regularly supplying the markets of China, Hong Kong, Taiwan, Singapore, Malaysia, Korea and Indonesia. Canada is the only trading partner outside of Asia (BAS, 1996 and 2002). The breakdown of the annual export volume and value are not available from the current statistics.

e. Trade controls, enforcement and identification of traded specimens

Traders and middlemen of sea cucumber products are required to secure quarantine clearance from the Regulatory and Quarantine Division of the Bureau of Fisheries and Aquatic Resources (BFAR) regional field office at the point of origin when transporting the commodity within the country. The clearance, which is being issued free of charge, contains the generic/common name and volume of the products to be transported.

Sea cucumber products intended for the foreign markets should be accompanied by an export commodity clearance, duly signed by the fisheries officer and all trade-related agencies at the One Stop Export Processing Center. The commodity clearance likewise contains the generic name (scientific name, whenever possible), English and local name and volume of the products. Identification of specimens from the landed catch and processed products for trade is only up to family level as field enumerators and quarantine officers have limited knowledge about sea cucumber identification, particularly of the processed products (BFAR FRQD pers. comm.).

f. Illegal, unreported and unregulated trade

The collection and trade in Philippine sea cucumbers are unregulated. Likewise, there is greater possibility of non-compliance with the permitting procedure by some exporters. This is likely the situation in countries where there is open access to resources and the absence of any conservation measure.

g. Levels of domestic consumption, trends and trade

Sea cucumbers are not a basic food source of Filipinos, but fresh meat is a delicacy in coastal villages. The fresh/frozen, dried and smoked sea cucumber products are being marketed locally in supermarkets and form part of cuisines in local hotels and restaurants (Roa, 1987; Gomez et al., 2003). The bulk of processed products, particularly the dried and smoked forms are intended for the export markets where they remain in demand and high value products (Roa, 1987, Schoppe, 2000).

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Sea Cucumber Population Status, Fisheries and Trade in the United States

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1. Information on wild populations

A) Tropical

i) **Western Atlantic**
There are seven sea cucumbers of potential commercial value in the waters surrounding Florida, Puerto Rico and the U.S. Virgin Islands (*Astichopus multifidus, Actinopygia agassizii, Isostichopus badionotus, Eostichopus amesoni, Holothuria mexicana, H. thomasae, and H. impatiens).* These occur in mangrove, grassbed, coral reef and sandy or silty environments. All species are most common from about 1 m to 10 m depth, except *A. multifidus* which is most common from 5-40 m depth. These species generally occur at densities of up to 1-2 animals per 10 m^2. Higher densities are occasionally observed for some species. For instance, *I badionotus* has been reported in sandflats at densities of 1 individual per 7-8 m^2.

ii) **Pacific**
A high diversity of sea cucumbers have been identified in the U.S. territories of Guam (30 species), CNMI, and American Samoa, and in the U.S. Freely Associated States (28 species), including 16 of commercial importance (Richmond, 1996). Fewer species occur in Hawaii. Most of the species that occur in the U.S. Pacific territories overlap with those found throughout southeast Asia and the south Pacific.

The primary commercial species in the U.S. Pacific has been *Actinopyga mauritiana*, which inhabits the surge zone of fringing and barrier reefs. It occurs to about 10 m depth, with the highest densities at about 2 m. In Saipan, Northern Marianas, it is reported at densities of 1-6 animals per 100 m^2 on the reef flat and 0.1-1.3/ 100m^2 on the reef slope. This species attains sexual maturity at about 22 cm, or 2-3 years in age, with a lifespan of about 12 years.

B) Temperate

i) **Northeastern Pacific**
There are 14 species of sea cucumbers found in the Pacific northwest. Two of these are commercially important, *Parastichopus californicus* (giant red sea cucumber) and *P. parvimensis* (warty sea cucumber). They are both epibenthic detritivores (deposit feeders) that consume organic detritus and small organisms within sediments and mud. These species are broadcast spawners, with separate sexes and a sex ratio of close to 1:1. Spawning occurs in late spring and summer (May to August), typically in shallow water (<16 m); they undergo visceral atrophy each year after spawning. Recruitment is sporadic and adults have a relatively high natural mortality. The primary predators are the sea stars, *Pycnopodia* and *Solaster*. Because of their life history traits, they are thought to have a low maximum yield per recruit and are particularly vulnerable to overfishing (Rogers-Bennett and Ono, 2001).

Parastichopus californicus occurs from Baja California (Cedros Island) to the Gulf of Alaska, from the lower intertidal to about 250 m. It is widely distributed throughout a variety of habitats (mud, gravel, rock rubble and solid bedrock) and environments (exposed coastal areas to sheltered inlets), with the greatest

density in areas with accumulations of high organic sediments. Animals are slow growing (5-20 mm at 1 yr; maximum size of 50 cm), and reach sexual maturity at 4-8 years; the lifespan is about 8-12 years (Cameron and Frankboner, 1989).

Parastichopus parvimensis is most common from Baja California (Mexico) to Monterey Bay, California, but occurs at lower abundances as far north as Point Conception. It is found from the intertidal to about 30 m depth in areas with little water movement. This species is smaller than *P. californicus*, with a maximum length of 30-40 cm.

A limited number of field surveys have been conducted to evaluate the status of *P. californicus* populations, with information used to manage commercial fisheries. In California, these species have a patchy distribution on rocky or sandy substrates, and do not appear to form seasonal, spawning or feeding aggregations. Population surveys have been monitored in the Channel Islands and Santa Barbara Islands since 1982. Between 1990-1994 the average density at all the monitored sites has declined but populations have been at about the same levels as in the 1980s for the last several years. However, populations at fished sites were 50-80% lower than at non-fished sites. For instance, at an established reserve in northern California (Cabrillo Reserve, 40-60 m) densities averaged around 1,000 per acre. Densities at a newly established reserve (Punta Gorda Ecological Reserve) ranged from 120 to 350 per acre, with only the large size classes observed surveys (Rogers-Bennett and Ono, 2001).

Oregon Department of Fish and Wildlife (ODFW) submersible surveys off southern Oregon found densities of cucumbers of 0.1 - 0.22/m^2 in 44 - 71 fathoms. Densities were less at shallower depths. Commercial densities in British Columbia are estimated at less than 0.25/m^2. However, at depths greater than 1300-1600 fathoms, sea cucumbers are the most numerous animal found.

ii) **North Atlantic**

There are four species of sea cucumbers found off the Northwestern Atlantic. Only one of these, *Cucumaria frondosa* (orange footed cucumber; pumpkins; great northern cucumber) is commercially important. *C. frondosa* ranges throughout North Atlantic and Artic Oceans, including the Norwegian, Barents and North Sea and the waters around Iceland. Its southern range along the northwestern Atlantic is Cape Cod and Nantucket, Massachusetts. It is distributed from the intertidal to over 300 m depth, with the highest abundance from 30-60 m. It inhabits a variety of substrates, including gravel, shell rocks, mud, with the densest populations found in rocky areas.

This species is a suspension (filter) feeder, consuming phytoplankton and organic detritus. It is slow growing, reaching a maximum size of 20 cm in inshore areas and 50 cm in deeper offshore waters. Sexes are separate and animals reach sexual maturity at 2.5-3 years, when about 3.5 cm in length. Spawning occurs between March and August. Animals grow to 12 cm within 5.5 years, and have an estimated lifespan of 10 years (Chenoweth and McGowan, 2004).

In Maine, population densities can reach 5 individuals/m^2 and populations can comprise up to 50% of the benthic biomass. Dive surveys using transects demonstrate the patchy nature of the species, with abundances ranging from 0.01 to 7.45 animals per square meter, with substantial differences in size and weight of animals between sites.

2. Nature of sea cucumber fisheries

In the United States, sea cucumber fisheries can be separated into: 1) those occurring in state waters, each of which is managed by individual states; and 2) those located in the EEZ (3-200 miles off the U.S. mainland and surrounding Hawaii and the Caribbean and Pacific territories), which are managed by NOAA Fisheries in coordination with Regional Fishery Management Councils.

There is no reported sea cucumber farming in the United States.

A) Tropical fisheries

i) Pacific

An intermittent fishery for holothurians in the Commonwealth of the Northern Marianas Islands (CNMI) dates back to the 1930s, primarily for export to Japan. In 1941, total catch on Saipan was 54,284 kg. A small commercial fishery for *A. mauritiana* and *H. whitmaei* was reopened for the first time in 1995, but was halted in early 1997 due to declining CPUE (Trianni, 2003). From October 1995-May 1997 the total catch was 268,068 animals (76 metric tons), most from Saipan and Rota, primarily for export to Taiwan and Hong Kong. One species (*H. atra*) is currently harvested on a subsistence level (Green, 1997).

In American Samoa, a small sea cucumber fishery targets the internal organs, which are bottled, fermented and marketed locally as "sea". The animals are returned after they eviscerate to allow for regeneration of the organs. There are no official records of sea cucumber exports, although occasional exports are thought to occur via foreign fishing vessels which visit American Samoa (T. Beeching, pers. Comm.).

In Guam, *Stichopus horrens* and *Holothuria atra* are harvested sporadically, at levels much less than in the 1800s, when catch of 2-3 tons were documented (Green, 1997). There is currently no active commercial fishery, although certain public access areas experience subsistence collection by Micronesians.

In State waters of Hawaii a low amount of commercial harvest of sea cucumbers ("lole") occurs (Table 1).

Table 1. Annual reported landings for the state of Hawaii. Source: Hawaii Division of Aquatic Resources reported landings tables, 1984-2003. Available on line at http://wpacfin.nmfs.hawaii.edu/hi/dar/Pages/hi_data_1.htm

Year	Landings	Total value (USD$)	Price per kg
2003	130.6	$929	$1.47
2002	102.1	$699	1.61
2001	54.0	$333	1.28
2000	113.4	$811	2.38
1999	51.3	$867	3.64
1998	52.6	$920	3.60
1997	50.3	$792	3.24
1996	53.1	$534	2.10
1995	23.1	$462	4.11
1994	28.6	$443	3.19

A Federal grant program funded a five-year project in several Pacific Islands [American Samoa, Guam, and Federated States of Micronesia (FSM)] on resource surveys, aquaculture and management with emphasis on three species, *H. nobilis*, *A. mauritiana* and *H. atra*. The project resulted in a general moratorium on export

harvests in Palau and portions of the FSM, and the development of a generic sea cucumber Management Plan for Micronesian states (Richmond, 1996).

ii) Atlantic
Sea cucumbers (*Holothuria* spp.) are included in the fishery management unit (FMU) of the Fishery Management Plan for Corals and Reef Associated Plants and Invertebrates of Puerto Rico and the U.S. Virgin Islands. However, there is no known harvest in federal waters of the U.S. Caribbean.

B) Temperate fisheries
Temperate North American sea cucumber fisheries are based on one or two species in each location. *Parastichopus californicu*s is the primary target on the west coast, with limited take of *P. parvimensis*, while the east coast fishery is based on *Cucumaria frondosa*. According to FAO statistics, the total capture fisheries production for the U.S. over the last 10 years (1992-2001) is 18,127 metric tons with a maximum production of 4,583 mt in 2000 (Table 5).

i) **California**
The California fishery started in 1978 and is based on *P. californicus* and *P. parvimensis*. It is both a dive and trawl fishery, with most trawling concentrated in southern California and diving in northern California. Until 1997 an average of 75% of the annual catch was from the southern California trawl fishery; this has declined in recent years, partially due to prosecution of illegal trawl fishers which reduced the total number of trawl fishermen. Beginning in 1997, divers who held sea urchin and abalone permits shifted their efforts to sea cucumbers, and the dive fishery increased substantially, accounting for 80% of the total harvest (Rogers-Bennett and Ono, 2001).

