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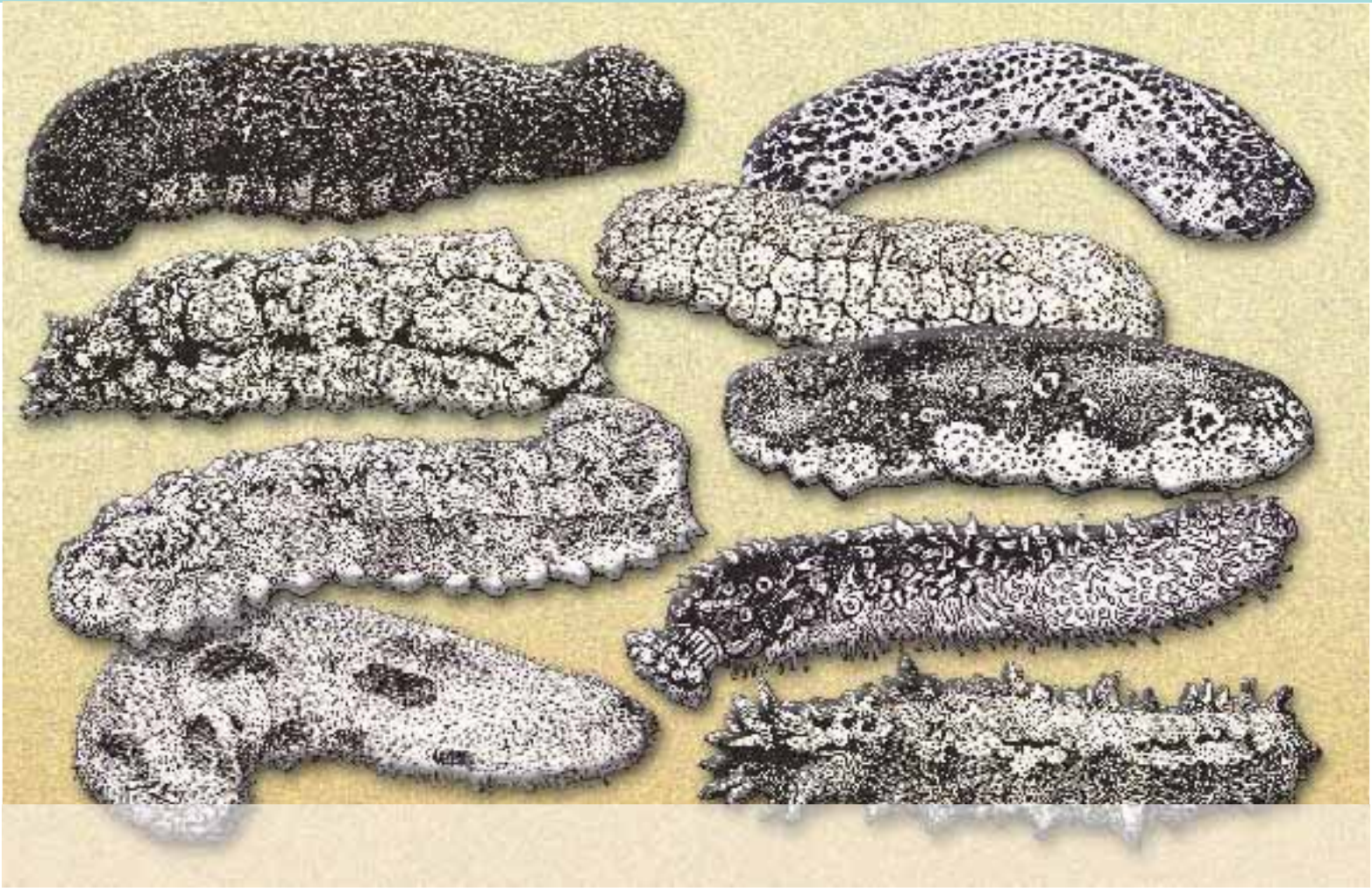
Sea cucumbers

A global review of fisheries and trade



Cover image:
Line drawings of selected sea cucumber species.
Drawings from the FAO Species Identification and Data Programme (SIDP).
Montage created by Alessandro Lovatelli and José Luis Castilla Civit.

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Preparation of this document

Prompted by concerns about the status of sea cucumbers stocks worldwide, because of the demand in international markets for bêche-de-mer, different initiatives have been implemented in recent years aimed at improving the understanding of these resources and fisheries, as well as to provide technical guidance for their conservation and sustainable exploitation. Two international meetings were held to review the situation of fisheries and to discuss management measures. The FAO Technical Workshop on Advances in Sea Cucumber Aquaculture and Management (ASCAM) was held in Dalian, People's Republic of China, in 2003. The CITES Technical Workshop on Conservation of Sea Cucumbers in the Families Holothuridae and Stichopodidae was held in Kuala Lumpur, Malaysia, in 2004. Building on the results of these meetings, both FAO Members and CITES Parties concurred on the urgent need to improve capacity of countries to manage sea cucumber fisheries through the provision of scientific information and management tools.

With this in mind, FAO has been implementing a Japanese-funded project on "CITES and commercially-exploited species, including the evaluation of listing proposals" which aims, among other things, to collate and disseminate information on the global status of commercially exploited sea cucumber stocks and to assist fishing nations in the conservation and sustainable exploitation of these benthic marine organisms. The main goal of the project is to develop technical guidelines to assist fisheries managers in deciding regulations and processes for the better management, conservation and sustainable exploitation of their sea cucumber resources. In support of the development of Technical Guidelines, regional reviews and hotspot analyses were commissioned to leading experts in sea cucumber fisheries and used as background documents in an FAO Technical Workshop on "Sustainable use and management of sea cucumber fisheries" held in Puerto Ayora, Galapagos Islands, Ecuador, from 19 to 23 November 2007.