Annual landings remained under 40,000 kg until 1982, when the principal trawl areas shifted from Los Angeles area ports to the Santa Barbara Channel. Annual landings fluctuated between about 20,000-60,000 kg until 1991 when it climbed to over 261,871 kg. In 1996, combined trawl and dive harvest peaked at 380,703 kg with an ex-vessel value of USD $582,370 (Rogers-Bennett and Ono, 2001).

Since 1992-1993, a special permit has been required for sea cucumber harvest. Permit recipients must have landed a minimum of 20 kg during the previous four year period. In 1997, separate permits were issued for each gear type, with a limit on the total number of permits issued. There are currently 113 sea cucumber dive permits and 36 trawl permits. There are no restrictions on catch.

ii) Oregon
Oregon's sea cucumber fishery began in 1993 and is based on *P. californicus*, with most collection by hand using dive gear. Harvest by trawl was also allowed, but it required an experimental gear permit (McCrae, 1994).

Oregon Department of Fish and Wildlife placed sea cucumbers within the Developmental Fisheries Program, which was developed in 1993 to allow for the controlled development of new commercial fisheries. Under the firs year of the program landings were 2335 kg by 9 divers, although 44 permits were issued; 4777 kg were landed by 22 divers in 1994. Since this time very little harvest of sea cucumber has occurred in Oregon waters, with exception of 1997 (Table 2). Permits were issued until 2003, when sea cucumbers were moved to category B of the Developmental Fisheries Program species list, which include those species with less potential for a viable fishery. For 2004, sea cucumber harvest no longer requires a developmental fishery permit (McCrae, pers. Comm.).

Table 2. Kilograms of sea cucumbers landed and fishing effort in Oregon, 1995-2003.

	1995	1996	1997	1998	1999	2000	2001	2002	2003
Kg landed	0	0	3295	0	3.28	132	15.9	0	312
Harvesters			5		2	1	2		2
Permits issued	15	3	7	9	2	7	8	4	2

iii)Washington

The Washington sea cucumber fishery is based one managed species, *Parastichopus californicus*. Commercial harvest primarily involves the use of dive gear, with lower levels of harvest by an experimental trawl fishery. Sea cucumbers may also be collected while diving for personal use, with a daily limit of 10 animals. There are 13 nonclassified sea cucumber species in Washington State waters that are collected at low levels for research and aquariums under Washington Department of Fish and Wildlife (WDFW) Scientific Collecting permits.

The commercial dive fishery is open year round; the experimental trawl fishery is closed during soft-shell Dungeness crab (reproductive) periods and trawling is prohibited in shrimp areas. The average statewide CPUE has increased since 1996 and has reached a historic high, possibly as a result of a smaller, more efficient fleet (Table 5). There are currently 46 licensed commercial divers, with a license reduction program initiated in 2002, with the goal of a reduction of the total number of licenses to 25.

Harvest in Washington State occurs under a cooperative management agreement with treaty tribes. There are five management regions in Puget Sound, with about 50% of the total quota allocated for state harvest and 50% tribal harvest. The annual statewide harvest guideline (1997-2002) was 427,690 kg, with a total estimated available commercial biomass of 5.58 million kg. The landed product has an ex-vessel value of about USD $1.2 million. As a precautionary approach, the 2003-2004 quota has been reduced by 15% of that calculated for 1997 until more recent biomass estimates are completed (Table 3). The quota has been developed determined using the Schaefer (1954) surplus production model based on estimates of biomass from catch-effort data, video surveys, and dive surveys (Bradbury, 1994).

Table 3. Harvest guidelines for sea cucumbers in Washington.
Source: Anonymous, 2003.

Management Region	Harvestable Surplus (kg)
San Juan	295,372
Strait of Juan de Fuca	70,755
Central Puget Sound (26C)	17,280
Central Puget Sound (remaining areas)	906
Hood Canal	3,084
South Puget Sound	30,840
TOTAL	372,055

Seven area closures for the dive fishery have been established in the current management plan, including two that are closed for human health reasons. Regulations on the trawl fishery include spatial closures (no trawling in water less than about 20 m depth), specific fishing locations, and restrictions on gear type and size, including maximum beam width for beam trawl gear and minimum mesh size for otter trawl gear.

Fish receiving tickets are submitted to WDFW after each fishing trip for use in determining when the annual tribal and State commercial harvest quota is reached. Fishermen also submit monthly harvest logs that include the date, vessel name or boat registration number, location fished, pounds landed, average depth of harvest, number of divers, and total diver hours spent fishing.

iv) Alaska

The Alaska sea cucumber fishery for *P. californicus* began in 1981 in Southeast Alaska as an experimental fishery, and in 1987 around Kodiak Island. Sea cucumbers are collected by hand using dive gear, typically at depths of 3-20 m, with no restrictions on the use of mixed gases or saturation diving. Initially most vessels were small skiffs operating as a day fishery. More recently, larger vessels with two divers and a crewman and living quarters have extended the range and duration of fishing trips.

The dive fishery in both locations was initially based only on a permit system. However, due to rapid expansion, the fishery exceeded the ability of the Alaska Department of Fish and Game to manage by a permit system. The fishery was closed in May 1990, until a management plan was written. This plan relies on a quota developed based on historic production, fisheries performance and biannual survey data of population biomass with a total harvest rate of 6%. The harvest rate is estimated to be 50% of MSY, calculated using surplus production model that incorporates 1) an estimate of virgin population size; 2) a reduction of the quota to 50% of the harvest rate derived from the model; and 3) with another 30% reduction to account for field sampling variability. In addition, there is no allowable harvest in areas with biomass estimates below a threshold of 1kg/m of shoreline (Woodby, Kruse and Larson, 1993).

The Southeast Alaska Sea Cucumber Commercial Fisheries Management plan was completed in October 1990. The management plan established 18 areas closed to fishing and annual guideline harvest levels of 6.4% of the total sea cucumber biomass taken on a 3 year rotational basis. There is also a seasonal closure (April-September), and a limit on the number of fishing days and hours per week, and trip limits for each vessel. There a progressive increase in effort to a maximum of 424 divers in 1995-1996 season. Beginning in 1996, a moratorium on the dive fishery was imposed, limiting the number of divers able to participate in the fishery to 472. There were 235 permits issued for the 2001/2002 season (Hebert and Pritchett, 2002). The quota for

2001/2002 was 646,466 kg, with an actual harvest of 652,477 kg with an estimated ex-vessel value of USD $2,517,289 (Table 4b). For the 2002/2003 an additional 58,000 kg were added to the quota within three new collection areas.

The commercial fishery was reopened in Kodiak in 1991 under a new management plan. Current management measures include 1) a closed season from May through September to protect spawning aggregations; and 2) fifteen large harvest refugia within the managed area. In addition, sea cucumber research control sites are monitored annually to differentiate environmental effects from fishing effects. Since 1995, fishing periods have also been reduced to three days per week to allow analysis of fishing performance and monitor progress towards the established harvest guidelines (Ruccio and Jackson, 2002). Divers are licensed and must obtain a Commercial Fisheries Entry Commission interim use permit. Fish tickets are required from fishermen, operators of commercial fishing vessels, processors and buyers. In addition, completed logbooks that provide coordinates of fishing areas must be submitted by each fishing vessel as one component of each fish ticket (Ruccio and Jackson, 2002). The number of permits has ranged from 18-86 each year, with a maximum number issued in 1986 and 18 permits issued in 2001. Annual quotas have been established for each area as guideline levels of harvest, currently amounting to 113,759 kg divided among Kodiak (90,719 kg) and Chignick (23,040 kg). Harvest in the 2000/2001 season amounted to 69,216 kg . Prices have fluctuated between USD $0.42-0.68 per kg with a total landed value in 2001 of about USD $190,000. Starting in 2002/2003 season, an additional four areas in Kodiak district and three other areas in the Aleutian Islands were open to experimental fisheries, with a guideline harvest level of 2268 kg for each area (Ruccio and Jackson, 2002).

Table 4a. Thousands of kilograms of sea cucumbers landed, fishing effort and landed value for Kodiak Island in Alaska, 1993-2001.

	1993	1994	1995	1996	1997	1998	1999	2000	2001
Kg landed	256.1	187.6	65.8	73.7	60	64.6	52.7	52.7	69.2
No landings	487	269	60	93	65	55	36	56	73
Permits issued	50	86	21	31	26	16	19	20	18
Value/kg (USD)	0.42	0.54	0.57	0.57	0.53	0.54	0.54	0.68	0.57

Table 4b. Total landings of sea cucumbers (thousands of kg), number of divers and ex-vessel value in millions of USD from 1986-2001 in Southeast Alaska.

Year	Kg landed	No divers	Ex-vessel Value
1986	15.44	7	0.007
1987	29.51	11	0.014
1988	363.51	57	0.169
1989	1051.58	205	0.969
1990	364.78	143	0.472
1991	394.62	187	0.697
1992	566.82	240	0.988
1993	437.42	320	0.995
1994	599.75	261	2.361
1995	604.23	424	1.846
1996	411.32	294	1.169
1997	405.85	226	1.458
1998	478.80	219	1.636
1999	711.98	200	3.060
2000	525.44	220	2.583
2001	652.48	235	2.517

v) **Maine**

The Maine sea cucumber fishery is a low value/high volume fishery that targets *C. frondosa*. The fishery began in 1988 with one operator, and expanded in 1994 when Asian markets for this species emerged. Fishermen use boats ranging from 12-30 m in length equipped with either scallop chain sweeps or light urchin drag gear. The gear is limited to 167 cm width and 7 m length and has a head bail constructed of less than 3.8 cm round steel stock. On a typical day, each boat harvests 70-200 totes of sea cucumbers. Catch per boat per day was about 7,212 kg, with an average of 16 (+/-5) tows per day. There are currently 16 endorsements, although only three are active (Feindel, 2002).

In the mid 1990s, the industry employed from 75-100 individuals that processed sea cucumbers and 15-20 fishermen, with annual harvest of 453,542-1,360,512 kg. Landings had increased to over 3.6 million kg in 1999 and over 4.08 million kg in 2000. In 2001, landings decreased to 1.27 million kg. The decline was associated with the closure of two of the three processing plants (Feindel, 2002).

There have been some problems associated with the fishery. The primary concern is that most of the fishing effort is clumped in a few sites in three locations in eastern Maine, and there are anecdotal reports that some sites have been fished out. In some areas there are substantial amounts of bycatch associated with the fishery.

In general, bycatch is low in rocky areas where the species forms dense aggregations, while bycatch is much higher in muddy and gravel environments (Feindel, 2002).

To address concerns of possible depletion of the resource as interest in the fishery peaked, and to address gear conflict issues among lobster fisheries, regulations were implemented in March 2000 under the 1999 Sustainable Development of Emerging Fisheries Act. This included restrictions that limited the fishing season (closures between July 1 and Sept 31), defined gear size, and established a maximum number of endorsements, with licenses given only to individuals that had sold 100,000 kg during the previous year. Licensed fishermen are required to submit logbooks that include information on catch, time at sea, area fished and the value (Feindel, 2002). Maine has established a small (USD$500) Sea Cucumber Management Fund (§6813) to research and manage the State's sea cucumber fishery and enforce laws related to sea cucumbers.

3. Domestic and international trade

A. Exports and domestic consumption

Most of the *Parastichopus* spp. harvested in Alaska, California, Oregon and Washington are exported to Hong Kong, Chinese Taipei, mainland China and Korea. Chinese markets within the United States also purchase a portion of the sea cucumber catch. The majority are boiled, dried and salted before export, while lesser quantities are marketed as a frozen, pickled or live product. Exports of *Parastichopus* spp. are worth 0.31-0.68/kg. while the processed sea cucumbers can sell for up to $9 per kg (wholesale).

In Maine, fishermen are paid about USD $0.05 per unprocessed animal ($7 per tote) of *C. frondosa*. Internal muscle bands and the dried body wall are the primary export product, currently worth about $1.59 per kg. After harvest the animals are either loaded onto refrigerated trucks at the dock and shipped to Seattle for processing, or they are processed in Maine and shipped to mainland China, Hong Kong, South Korea, Singapore, Chinese Taipei and Japan. The peak export value of this fishery is estimated to be less than 1% of the global trade (Feindel, 2002).

The byproduct of processing from *C. frondosa* is marketed in the United States as nutritional supplement providing chondroiton (*NutriSea*), and is also sold as a treatment for arthritis for people (*ArthriSea* and *SeaCuMAX*) and pets *(Sea Jerky*) (Coast side Bio Resources, Stonington, Maine). The by product is also marketed as compost in Maine.

In American Samoa, the viscera of sea cucumbers are bottled, fermented and sold locally as a product called "sea".

B. Imports

i) Beche-de-mer
No commercial statistics are available on U.S. sea cucumber imports for food.

The west coast of the U.S. is a trans-shipment point for sea cucumbers originating in Latin America en route to Asia.

ii) Aquarium trade

The United States imports a small volume of live sea cucumbers for the aquarium trade primarily from south-east Asia. The genus *Pseudocolochirus* is the dominant import, although several smaller species such as *Pentacta anceps* and *Colochirus robustus* are also available. One Caribbean species, *I. badionatus*, is commonly imported and also collected in U.S. waters

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In Washington state, imports of live sea cucumbers is prohibited except by permit for scientific research or display under WDFW invertebrate disease control permits. There are no restrictions on import of market ready species for human consumption.

Table 5. Sea cucumber production and export. Production is in metric tons (FAO FishStat Plus v. 2.3; Hong Kong SAR import statistics).

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
U.S. Production	<0.5	481	472	2141	729	1779	-	2406	3732	4583
Hong Kong imports										181.57

Table 6. Summary of available information on commercial landings of sea cucumbers in the United States in metric tons (mt), live weight. * Washington data for 1999-2001 is the total allowable quota (not landings).

	1993	1994	1995	1996	1997	1998	1999	2000	2001
Alaska	693.5	786.7	670	485	465.8	543.4	764.6	578	721.7
Oregon	2.3	4.8	0	0	2.9	0	0.003	0.1	0.01
California	265.8	293.0	267.6	381	193.0	341	272		
Washington			529	237	227.0	208	427*	427*	427*
Maine		1451	1950	1270	453.0	2359	3630	4080	1270

Table 7. Controls and enforcement measures for sea cucumber fisheries in U.S. temperate waters.

Location	Licensing	Reporting	Validation
Alaska, USA	Divers registered and permitted.	Dive/harvest logbook with date, location (GPS), depth, bottom time, quantity.	Divers can only obtain permits for urchins or sea cucumbers but not both.
Washington, USA	Limited entry; 190 divers in 2000.	Logbooks with daily reporting of catch to avoid exceeding quota.	Must submit logbooks every month with data on date, depth location and amount (number and weight) collected.
Oregon, USA	Licenses issued up to 2003, with only two divers requesting a license.	Fish receiving tickets (dock ticket) required from sea cucumber dealers with fishermen's name, location, date and amount.	Cucumbers are listed under developmental fisheries species list category B. As of 2004 the fishery no longer requires a permit.
California, USA	Separate annual permits for each gear type: 113 dive permits and 36 sea cucumber trawl permits.	Dive and trawl fisheries target different species; all data lumped as sea cucumber landings.	Limit permits by requiring a minimum landing of 50 lbs during the previous year. Trawl fishery declined in 1998-1999 due to prosecution of 16 trawl fishermen that fraudulently obtained sea cucumber permits.
Maine, USA	16 endorcements (only 3 active).	Harvester Logbooks.	Limit licenses to fishermen that landed >250,000 lbs in a previous year. No incidental take allowed, only take through targeted, licensed fishery.

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NATIONAL REPORT – CANADA

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1. Nature of sea cuucumber fisheries
a. Species harvested

Species: *Parastichopus californicus* (Stichopodidae)
Location: British Columbia, west coast of Canada.
Range of species: Gulf of Alaska to Baja California; 0-249m.

Species: *Cucumaria frondosa* (Cucumariidae)
Location: Newfoundland, east coast of Canada. Test fishery. Most from by-catch of scallop dragging.

b. History of fishery

- Commercial exploitation began in 1971.
- Licensed fishery began in 1980 with many quotas overruns.
- Area closures and adjusted quotas began in 1986.
- Licenses limited in 1991.
- 1993-1996 a 3 year rotation introduced.
- In 1995 individual quota system introduced. Rotation no longer used.
- Quota management areas are being broken into smaller parcels to distribute effort.

c. Status of fishery in British Columbia

- Total allowable catch (TAC) based on stock assessment research earlier in the year. Commercial license holders and First Nations participate in biomass surveys.
- TAC in 2000 816,000 lbs
- TAC in 2001 850,000 lbs
- 25% of BC coast is open for commercial harvesting, 25% for research, 50% closed to harvesting pending more basic biological information and a review of adaptive management plan.
- 80% of fishery is on north and central coast of BC; 20% south coast.

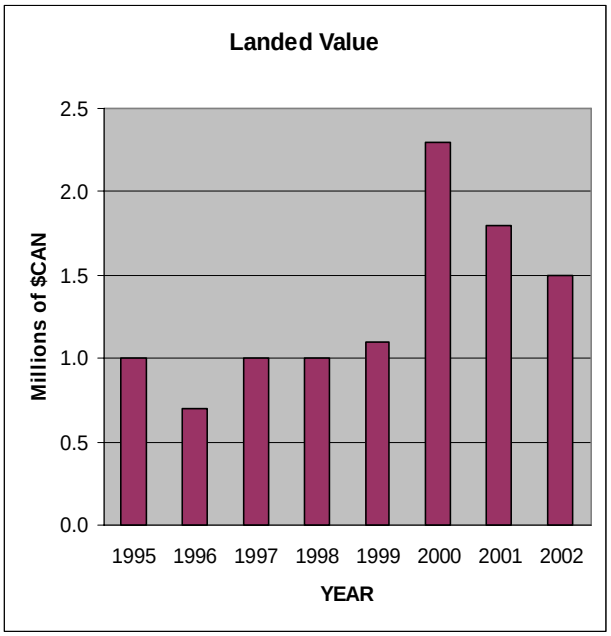
d. Harvesting

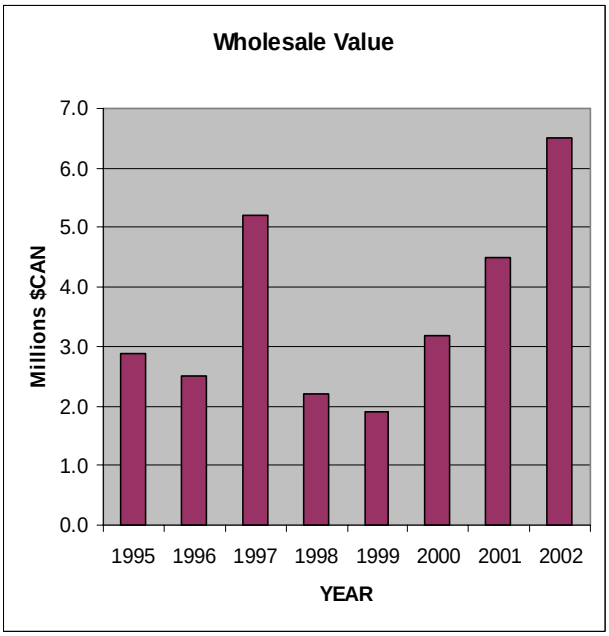
- Harvested by divers.
- 3 to 4 week fishery in the fall of year.
- Product sold as frozen muscle strips and dried skin.
- Exported to Hong Kong, Taiwan, mainland China, and Korea plus some domestic market.

e. Value of sea cucumbers in British Columbia

In 2002:

- 1,200 tonnes were harvested.
- Landed value was 1.5 million CAN$
- Wholesale value was 6.5 million CAN$
- Recreational harvesters are allowed 12 per day with a possession limit of 24.





f. National Policy

- Federal Department of Fisheries and Oceans manages the fishery through an adaptive management strategy.
- Sea cucumber Sectoral committee meets twice a year to discuss research objectives and plans, review stock assessment advice, and draft a management plan.
- 85 licenses based on an individual quota system.
- Minimum 2% of TAC goes to First Nations food, social and ceremonial use. The rest is distributed to the commercial licenses.
- The fishers are required to develop and fund a catch monitoring and validation program to ensure area and individual quotas are not exceeded.

g. Outlook

- With over 50% of the coast closed to harvesting there is presently no risk of stock collapse.
- Annual quotas are closely adhered to through the port validation of all landings.
- The effort or removing these detritus feeders from the ecosystem has not been investigated.

NATIONAL REPORT – EGYPT

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1. Nature of sea cucumber fisheries

First noted in the mid-1990s, the sea cucumber fishery started officially in 1998 in the southern part of Egypt. In the Red Sea the harvesting of sea cucumber involves two processes. In the south and in the Gulf of Suez trawlers harvest the sea cucumber using a benthic trawl. Initially part of the bi-catch, sea cucumber were later specifically targeted and subject to heavy trawling activity. In the central part of the Red Sea and the Gulf of Aqaba, scuba-diving is used for collecting the animals. In addition, some species are harvested by hand at low tide on the reef flats. In Egypt the processing of sea cucumber is not significantly different from the methods described previously in other fisheries and many descriptions have been given.

The catch and the total income derived from Bech-de-mer fishing in the Red Sea is known to have increased significantly between 1998 and 2000, mainly due to the dramatic increase in the value of sea cucumber over that period. In 1999, as the price of Bech-de-mer increased, the fishery expanded to cover the rest of the Egyptian coast of the Red Sea. During this time the number of boats using either SCUBA or trawling techniques doubled and the number of companies involved in the fishery increased significantly.

In April 2000 the Red Sea Governorate banned the fishing of sea cucumber in the Red Sea until a stock assessment supported by the Darwin Initiative could be performed. However, this ban only existed for the area of coastline under the jurisdiction of the Red Sea Governorate. The neighboring Suez Governorate, for example, continued with an open fishery. This lead to further depletion of stocks in the Red Sea as a whole, and added to the difficulty of policing of Red Sea Governorate coastal areas.

Furthermore, the ban also resulted in the development of a large illegal fishery in the region under the jurisdiction of the Red Sea Governorate. This illegal fishery continued unabated both as a result of the low level of patrolling (and difficulty of policing such a large area) and the development of a conflict between the EEAA, which wanted to limit the fishery, and the Ministry of Agriculture, Department of Fisheries, which aimed to exploit the resource to its maximum. There was a further, social, consequence of the illegal fishery. The official number of recorded deaths of fishermen involved in fishing for sea cucumber using SCUBA increased six-fold between 2000-2002.

Further evidence of the likely over-exploitation of the commercial species of sea cucumber in Egypt was illustrated by the fact that during the period 1998-2002 the number of species fished increased from an initial two, to up to 14 in the case of SCUBA. Thus, as the fishery increased, the numbers of the most valued species decreased and fishermen attempted to compensate for this by collecting other, less valuable species.

As a result of the conflict between different government agencies, the sea cucumber fishery was re-opened in 2002 and licenses were given to fishermen to collect sea cucumber. A total number of 52 boat licenses and 100 individual fishermen licenses were issued. Due to the further depletion of commercial holothuria, in March 2003 a meeting was held in the Red Sea Governorate to discuss the problem of seacucumber fishing in the Red Sea. The meeting included representatives from the EEAA, Ministry of Agriculture and Red Sea Governor. As a result of this meeting a second, complete ban on the fishery was instigated until the report of the current stock assessment could be provided.

Clear differences have been found in the abundance of the main commercial species when fished and non-fished areas are compared. There has been an almost complete loss of the most valuable species *H. scabra* and *H. nobilis*, as well as the removal of most commercial species from most fished areas. Whilst both seagrass and coral sites have been targeted by fishermen, their impact on seagrass areas appears to have been more severe.

Based on the interview data it is estimated that approximately 2400 tonnes of *H. scabra* were collected by trawling in 1998, dropping to 48 tonnes by 2001. Collection of *H. scabra* by divers peaked in 2001 with 896 tonnes and fell in 2002 to 67 tonnes. These figures are masked partly by the collection of other species, most of which have also shown a marked decline in catch. Based on the area survey it is estimated that there is approximately 400 tonnes of *H. scabra* left throughout the Red Sea coast of Egypt. This figure takes no account of habitat selectivity by this or any other species.

NATIONAL REPORT – AUSTRALIA

The CITES Management Authority of Australia

The Australian Government Department of the Environment and Heritage (DEH)]

Sea cucumber fisheries and current trade

- Legal trade

The Department of the Environment and Heritage (DEH), the CITES Management Authority of Australia, is responsible for the implementation of Australia's environmental legislation, the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The international movement of wildlife specimens is regulated under Part 13A of the EPBC Act, the objectives of which are:

- To ensure that Australia complies with its obligations under CITES and the Biodiversity Convention;
- To protect wildlife that may be adversely affected by trade;
- To promote the conservation of biodiversity in Australia and other countries;
- To ensure that any commercial utilisation of Australian native wildlife for the purposes of export is managed in an ecologically sustainable way;
- To promote humane treatment of wildlife;
- To ensure ethical conduct during any research associated with the utilisation of wildlife; and
- To ensure that the precautionary principle is taken into account in making decisions relating to the utilisation of wildlife.

Exporting

Sea cucumbers are considered regulated native specimens under Part 13A of the EPBC Act and therefore require an export permit from DEH. In order to get this permit, the operation from which the specimens are sourced needs to be an approved wildlife trade operation under the EPBC Act. There are a number of requirements that need to be met in order for an operation to be approved under the EPBC Act, including meeting the objectives of the Part (as listed above) and a 20 business day public comment period. Permits may also be issued for non-commercial purposes including education and research. Further detail regarding requirements for an approved operation under the EPBC Act can be found at http://www.deh.gov.au/coasts/fisheries/index.html .

Currently six sea cucumber fisheries in Australia have export approval under the EPBC Act (see Table 1 for details). A number of permits have been issued to companies to export sea cucumber product from these fisheries. These fisheries will all be undergoing a comprehensive assessment of their ecologically sustainable management against the *Guidelines for the Ecologically Sustainable Management of Fisheries* (http://www.deh.gov.au/coasts/fisheries/assessment/guidelines.html) within the next year.

Importing

No conservation-based import controls currently exist for non-live sea-cucumbers (controls may exist for other purposes such as animal or human health quarantine). For live sea-cucumbers, some species may be imported under an import permit; the remainder may not be imported.

- Illegal, unreported and unregulated trade

No data is available on levels of illegal, unreported and unregulated export or import.

- Bycatch

A very minor amount of sea cucumber is taken as bycatch in a number of trawl fisheries around Australia. For further detail on fisheries that have reported sea cucumber bycatch please see Table 1. Sea cucumber is not permitted to be retained if taken as bycatch in any of these fisheries.

- Socio economic characteristics of the trade is sea cucumbers

No information is available on the socio-economic characteristics of Australian trade in sea cucumbers.

Management and conservation strategies and practices

- **Fisheries management approaches**
- **Wild harvest**
- **Aquaculture**
- **Restocking**

Information relating to these items can be found in Table 1.

Australian sea cucumber fisheries are separately managed by the Commonwealth and State fisheries management authorities, therefore management arrangements vary across the different Australian jurisdictions.

Table 1 Summary of Australian sea cucumber fisheries

Commonwealth	
Management agency	Australian Fisheries Management Authority
Fishery	Coral Sea Fishery (holothurian component)
Total Catch 2002-2003	10,042kg were taken during the financial year. Almost no fishing has taken place since then.
Status	Unknown.
Species harvested	*Actinopyga mauritiana* (Surf redfish) *Actinopyga miliaris* (Blackfish) *Holothuria atra* (Lollyfish) *Holothuria nobilis* (White teatfish) *Holothuria scabra* (Sandfish) *Holothuria whitmaei* (Black teatfish) *Stichopus chloronatus* (Greenfish) *Thelenota ananas* (Prickly redfish) *Thelenota anax* (Amberfish)
Management measures	• Harvest not permitted within Nature Reserves within the fishery boundaries. • Sea cucumber may only be collected by hand with the use of SCUBA diving equipment. • Number of persons in the fishing operation limited to seven. • Catch limit of 75 t landed weight, per permit per year. • Species specific minimum size limit guidelines. • Catch limits for high value species per permit, comprising: - White teatfish – 2 tonnes - Black teatfish – 500 kg - Prickly redfish – 10 tonnes - Sandfish – 5 tonnes - Surf redfish – 5 tonnes - All other species – Uncaught proportion of 75 tonnes.
Other information	Two permits have been granted for the sea cucumber sector of the Coral Sea Fishery.
Fishery	Torres Strait Sea Cucumber Fishery
Total Catch 2002	Queensland logbooks recorded 126,556kg
Status	Sandfish, black teatfish and surf redfish overfished.
Species harvested	*Actinopyga echinites* (Deepwater redfish) *Actinopyga lecanora* (Stonefish) *Actinopyga mauritiana* (Surf redfish) *Actinopyga miliaris* (Blackfish) *Bohadschia vitiensis* (Brown sandfish) *Holothuria atra* (Lollyfish) *Holothuria edulis* (Pinkfish) *Holothuria fuscopunctata* (Elephant's trunkfish) *Holothuria nobilis* (White teatfish) *Holothuria scabra* (Sandfish) *Holothuria whitmaei* (Black teatfish) *Stichopus chloronatus* (Greenfish) *Stichopus variegates* (Curry fish) *Thelenota ananas* (Prickly redfish) *Thelenota anax* (Amberfish)

Management measures	• Limiting the method of taking sea cucumber to either hand or hand held non-mechanical implement, without underwater breathing apparatus. • A ban on the use of hookah gear. • Limiting Islander dinghies to less than 7 metres in length. • Non-Islander boat limited to 20 metres. • Size limits. • Bag limits for traditional fishing. • Total Allowable Catch (TAC) of: - Sandfish – 0 tonnes - Black teatfish – 0 tonnes - Surf redfish – 0 tonnes - White teatfish 260 tonnes - Prickly redfish – 260 tonnes - All other sea cucumber – collectively 80 tonnes
Other information	Fishing is limited to traditional inhabitants with the exception of one long-term non-Islander operator. Additional restrictions apply to this license holder to promote participation of Islanders in these activities. There are approximately 180 Islander dinghies in the fishery. Fishing for sea cucumber became important to the economy in the Torres Strait in the early 18th century. The fishery has been through periods of expansion and contraction primarily as a result of changes in market demand. During the 1990s, the fishery in Torres Strait experienced a resurgence. Fishing for sandfish on the Papua New Guinea side of Torres Strait was closed in 1993 due to concerns about overfishing. The closure remained in force until October 1995 and the fishery then operated under a management plan which included a 40 t (dry wt)/year Total Allowable Catch, a closed season and minimum sizes. Following a few years of fishing the sandfish fishery on Warrior Reef was again closed. Fishery independent assessments of the reef conducted since the closure have shown very little, if any signs of recovery. The sea cucumber fishery on the Australian side of Torres Strait experienced a similar boom which began in 1994, with catches in 1995 estimated to be between 1200 t and 1400 t; all but ~50 t of this being sandfish. Levels of exploitation were similar to those prior to the closure of the PNG Torres Strait fishery, and a survey in November 1995 found that the fishery was probably over exploited. A zero TAC has been placed on three species in response to concerns about sustainability of the species.
Recreational harvest	None
Illegal harvest	There are some reports of illegal harvesting of sea cucumber by Papua New Guinean fishermen. Quantities taken are unknown.
Bycatch	Sea cucumber are taken as bycatch in the Northern Prawn Fishery and Torres Strait Prawn Fishery, but are not retained.
Re-stocking / Aquaculture	None currently

Table 1 Summary of Australian sea cucumber fisheries (continued)

Queensland	
Management agency	Queensland Fisheries Service
Fishery	Queensland East Coast Beche-de-mer Fishery
Total Catch 2002/2003	264 tonnes (wet gutted weight)
Status	Black teatfish overfished.
Species harvested	*Actinopyga echinites* (Deepwater redfish) *Actinopyga mauritiana* (Surf redfish) *Actinopyga miliaris* (Blackfish) *Holothuria atra* (Lollyfish) *Holothuria fuscopunctata* (Elephant's trunkfish) *Holothuria nobilis* (White teatfish) *Holothuria scabra* (Sandfish) *Holothuria scabra* var. *versicolor* (Golden sandfish) *Holothuria whitmaei* (Black teatfish) *Stichopus chloronatus* (Greenfish) *Stichopus variegates* (Curry fish) *Thelenota ananas* (Prickly redfish)
Management measures	• Limited entry. • Minimum size limit of 15 cm for all species. • Specimens may only be taken by hand, and commercial fishers may use underwater breathing apparatus • TAC of 380 tonnes (wet weight) comprising: - Black teatfish – 0 tonnes - White teatfish – 127 tonnes - All other sea cucumber – 253 tonnes • TAC is divided among the 18 authority holders using a system of individual quotas. • Zones associated with Marine Parks closed to beche-de-mer harvest. • Permanent closure at the southern end of the fishery. • Only 4 dories may be used in association with the primary fishing vessel. • Prior reporting of product landings
Other information	Access to black teatfish populations in the Queensland East Coast Fishery was closed in October 1999 in response to serious decline in abundance of the species. Since this time fishery independent assessments of black teatfish stocks have shown very little, if any signs of recovery.

Queensland (continued)

Fishery	Queensland Morton Bay Beche-de-mer Fishery
Total Catch 2003	24 tonnes sandfish (wet gutted weight)
Status	Developmental fishery – underfished.
Species harvested	*Holothuria scabra* (Sandfish) *Stichopus horrens* (Peanutfish)
Management measures	• Limited entry. • Minimum size limit of 17 cm for both species. • Specimens may only be taken by hand. Hookah and scuba equipment is not permitted. • Fishery closed between 1 October and 30 November each year. • TAC of 45 tonnes gutted wet weight of sandfish and 25 tonnes gutted wet weight of peanutfish each year. • Zonal trigger limits for tonnage collected and time fished. • No more than two boats (less than 7m in length), each with no more than 3 persons, may be used at any one time. • Prior reporting of fishing activity
Other information	Only one non-transferable authority has been issued for the fishery. The fishery commenced harvesting in April 2003.
Fishery	There are small amounts of colourful holothurians collected in the Queensland Marine Aquarium Fishery for ornamental aquarium purposes.
Recreational harvest	Unknown, however thought to be very low.
Bycatch	Sea cucumber taken as very minor bycatch in prawn trawl fishery. They are **not** able to be retained.
Re-stocking / Aquaculture	One licensed hatchery (sandfish) and arrangements being made for trial growout.

Table 1 Summary of Australian sea cucumber fisheries (continued)

Western Australia	
Management agency	Department of Fisheries, Western Australia
Fishery	West Australian Beche-de-mer Fishery
Total Catch 2001/02	71,360 kg (live weight)
Status	Developmental fishery
Species harvested	*Actinopyga echinites* (Deep water red fish) *Holothuria atra* (Lolly fish) *Holothuria fuscogilva* (White teatfish) *Holothuria nobilis* (Black teatfish) *Holothuria scabra* (Sandfish) *Thelenota ananas* (Prickly red fish)
Management measures	• Limited entry. • Specimens can only be harvested by diving or direct collection by hand. • Species specific size limits. • Limited species permitted to be collected. • Maximum of 4 divers at any one time.
Other information	Access to the fishery is limited to six endorsed operators, all owned by the same company. There is one Aboriginal community with a non-transferable permit but it is not currently active. Since the rapid development of the fishery in the mid 1990's, when catch rates reflected the 'virgin' nature of the stock, production from the fishery has begun to stabilise. Fishing occurs in a relatively limited area compared to the wide distribution of the species within Western Australia. Sandfish dominates harvest from the fishery.
Recreational harvest	Negligible
Bycatch	Sea cucumber taken as bycatch in trawling fisheries but they are not allowed to retain it.
Re-stocking / Aquaculture	No established activity.

Northern Territory	
Management agency	Northern Territory Department of Business, Industry and Resource Development (DBIRD)
Fishery	Northern Territory Trepang Fishery
Total Catch 2002	207 tonnes
Status	Ecologically sustainable. Low participants (only 6 operators), large area.
Species harvested	*Actinopyga echinites* (Deep water red fish) *Holothuria atra* (Lolly fish) *Holothuria nobilis* (Black teatfish) *Holothuria scabra* (Sandfish) *Thelenota ananas* (Prickly red fish)
Management measures	• Limited entry. • Specimens can only be harvested by hand. • Species specific size limits. • Fishery split into two zones, with no more than three licences in each.
Other information	Entry is limited to six licences, and all are owned by a single company. The functional fishery only utilises a small proportion of the available fishing grounds. Sandfish dominates harvest from the fishery. The DBIRD advises that the NT Trepang (sea cucumber) fishery is a well managed sustainable fishery. The fishery is still in the developmental stage with catches well below the long term historical catch rates from periods when the fishery was heavily fished. The management arrangements aim to reduce any uncertainties by limiting the total number of licences available, fishing capacity, permitted methods and protecting adequate numbers of breeding stock. The adoption of such a strategy aims to ensure there is a high probability of the fishery not exceeding sustainable harvest levels, acknowledging that historical limits were a significant magnitude higher than current catch.
Recreational harvest	Negligible
Bycatch	Nil
Re-stocking / Aquaculture	Great interest in stocking and ranching for aquaculture in regional and indigenous communities.

NATIONAL REPORT – COSTA RICA

1. Information on wild populations

a) Species of non-commercial and commercial sea cucumbers in your country's waters:

Commercial: *Holothuria inornata* y *Stichopus fuscus*
Non-commercial: There is no information

b) Area of distribution, and habitats if known:

Distribution: In Costa Rica there are cucumbers of sea on both coasts: Pacific and Caribbean.It is known that there are cucumbers in the zones of sand, rocks, coral reef, to little depth, in clear and not contaminated waters.

American Pacific: In Costa Rica: Bay Salinas, Bay Cuajiniquil, Bay Santa Elena, Bay Culebra (Snake) (according to study realized in the place).
Habitat: superficial Waters in botton sandy, rocky (preferred).

c) Abundance (including anecdotal information): There is no information.

2. Nature of sea cucumber fisheries

a) Commercial, artisanal, subsistence: The harvest was with commercial ends between 1993 and 1994. At present there are not fisheries of these species.

b) Estimated number of fishers: 10 fishermen, according to the decree that regulates the harvest of sea cucumbers. Nevertheless, before the emission of the decree there was not a control of this situation.

c) Type of fishing methods and gear equipment used: Diving to lung, diving using compressor on board, hose, regulator, boats, outboard motor.

d) Licensing/permitting requirements: According to the Decree N° 23138-MAG, publishing in La Gaceta N° 80 on April 27, 1994: Licenses: 10
Requisites: 1-1200 sea cucumbers for fisherman per month
2- the fishing would be for two months per year
3- fishermen should land the product only in the ports of Cuajiniquil and Coco Beach.
4- fishermen will have to present a monthly report.
5- facilities for the process of the product must possess the permissions of industrialization, marketing and conservation of fishing products.

e) Sea cucumber farming, if any**:** In Costa Rica does not exist sea cucumbers farming.

f) Preferred markets (live vs. dried): Does not arrange of information of markets, but they were commercialized dried.

g) Identification of the most important uses of sea cucumbers: Information does not exist, but seemingly it was for consumption.

h) Landing data (species, bycatch, kg, sizes, etc), if available: There is no landing data.

i) Conservation measures (minimum harvesting size, closed areas, closed seasons, etc):

- Minimum harvest size: 20 cm
- Closed areas: only the crop was allowed between the bordering zone with Nicaragua and Punta Mala in Costa Rica, except in Bay Cuajiniquil, Muñeco Island , Bay El Hachal and Bay Tomas and in protected areas.
- Closed seasons: only the crop was allowed between October and April.

3. Domestic and International Trade

a) Information on value, retail, wholesale prices and trends:

Value or price: 30-40 colons at the cost of 10 years ago (it is equivalent at present to 0.07 to 0.09 dollars) exchange rates 1 $ = ¢ 425
Other information: There is no available data due to the fact that the activity of crop was left 10 years ago.

b) Export volumes, values and trends; import volumes, values and trends: There is no available data.

c) Information on key sea cucumber trading countries and territories: There is no information.

d) Trade controls and enforcement, including identification of specimens in trade: Before the decree there was neither regulations nor control, as soon as the decree was published, the Headquarter of Fishing Resources and Aquaculture realized control in the ports of discharge, in addition to the monthly reports that there had to present the fishermen who had to include: number of captured individuals, zone of harvest, invoices of selling of the product, date of selling, quantity and buyer.

e) Information on illegal, unreported and unregulated trade: There is no data.

f) Levels of domestic consumption, trends and trade: In Costa Rica there does not exist the habit of consuming sea cucumbers.

HARVEST AND TRADE OF TREPANG (FAR EAST SEA CUCUMBER) FROM THE RUSSIAN FAR EAST

TRAFFIC Europe-Russia

Far East sea cucumber (trepang) (*Apostychopus japonicus*, Selenka, 1867; old scientific name *Stychopus japonicus var. armatus*, Selenka, 1867) lives along Primorie coast up to Vladimir Bay to the north, near southern coast of Sakhalin island (Aniva Bay. isle of Moneron), along Korea peninsular and in the Yellow sea up to 33° northern latitude. Some of the latest research shows that the different species inhabit waters near Japan. Trepang lives on sea bottom at depth 20-50 m but could be found up to 150 m.

Trepang plays an important role in the littoral ecosystem as it adsorbs organics from bottom sediments (the only big benthos species in the area). One animal could process bottom ground from the area of 10-50 m^2 annually. Thus serious decrease in population of trepang could lead to intensification of eutrophication process in littoral areas.

Trepang is traditionally in high demand in Eastern medicine and cuisine. It contains biologically active elements such as tri-terpene glycosides. Sometimes trepang is called "sea ginseng" and believed to be effective for prophylactics of many diseases including cancer and impotency.

Harvest of trepang started in the region since the end of 19 century. At present the main technique is a diving. In 1970es the day norm for one boat (3 divers) was 242 kg (raw weight). According to the Pacific Institute of Fishery and Oceanography the trepang stock in Peter the Great Bay in 1970 was 6,030 tons (21,600 tons in 1959); about 1800 tons in Aniva Bay. Only 5% were matured animals good for harvest. Due to extensive harvest and several unfavorable for breading years total catch decreased significantly by the year 1977 (1970 – 274 tons; 1975 – 150 tons; 1977 – 35 tons). As a result the trepang harvest in Primorie was prohibited since 1978, and since 1980 on Sakhalin. At that time according to the experts the official harvest by state organizations was almost equal to private. By the year 1998 the stock of trepang in Primorie waters was estimated at about 300 tons (but the last real field census had taken place in 1970). Additional factors threatening trepang population are harvest during spawning period and harvest of animals at early estrus period.

Intensive illegal harvest started since the catch ban was established. Initially it was harvested for restaurant business but since early 1990s the main destination became China. Very soon harvest of trepang from small private business was converted into well organized and centralized criminal activity. Cost of raw trepang at black market is $2.5-4 per kilogram or $85-120 for kg of dried trepang (boiling and drying reduce weight by 16 times). Average cost of 1 dry kg at the Chinese border is USD100.

In some locations up to 80% of local male population is involved into this business, which is localized by several areas of trepang habitats. Usually dry trepang is going for export. Only in Peter the Great Bay about 300 ????????? are involved who harvest about 160 tons (in dry weight worth at 1 million USD). Far East Customs Department reported about 10 tons of seized dry trepang during 1995-1999 and 554 kg in 2001. Usually trepang is traded in large stocks.

The real status of the population and harvest pressure are unknown. The evidences and interview with locals and specialists show that trepang is already extinct in some areas and its population is decreasing rapidly.

NATIONAL REPORT – PAPUA NEW GUINEA

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INTRODUCTION

The tropical fisheries for beche-de-mer in Papua New Guinea (PNG) is one of the most important sources of income for rural coastal and island villagers throughout the country. The beche-de-mer fishery in PNG has a direct impact to the sociological and economic well being of communities as it allows for greater participation than any other fisheries in PNG. It assists in maintaining rural social stability by providing income-earning opportunities in remote locations where other earning opportunities are limited. Due to the simple, low technology methods of processing, it is an ideal commodity for rural areas as it does not require large capital outlays and can be stored for long periods without deterioration and without the need for immediate transport.

The income derived by coastal communities from the sale of beche-de-mer has increased dramatically throughout the 1990's in PNG. The large increase in production of beche-de-mer can be attributed to the decline in copra prices, the effects of drought in previous years, increased fishing for beche-de-mer in remote locations, a decline in the value of trochus and blacklip, and the establishment of new markets for previously low-value or non-commercial species, associated with the economic boom experienced by China. The diversity of beche-de-mer is now being altered in some areas due to this intensified and extensive exploitation and thus represents a threat to community livelihood strategies, and the fishery itself.

There is a need for a positive long-term impact on the development of the beche-de-mer fishery in a sustainable manner whilst maximising long term yields from the fishery.

1. Information on wild populations

In PNG, populations of commercial beche-de-mer are thought to be found in the Milne Bay, Manus, New Britain, New Ireland, Western and Central Provinces (DPI, 1983). Previous surveys have been limited to several species found in coastal lagoons along the South Papuan Coast (Shelly, 1981), and in some areas of New Ireland (Tenakanai, 1991), Madang (Lokani *et al,* 1992), Western (Mohiba *et al,*1993), Milne Bay (Lindholm, 1978; DFMR, no date; Chesher, 1980; Lokani *et al,* 1997; Skewes *et al,* 2002), Manus (Lokani and Chapau, 1992) and New Britian (Mobiha *et al,* 2000; Gisawa, 2002). See Annex 1 for distribution table.

The PNG National Fisheries Authority has an active stock assessment program, and surveys are ongoing around the country. Further follow up work is still required if the beche-de-mer fishery in PNG is to remain viable. There has been no annual surveys done during closure and prior to opening to assess the inter-annual change in stock variability.

2. Nature of sea cucumber fisheries

a) Culinary and Traditional Usage

With some exceptions, beche-de-mer does not appear on either traditional or modern menus of most Melanesian and Pacific communities, and thus the export trade does not conflict with local nutrition (except indirectly when it draws fishermen and gardeners away from their normal activities). In PNG, black teatfish, *H. fucogilva* (white teatfish), sandfish, and *Thelenota ananus* (prickly redfish) are consumed in different localities notably Central, Manus, West New Britain, Milne Bay province and New Ireland Provinces (Shelley, 1986; Lindholm, 1978).

b) Harvesting

Traditional methods of harvesting of beche-de-mer in PNG are done either by hand-collection or free diving. If it is in shallow enough water, people will wade across the reef collecting or if slightly deeper water, will dive down and spear it with a lengthened spear. If it is in deeper water, a small harpoon embedded in a lead weight will be dropped. The small harpoon punctures the beche-de-mer and brought by them to the surface. Dinghies are beginning to take the place of sailing canoes. The exporters sell them to villagers outright or on a hire-purchase scheme (see Smaalders and Kinch, 2003). The use of lights is a common practice. Hookah gear has been used in recent years.

c) Processing

Beche-de-mer is produced by a process of boiling, cleaning, drying and smoking and requires the use of boiling containers (typically discarded 200 litre oil drums); smoke sheds and racks, and large quantities of firewood. The boiling and drying process is to preserve and prepare the product for marketing. Beche-de-mer is usually boiled for a period of 2-3 hours. The cooled, cooked beche-de-mer is then taken to the sea where they are washed. Remnants of the stomach are then removed either by cutting down the length of the body in the case of black teat, white teat and prickly redfish, or by reaming a stick down the inside of them in the case of blackfish and greenfish. Prior to drying the body of beche-de-mer is opened wide and short sticks are inserted across the body cavity. The function of the sticks is to hold the cut edges apart to allow the interior to dry evenly by smoke and sun drying. Some are later wrapped in bark string or twine to ensure they achieve the shape desired by the purchasers. Drying is a slow process taking several days. The drying racks are usually housed in a small wooden stick-framed building covered with woven coconut palm fronds, which helps to concentrate the heat and smoke. After the curing process is finished, the beche-de-mer is then packed in copra or plastic sacks and delivered to market or sold to trade stores.

d) Sea cucumber farming, if any

There is no aquaculture of beche-de-mer in PNG though several proposals have been developed for it implementation.

e) Landing data

See Annex 2 for export figures.

f) Conservation measures

The need for the management of beche-de-mer fisheries in PNG was recognised from its inception in the 19th century due to declining catches. In 1881 a closed season was attempted by the colonial government, but failed to stop illegal fishing. In the early 20th Century attempts were made to manage the beche-de-mer at the Trobriand Islands in the MBP with an Act in the Colonial Administration (Territoty of Papua, 1934).

Today, the National Fisheries Authority (NFA) has gazetted the *National Beche-de-mer Management Plan 2001,* for regulation and management of the industry and the implementation of Provincial Management and Advisory Committees. The objectives of the *National Management Plan* are to manage the beche-de-mer fishery so that Papua New Guinea gains the maximum economic benefits from the fishery; to ensure that the development of the bêche-de-mer fishery benefits coastal communities, particularly customary users; and to ensure use of the bêche-de-mer resource is sustainable and that bêche-de-mer fishing has minimal impact on the marine and coastal environment.

One issue that needs to be recognised is the lack of extension for fishers on minimum size limits, appropriate collection and processing techniques. This has resulted in a loss of potential income and depletion of future stocks through the indiscriminate collection and subsequent rejection of undersized bêche-de-mer. Also a proportion of animals are rejected by purchasers due to decomposition caused by incomplete processing, drying and improper storage. Diving at night with torches and with under water breathing devices is prohibited.

Table 1. Size Limits for Beche-de-mer from the National Management Plan

High Value Species	**Scientific Name**	**Live Length (cms)**	**Dry Length (cms)**
Sandfish	*Holothuria scabra*	22	10
Black Teatfish	*H. nobilis*	22	10
White Teatfish	*H. fuscogilva*	35	15
Greenfish	*Stichopus chloronotus*	20	10
Curryfish	*S. variegatus*	25	10
Prickly Redfish	*Thelenota ananus*	25	15
Surf Redfish	*Actinopyga mauritiana*	20	8
Blackfish	*A. miliaris*	15	10
Stonefish	*A. lecanora*	15	10
Low Value Species	**Scientific Name**	**Live Length (cms)**	**Dry Length (cms)**
Tigerfish	*Bohadschia argus*	20	10
Brown Sandfish	*B. vitiensis/B.marmorata*	20	10
Chalkfish	*B. similes*	25	7
Flowerfish	*B. graeffei*		
Amberfish	*Thelenota anax*	20	10
Lollyfish	*Holuthuria atra*	30	15
Elephant Trunkfish	*H. fuscopuntata*	45	15
Pinkfish	*H. edulis*	25	10
Snakefish	*H. leucospilata*	-	-
Deepwater Redfish	*Actinopyga echinites*	25	15

Currently the compulsory closed season will occur each year from October 1-January 15 or when the TAC is reached. Each province has a set TAC.

An issue for the NFA who has responsibility for enforcing the TAC and the beche-de-mer fishery in the MBP is that the TAC has been continuously exceeded in recent years. For example the TAC set for the MBP in 2000 was 60 metric tonnes, but records show that nearly 184 metric tonnes were exported. In 2001, the TAC was set at 140 metric tonnes and nearly 210 metric tonnes was exported. The *National Beche-de-mer Management Plan 2001* has now been amended whereby if a province exceeds it's TAC it has the amount that is over deducted from the next year. There are currently moratoriums on harvesting in the Manus and Western Provinces' fisheries.

The PNG government is faced with the difficult decision of whether to take further management measures in an effort to make the fishery sustainable (albeit at a lower level of catch, and without any assurance of success), or to accept the unsatisfactory 'boom and bust' cycle of harvesting and wait for a long-term recovery. The latter is not in the interest of the fishery as slow recovery rates for depleted beche-de-mer populations have been recorded for some beche-de-mer fisheries in the South Pacific.

Overall the enforcement of the management plan has been poor.

3. Domestic and international trade

a) History of Commercial Exploitation

The beche-de-mer fishery in PNG is documented from 1878 but was probably exploited earlier than that (see Russell, 1970; Shelley, 1981). Beche-de-mer exports in PNG peaked in 1883 and then declined until 1888 where it peaked once again and declined again after. Factors contributing to this were the competition from sandalwood and falling beche-de-mer prices (Lokani, 1995). During this period, the value of beche-de-mer export for British New Guinea [Papua] ranged from 70-95% of all exports (see Lokani, 1990, 1995).

Anecdotal evidence suggests that exploitation of beche-de-mer in PNG declined in the latter half of the 19th century probably because of over-fishing. The harvesting of beche-de-mer was also affected in the first half of the 20th Century when the Chinese and Japanese markets were closed due to the Sino-Japanese War and World War II. The volume of exports during the 1960s and 1970s was due to enterprising Chinese based in Port Moresby, Samarai, Rabaul, Kavieng and Kieta (DFMR, no date). During the 1970s the only area of PNG that was producing beche-de-mer in commercial quantities was the MBP.

All the commercially-exploited species of beche-de-mer are in the two families Holothuriidae and Stichopodidae in the order Aspidochirotida. Currently 19 species of beche-de-mer are taken from PNG waters with most of these being low value species and the fishery is currently changing from a low-volume, high-value fishery to a high-volume, low-value trade.

b) Export volumes, values and trends

Like all of the other Melanesian countries experiencing the current boom, there are now many more different beche-de-mer species being fished in than previously and prices have increased exponentially. Brown sandfish, greenfish and *Bohadschia similes* (chalkfish) were not previously exported and some common names often represent a number of species, particularly *H. atra* (lollyfish) and *Actinopyga miliaris* (blackfish). Some species of previously low-value beche-de-mer have shown increases in prices between approximately

1,000-3,000 per cent indicating that the process of depletion could progress through the value chain if not properly managed. This increase in value may also be due to market acceptance as previously unknown low-value product becomes better known to consumers

The MBP is the largest producing province in PNG and now contributes roughly 40% of the total exports. The increased production, can also be related to declines in other provinces, notably Western and Manus and also the opening up of previous unfished areas within the MBP.

c) Information on key sea cucumber trading countries and territories

All beche-de-mer exported from PNG is usually exported to Hong Kong (a Special Administrative Region of the Republic of China), Singapore and Korea.

d) Licensing and permitting requirements

The beche-de-mer industry is a restricted activity under the laws of PNG and a non-citizen should not be issued with any license, engage in any part of the domestic beche-de-mer fishing industry or finance any aspect of the domestic industry. Despite this, non-citizens are still actively involved in the beche-de-mer fishery throughout the country, usually they advance money to a local buyers in order that they can purchase product.

One major issue of smuggling activities is that there are no official records, which has serious implications for the enforcement of the TAC.

CONCLUSION

Management of the beche-de-mer fishery in PNG is required to achieve sustainable levels because it provides the only realistic self-generated source of cash to island and coastal communities. Since beche-de-mer stocks are under increasing pressure from over-fishing some immediate steps need to be undertaken to limit the effort exerted on the stocks as a loss of income and depletion of future stocks through the indiscriminate collection and subsequent rejection of undersized bêche-de-mer will cause dire social problems.

Management strategies that could be tested include having TACs at the Local level Government level and for certain species with low abundances it maybe necessary to implement specific closures on these species by the setting of species specific TACs. Resources need to be allocated for awareness and capacity building at the village level for management of these valuable resources. This would include extension and training materials on processing and appropriate harvesting methods; village awareness of over fishing on resource sustainability; the possible incorporation of traditional closed seasons or areas (the best means of policing closed areas may be through village involvement) and limited entry.

Effective monitoring is necessary to prevent over-exploitation and depletion of beche-de-mer resources and further study is required on models of resource extraction. There is a need to continue stock assessments; monitor active fisheries and recovery rates; apply proper enforcement of recording of data; empowerment and support for fisheries inspectors and monitoring of overseas market. Finally, the potential for hatchery and re-seeding programs should be investigated.

Fig. 2 Boiling and processing beche-de-mer

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Annex 1: Species Density for PNG

Species	Mean Density (No./ha)	Maximum Density (No./ha)	Abundance Range (No./200 m²)	Province	Reference
Holothuria nobilis (black teatfish)		275		West New Britain	Lokani, 1991
	9.75			Manus	Lokani and Chapau, 1992
	16.83			Madang	Lokani *et al*, 1992
	0.18			**Milne Bay**	Skewes *et al*, 2002
H. fuscogilva (white teatfish)		54		West New Britain	Lokani, 1991
	3.50			Manus	Lokani and Chapau, 1992
	3.27			Madang	Lokani *et al*, 1992
	0.42			**Milne Bay**	Skewes *et al*, 2002
H. scabra (sandfish)	2,900.00	13,500		Central	Shelly, 1981
	19.13			Manus	Lokani and Chapau, 1992
	22.23			Madang	Lokani *et al*, 1992
			0.40-9.82	Western	Mobiha *et al*, 1993
	0.00			**Milne Bay**	Skewes *et al*, 2002
H. atra (lollyfish)	80.04			Madang	Lokani *et al*, 1992
			0.00-17.00	Western	Mobiha *et al*, 1993
	9.81			**Milne Bay**	Skewes *et al*, 2002
H. fuscopunctata (elephant trunkfish)	18.21			Madang	Lokani *et al*, 1992
			0.00-0.02	Western	Mobiha *et al*, 1993
	0.04			**Milne Bay**	Skewes *et al*, 2002
H. leucospilota (snakefish)	3.29			Madang	Lokani *et al*, 1992
Actinpyga echinites (deepwater redfish)	1,800.00	12,500		Central	Shelly, 1981
		4,025		West New Britain	Lokani, 1991
	105.50			Manus	Lokani and Chapau, 1992
	6.69			Madang	Lokani *et al*, 1992
A. lecanora (stonefish)		25		West New Britain	Lokani, 1991
	0.86			Madang	Lokani *et al*, 1992
	0.02			**Milne Bay**	Skewes *et al*, 2002
A. mauritiana (surf redfish)		304		West New Britain	Lokani, 1991
	9.50			Manus	Lokani and Chapau, 1992
	38.69			Madang	Lokani *et al*, 1992
			0.00-0.21	Western	Mobiha *et al*, 1993
	0.12			**Milne Bay**	Skewes *et al*, 2002
A. miliaris (blackfish)	36.9			Manus	Lokani and Chapau, 1992
	4.34			Madang	Lokani *et al*, 1992
			0.00-0.75	Western	Mobiha *et al*, 1993
	0.12			**Milne Bay**	Skewes *et al*, 2002
Thelenota ananus (prickly redfish)		79		West New Britain	Lokani, 1991
	1.63			Manus	Lokani and Chapau, 1992
	8.04			Madang	Lokani *et al*, 1992
	0.47			**Milne Bay**	Skewes *et al*, 2002
T. Anax (amberfish)	4.50			Manus	Lokani and Chapau, 1992
	6.03			Madang	Lokani *et al*, 1992
	0.63			**Milne Bay**	Skewes *et al*, 2002
Stichopus chloronotus (greenfish)		4,258		West New Britain	Lokani, 1991
	16.00			Manus	Lokani and Chapau, 1992
	128.20			Madang	Lokani *et al*, 1992
			0.00-1.21	Western	Mobiha *et al*, 1993
	3.81			**Milne Bay**	Skewes *et al*, 2002
S. hermanii (curryfish)		456		West New Britain	Lokani, 1991
	8.63			Manus	Lokani and Chapau, 1992
	8.06			Madang	Lokani *et al*, 1992
			0.06-3.08	Western	Mobiha *et al*, 1993
	0.09			**Milne Bay**	Skewes *et al*, 2002
Bohadschia graeffei (flowerfish)	3.45			Madang	Lokani *et al*, 1992
			0.00-9.06	Western	Mobiha *et al*, 1993
	0.37			**Milne Bay**	Skewes *et al*, 2002
B. argus (tigerfish)	9.48			Madang	Lokani *et al*, 1992
			0.00-0.21	Western	Mobiha *et al*, 1993
	1.33			**Milne Bay**	Skewes *et al*, 2002
B. vitiensis (brown sandfish)	4.43			Madang	Lokani *et al*, 1992
			0.00-1.00	Western	Mobiha *et al*, 1993
B. marmorata (brown sandfish)	**0.99**			**Milne Bay**	Skewes *et al*, 2002

Annex 2: PNG Beche-de-mer Exports 1960 – 2001

Year	Quantity	Price in Kina	Reference
1960	1,623	-	Lindohlm, 1978
1961	2,400	-	Lindohlm, 1978
1962	4,448	-	Lindohlm, 1978
1963	12,845	-	Lindohlm, 1978
1964	6,295	-	Lindohlm, 1978
1965	4,092	-	Lindohlm, 1978
1966	4,413	-	Lindohlm, 1978
1967	10,468	-	Lindohlm, 1978
1968	11,183	-	Lindohlm, 1978
1969	12,401	-	Lindohlm, 1978
1970-71	6,527	-	Lindohlm, 1978
1971-72	3,872	-	Lindohlm, 1978
1972-73	9,869	-	Lindohlm, 1978
1973-74	4,068	7,041	DFMR, no date
1974-75	1,214	2,590	Lindohlm, 1978; DFMR, no date
1975-76	1,665	4,470	Lindohlm, 1978; DFMR, no date
1977	5,325	13,297	Lindohlm, 1978
1978 (Jan-Apr)	5,903	-	Lindohlm, 1978
1979	1,300	4,000	DFMR, 1979
1980	2,351	7,445	Wright, 1986 cited in Kailola with Lokani,
1981	11,090	25,966	Wright, 1986 cited in Kailola with Lokani,
1982	22,960	73,409	Wright, 1986 cited in Kailola with Lokani,
1983	7,630	23,938.97	Lokani and Kubohojam, no date; Lokani, 1990
1984	4,668	13,472.49	Lokani and Kubohojam, no date; Kailola with Lokani, no date; Lokani, 1990
1985	19,491	58,192.00	Lokani and Kubohojam, no date; Lokani, 1990
1986	119,376	361,336	Kailola with Lokani, no date
1987	192,055	591,009.22	Lokani and Kubohojam, no date; Lokani, 1990
1988	202,789	801,770.13	Lokani and Kubohojam, no date; Lokani, 1990
1989	194,896	1,146,584.85	Lokani, 1990
1990	238,923	-	Lokani and Kubohojam, no date;
1991 (Jan-Aug)	626,047.50	4,637,807.43	Lokani and Kubohojam, no date; Gaudechoux, 1993
1992	655,462.00	4,993,123.00	Myint, 1996
1993	499,489.46	3,044,843.86	Myint, 1996
1994	208,795.70	-	NFA database
1995	444,747.00	4,491,037.71	Myint, 1996
1996	586,201.80	7,872,385.78	NFA database
1997	505,402.40	7,683,437.15	NFA database
1998	678,848.85	16,892,866.13	NFA database
1999	394,682.45	11,023,884.90	NFA database
2000	607,311.06	16,311,191.35	NFA database
2001	482.281.40	17,196,625.33	NFA database

(Note: This Table is to be used as a guide only. All data supplied by the NFA database may be incomplete as the database is still under development and all entries may have not yet be included).

Recommendations of *Advances in Sea Cucumber Aquaculture and Management.*

This document is an extract from *Advances in Sea Cucumber Aquaculture and Management*. 2004. Lovatelli, A., C. Conand, S. Purcell, S. Uthicke, J.-F. Hamel & A. Mercier, eds. regarding the recommendations made at the Workshop on Advances in Sea Cucumber Aquaculture and Management (ASCAM), 14-18 October 2003, Dalian, China.

Recommendations for sea cucumber fisheries and management – Sessions 1 and 2

From the reports presented during this workshop on sea cucumber fisheries and aquaculture, it was clear that sea cucumbers in most countries are suffering from heavy exploitation and population depletion. The discussion sessions were used to develop recommendations agreed by the participants.

During these discussions, it was recognized that a critical need is to establish and implement management plans towards sustainability of adequate breeding populations of all fished species. Countries should also aim to develop management plans prior to opening further fisheries - only one of the counties reported at this conference (Cuba) had data of virgin stock biomass.

An overriding issue is the lack of information on appropriate management approaches and analytical tools. The fact that over fishing and stock depletion is still occurring indicates that specific approaches are needed for managing sea cucumber trading and fisheries.

Catches and processed products records

In order to manage the existing resources and regulate trade, data at the national level (on catches, processing and exports) need to be collected. Because these activities demand human resources, governments should incorporate these activities into the fishery section of their national budgets.

Statistics at national and international levels should be standardized to ease cross-referencing between countries.

Major points to be considered, as inaccuracies still appear in several countries:

- Records on the main species or taxonomic groups should be made available to the public.
- Wet weights should be recorded for landings, and it should be clearly defined if these are gutted or whole animal wet weights (and, if possible, conversion factors between these given).
- The grades and sizes need to be recorded in order to quantify the extent of harvests and processed products.
- The numbers of animals should also be listed in records, to allow an estimation of the sizes.
- Data from processors should reflect the actual weight of the product forms (e.g. fresh, frozen, dried).
- Compilation of the statistics should be the responsibility of the national authority.
- If data are collected through exporters/ traders at the national level, regulations (and possibly penalties) should be placed on the non-reporting of exports.
- Double-reporting in trading (import and re-export) needs to be monitored and documented by regional/ international bodies.
- A uniform taxonomic guide is needed for fishery workers and traders. This point will need some agreements between scientists, as the names of several species changed recently.

Harvesting and post-harvesting methods and information

In many sea cucumber-producing countries, a large section of the harvest is produced as a sub-standard product that enters international trade as low value items. In many cases, both fishermen and exporters fail to realize the maximum value of the resource. Therefore technical assistance on post harvest handling, processing and quality assurance is required in developing countries. This may reduce pressure on the existing sea cucumber resources if fewer animals need to be harvested to earn equivalent money.

A strong recommendation was for the development of manuals and training courses/workshops for best practices in post-harvest handling and processing. These should be presented in local languages and in simple terms.

These manuals should include, but not be restricted to, the following:

- Fishing and handling methods to minimize damage of harvested animals
- Post-harvest handling techniques
- Updated and reliable methods for processing, established from both research and sourcing of existing information. These should be described for different species, but recognizing differences in needs of different buyers and markets

Additionally, research is needed to analyse the supply and demand for sea cucumbers with projections for the next 15-20 years. In particular, it should be investigated as to what effect the large increase in production of *A. japonicus* in China will have on the global market.

Socio-economics and legislation

Public awareness of sea cucumber fisheries should be raised at a range of levels to highlight their importance and vulnerability to overfishing. Networking and cooperation among researchers and fishery workers should be promoted. This could be achieved by forming associations for processors and traders, researchers, fishery managers and farmers. Additionally, newsgroups via email or the internet would be valuable for exchange of information.

Sea cucumber fishing is very important to the livelihoods of coastal communities, particularly artisanal and small-scale fishers in developing countries. Therefore, socioeconomic issues in sea cucumber fisheries are important and should be recognised and incorporated in fishery management programmes. In particular, livelihood options should be made available to fishers if management regulation put restrictions on the fisheries, such as bans on fishing.

International intervention (e.g. IUCN/CITES) may be needed to assist in the conservation and management of sea cucumbers. However, caution should be exercised when intervening in or regulating trade for all regions, as there are regional differences in the status of populations of sea cucumbers, habitats and environment. The possibility to initiate listing in CITES Appendix 2 or 3 for certain countries should be examined and the effects analysed. A sea cucumber species from South America and the Galapagos Islands were the first such animals listed in Appendix 3.

Legislation should involve the following:

- Participation of stakeholders (including fishers, processors, policy makers, managers, exporters) in formulating management plans
- Authority divested at local/customary level, in certain circumstances (e.g. Melanesian artisanal fisheries with customary tenure)
- Enforcement to ensure protection of sea cucumbers and their habitats

Stock assessment

Common methods of data collection and presentation of results should be developed for commercially exploited species. However, it should be clearly recognized that ecological traits differ markedly amongst species, thus a management as a multi species fishery is strongly discouraged.

Initial stock surveys should be conducted before a fishery commences in order to obtain information on the virgin biomass. Monitoring the recovery of stocks after fisheries have been closed should also be encouraged.

Several key recommendations:

- Habitat types (e.g. cover of sea grass or corals, sediment or substratum characteristics) should be recorded for each survey unit (e.g. transect).
- GPS waypoint referencing should be applied where possible. This technique will allow sites to be visualized using GIS technology and can allow more accurate calculation of stock densities and, in certain circumstances, distances between individual holothurians.
- The size and spatial context of the populations need to be defined, in particular, the area surveyed and the likely area occupied by the sub-population.

Management plans

Management plans for sea cucumbers fisheries should be conservative because stocks are vulnerable to overfishing. The most incipient threat is the depletion of sustainable breeding populations that endangers natural replenishment of populations.

The participants identified a number of recommendations for fisheries managers that should be followed to prevent depletion of breeding stocks:

- The collection of sea cucumbers using compressed air (either SCUBA gear or hookah) or weighted hooks should be restricted. Bans on using compressed air can protect deep stocks, but caution should be given because shallow stocks may be more important for spawning. In cases where SCUBA or "hookah" diving is permitted, the divers need to be trained to avoid risk to life of the divers and adhere to accepted OH&S guidelines, including the use of safe equipment.
- A "code of conduct" should be promoted for responsible fishing practices. This would involve common sense fishing practices such as not collecting under-sized sea cucumbers and preserving a proportion of the populations to act as breeding stock.
- Habitats should be protected as well as the resource. Authorities should endeavour to protect the ecosystems in which sea cucumbers live and, conversely, recognize the important role that sea cucumbers play in ecosystem processes. Where sea cucumber habitats have been damaged, rehabilitation should be considered.

- Attention should be given to evaluating the occurrence and significance of sea cucumbers as by-catch in trawl nets and dredges. These indiscriminate fishing methods can impact populations and habitat. By-catch of sea cucumbers in other fisheries needs to be both researched and documented.
- Sea cucumbers should be recognized as significant marine resources, whether fished or not. The management of sea cucumbers should be embodied within the broader context of sustaining marine resources.
- Regular monitoring of populations should be employed and, in the case of restocking or use of moratoria, the recovery of depleted populations should be evaluated.

Fisheries regulations should aim to protect ample breeding populations of each species. If the populations of any species are fished below levels perceived to be minimal for breeding populations, then bans or moratoria should be placed to halt further fishing. For areas that have been closed to fishing by moratoria, the lifting of fishing bans should only proceed after it is established that stocks are viable for reproduction and can sustain fishing.

Critical Research Needs

Research and assistance should have a stronger emphasis in countries where sea cucumber fisheries are important, where exploitation has been high, or where knowledge is critically lacking. Research should also be promoted in a range of countries to test generalities among regions and cultures. The main research topics needing attention are listed below.

1) Parameters for fishery models: Growth, mortality and recruitment

Most crucial is the need for research on growth rates, particularly in early stages (juveniles) in the wild. This information must be gained from individual species obtained in laboratory and field studies. In addition, data from several locations need to be available in order to know if patterns are general or location-specific. Information on mortality and longevity in the wild are also needed, to allow sustainable catch rates to be estimated.

Research on larval ecology and recruitment processes of holothurians is also needed to develop fishery models, and these processes will be widely variable in space and time.

Maximum sustainable yields should be estimated for different types of sea cucumber fisheries, based on surveys of stock size and estimates of recruitment, growth and natural mortality. In many cases, however, these data may not be available. If this is the case, TACs should be set conservatively (e.g. assuming less that 10% of virgin biomass can be taken) until subsequent monitoring of stocks, recruitment and catch data indicates that catch rates could be increased without jeopardizing larval production and subsequent recruitment.

Moreover, TACs alone are not sufficient for the management because this tool does not consider the size structure of existing stocks. A fishery could be made up of small animals, which are harvested at the expense of egg production of the site.

2) Minimum stock size for viable breeding populations

Populations need to be maintained at a minimum threshold level to ensure successful reproduction in the wild. This is because sea cucumbers use chemical cues to spawn and need to be close to mates in order for fertilization of oocytes. Below such threshold densities of adults, populations will fail to repopulate naturally. A disproportionate reduction of recruitment when densities of spawners are reduced has been termed the “Allee” effect in the general ecological literature.

Studies are needed to establish the thresholds for minimum size of effective breeding populations to avoid Allee effects. Some literature exists for other taxa, but research is needed on the research tools to establish this threshold. Therefore, substantial information on fertilization kinetics, reproduction and chemical cues in holothurians is required. Research related to population size-dependent reproductive success exists, but these studies have long been considered theoretical aspects with little practical use and therefore not used by the fisheries industries/program managers. This means, not only more research but also better distribution and application of the existing literature is needed.

3) General ecological studies

In addition to studies on larval recruitment (see above), other studies should examine the factors affecting the movement of sea cucumber larvae within the water column and factors influencing settlement. An understanding of larval movement and settlement processes will improve predictions on dispersal and the likelihood of self-recruitment and natural replenishment of populations. Specifically, more information is needed on the source and sink of recruits for local populations.

General research tools are needed for collecting and analysing quantitative data on the ecology of sea cucumbers, taking into consideration their seasonal and diurnal behaviours.

Information on the juvenile ecology of holothurians is sparse, but is needed.

Little research exists on the effects and benefits of sea cucumbers on ecosystem. Data available indicate that removal of these animals could lead to major changes to the ecosystem, such as decreased overall productivity. However, to confirm this effect, large-scale experimental work in multiple areas with natural densities and over-fished areas must be conducted.

4) Effectiveness of MPAs or No-Take Zones *and methods of management*

Different modes of management have been used for sea cucumber fisheries but few cases, both of failures and successes, have been documented. There is a need for a review that summarizes case studies where management has worked and how participatory management can be used.

Knowledge on the effectiveness of MPAs (especially *No-Take Zones*) and comparison of a range of management methods (such as broad fishery closure) should be collated. Research should also be encouraged to determine the appropriate sizes, numbers and spatial design of MPAs, and to investigate if "spillover" effects from these zones into fished areas occur. This could also include a review of existing literature and case studies on MPAs.

Research is needed generally for understanding which management tools/approaches are best for sea cucumber fisheries and under which circumstances. This could include tax, regulating the number of fishers, fishing effort, times, sites, sizes.

5) Stock delineation

Stock delineation and quantifying the extent of populations are important for managing stocks and understanding recruitment. Such information is particularly relevant for restocking over broad spatial scales, due to likely adverse effects on genetic diversity if genetically different stocks are mixed.

6) Taxonomy

The taxonomic status of some of the most valuable holothurian species is uncertain and recent studies indicated the potential for the existence of a number of cryptic species among holothurians. Classical and genetic taxonomic studies are needed to clarify the status of beche-de-mer species.

7) Restocking

Restocking is generally only a last resort if other management measures to recover a depleted fishery have failed. Good management to preserve breeding populations should be the first solution, because there are risks of changing genetic diversity of existing stocks when juveniles are released for restocking or stock enhancement.

Recommendations for restocking:

- Definitive studies are needed about the economic viability and returns from restocking programs in which hatchery-produced juveniles are released into the wild.
- The value and significance of restocking to ecosystem functioning and long-term repopulation needs to be included in cost-benefit analyses.
- Release of hatchery-produced juveniles should only be conducted at sites with the same genetic stock as the broodstock used for production. Translocation of animals into foreign grounds should be prohibited.
- Spawners (both male and female) must be chosen in sufficient numbers to warrant genetic diversity and gene frequencies in the offspring similar to that in the receiving areas.
- The danger of the transfer of disease, parasites and introduced species from restocking programmes needs to be controlled. Transfer protocols and disease checks need to be developed to ensure healthy juveniles are used for restocking.
- The carrying capacity of the habitat (in terms of both number and biomass) should be evaluated before restocking.
- Methods on the best strategies for releasing juveniles should be researched prior to restocking.

Recommendations for aquaculture – Session III

1. Dissemination of available data on sea cucumber aquaculture

The presentations and following discussions have brought to light a huge amount of knowledge. Several ways to disseminate and share this information have been proposed.

Publication of a manual or guide on sea cucumber aquaculture. The chief recommendation made by the participants of the workshop was to prepare and publish a reference manual that would compile the various aquaculture techniques currently available or being developed for the main commercial species of sea cucumbers. This practical guide should be well illustrated and be written in a clear accessible

language that would address the needs of prospective aquaculturists and farmers. It would indirectly provide basic information on sea cucumber aquaculture to stakeholders and policy makers. Although it should first be published in English, the book could eventually be translated to reach a broader audience, especially the Chinese community who has made a significant contribution to this field. Topics that are likely to be covered in such a manual include:

Hatchery techniques

- o Brood stock collection and handling
- o Spawning induction
- o Larval rearing
- o Early juvenile rearing

- **Farming/sea ranching techniques**
    - o Juvenile grow-out
    - o Pond preparation/management
    - o Co-culture with other species (polyculture)
- **General advice**
    - o Summary of cautions and known difficulties
    - o Main components and basic costs of a sea cucumber aquaculture project
    - o Glossary of technical and popular terms

Enhancement of international exchanges The bringing together of experts from the scientific, technical and business aspects of sea cucumber aquaculture was another important outcome of the workshop. In order to encourage collaboration and technology transfer, it has been suggested that a directory of specialists from the different fields of activity be compiled and made available. It could include a complete listing of available references pertaining to the main commercial species as well as a list of available directories/contacts pertaining to import/exports and markets. This index of literature and experts should be accessible in print as well as through the internet. An additional means of encouraging communication, cooperation and collaborative efforts that has been proposed is the creation of workgroups and networks, perhaps through international agencies such as the World Aquaculture Society.

Because communication relies on a certain degree of uniformity, consideration should be given to the standardization of the vocabulary used to report the data in the future.

2. Suggestions for future research and development

The presentations and discussions have shown that although significant breakthroughs and advances have been made by many teams in the field of sea cucumber aquaculture, a number of aspects still need to be investigated in order to allow further development. This is especially true for tropical species of sea cucumbers being cultivated in developing nations.

2.1 Fundamental biological research. Several problems in the culture of sea cucumbers stem from the lack of basic knowledge on the general biology of both adults and juveniles. Main areas of research should include reproduction, feeding ecology, substrate selection, predation on all life stages and chemical defences.

It has been suggested that hatchery-reared juveniles could develop a behavioural deficit that would lower their survival rate once they are released in the field during the course of restocking procedures. This has to be studied as well as the potential effect of captive-breeding on the presence or levels of bioactive substances in the tissues, which have various roles: some can serve as defence mechanisms and other have properties that are valued in processed products sold for human consumption.

A better knowledge of the diseases and parasites that affect all the life stages has to be acquired in order to identify the causal agents of the major culture failures, and discriminate between the deleterious and potentially beneficial species that live in association with sea cucumbers.

2.2 Hatchery techniques. Most of the existing methods used to induce spawning in sea cucumbers are still not very reliable. Furthermore, the common practice of shocking the brood stock (thermally or mechanically) is suspected to result in the shedding of immature or deteriorated gametes. Alternative methods for spawning induction should be investigated to maximize both the quantity and quality of gametes obtained, and optimise the success of the cultures.

Metamorphosis from pelagic to benthic forms remains a crucial step in sea cucumber aquaculture during which high mortality rates are recorded. Hence, investigation of settlement requirements and preferences should remain a priority. The formulation of feeds should also be studied to improve the growth and survival rates of the larval and juvenile stages.

Another important research area is the control of disease outbreak in aquaculture. The uncontrolled utilization of antibiotics is a growing concern. Their effect on the sea cucumbers themselves, on the environment and on the eventual consumers should be investigated closely and alternatives developed and promoted.

2.3 Farming/sea ranching. For the species that have been successfully reared to juveniles, methods used in the growout of post-metamorphic stages should be improved to maximize cost-effectiveness. More specifically, different factors pertaining to the preparation and optimisation of ponds and sea ranching sites (habitats, substrates, enclosure materials, control of environmental factors, etc.) could be studied.

The possibility of recycling abandoned infrastructures used to grow other marine species to meet the needs of sea cucumber aquaculture should be assessed, as well as the prospects for co-culture of sea cucumbers with other commercial species, either simultaneously or successively.

3. General preoccupations

Even though the purpose of the workshop was to gather knowledge from different experts in order to promote and help in the development of sea cucumber aquaculture, several participants have expressed a number of concerns. One of the concerns is the potential effect that commercial-size aquaculture facilities could have on the environment. As the industry develops, the benefit and usefulness of farming and sea ranching in different environments and countries should be addressed and weighed against the cultural and environmental costs. Ultimately, guidelines for ethics and conservation measures should be developed and promoted.

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