This publication collects all the regional reviews and hotspot analysis prepared for the project and presented at the workshop. Together they provide a comprehensive and up-to-date evaluation of the global status of sea cucumber populations, fisheries, trade and management, constituting an important information source for researchers, managers, policy-makers and regional/international organizations interested on sea cucumber conservation and exploitation.

To facilitate the reading of this document and to accurately distinguish China from China, Hong Kong Special Administrative Region, the comma in the official name of the China, Hong Kong Special Administrative Region has been intentionally omitted.

Abstract

The present document reviews the population status, fishery and trade of sea cucumbers worldwide through the collation and analysis of the available information from five regions, covering known sea cucumber fishing grounds: temperate areas of the Northern Hemisphere; Latin America and the Caribbean; Africa and Indian Ocean; Asia; and Western Central Pacific. In each region a case study of a "hotspot" country or fishery was conducted to highlight critical problems and opportunities for the sustainable management of sea cucumber fisheries. The hotspots are Papua New Guinea, Philippines, Seychelles, Galapagos Islands and the fishery for *Cucumaria frondosa* of Newfoundland in Canada.

Across the five regions, the scale of catches and the number of exploited species varies widely, the Asian and Pacific regions being those with the highest catches and species diversity. Most fisheries are multispecific, or have evolved from single-species to multispecies fisheries as the more valuable species became overexploited. There are many typologies of sea cucumber fisheries, ranging from artisanal, to semi-industrial and industrial. The bulk of the catches are exported to supply the Asian bêche-de-mer market, with China Hong Kong Special Administrative Region (SAR) the main export destination for the totality of countries reviewed. With the exception of some stocks in the temperate areas of the northern hemisphere, sea cucumber stocks are under intense fishing throughout the world. In Latin America and the Caribbean it appears that high valued commercial species have been depleted. In the majority of the countries reviewed in the Africa and Indian Ocean region stocks are overfished. Likewise in the Asian Pacific region the most sought-after species are largely depleted.

Despite the fact that sea cucumber fishing is not a traditional activity, a large number of coastal communities have developed a strong dependency on it as alternative source of income. Reconciling the need for conservation with the socio-economic importance that these fisheries have acquired will require effective management efforts, which are currently lacking in many places. The hotspot case studies show for instance that, despite the adoption of management plans in some countries, the lack of enforcement capacity poses considerable constraints on the effectiveness of adopted management measures, besides exacerbating illegal, unreported and unregulated fishing and trade.

The papers also discuss some of the factors behind the unsustainable use of sea cucumbers and the role and potential benefits of alternative management measures, such as the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The lack of capacity to gather the basic information needed for management plans, weak enforcement, the high demand from international markets and the pressure exerted from resource-dependent communities figure high as important factors responsible for the critical status of sea cucumber fisheries worldwide. Authors concur on the need for immediate actions to stop the trend of sequential depletion of species if we are to conserve stocks biodiversity and sustain the ecological, social and economic benefits of these resources.

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Abbreviations and acronyms

ACIAR	Australian Centre for International Agricultural Research
AFLP	amplified fragment length polymorphism
ASCAM	Advances in Sea Cucumber Aquaculture and Management
BACI	before–after, control–impact
BFAR	Bureau of Fisheries and Aquatic Resources
CAFID	Canada/Newfoundland Cooperation Agreement for Fishing Industry Development
CCC	Coral Cay Conservation
CCFI	Canadian Center for Fisheries Innovation
CDF	Charles Darwin Foundation
CFMDP	Coastal Fisheries Management and Development Programme
CICIMAR	Centro Interdisciplinario de Ciencias Marinas (Mexico)
CITES	Convention on the International Trade in Endangered Species of Wild Fauna and Flora
CN-MAD	National Committee in Madagascar
CNMI	Commonwealth of the Northern Mariana Islands
CPUE	catch per unit effort
CRED	Coral Reef Ecosystem Division
CSIRO	Australia Commonwealth Scientific and Research Organization
CUD	Belgian University Corporation for Development
DA-BFAR	Department of Agriculture-Bureau of Fisheries and Aquatic Resources
DFA	Department of Fisheries and Aquaculture (Canada)
DFMR	Department of Fisheries and Marine Resources
DFO	Department of Fisheries and Oceans (Canada)
DOST	Department of Science and Technology
DPRK	Democratic Peoples' Republic Korea
EEZ	exclusive economic zone
EIO	Eastern Indian Ocean
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FFAW	Fish, Food and Allied Workers
FSM	Federated States of Micronesia
FUNZEL	Fundación Zoológica de El Salvador (Honduras)
GATT	General Agreement on Tariffs and Trade
GBR	Great Barrier Reef
GEM-USAID	Growth with Equity in Mindanao
GMR	Galapagos Marine Reserve
GNPS	Galapagos National Park Service
ICAR	Indian Council of Agricultural Research
ICNAF	International Convention for the Northwest Atlantic Fisheries
IMA	Inter-Institutional Management Authority
INVEMAR	Instituto Investigaciones Marinas y Costeras (Colombia)
IPN	Instituto Politécnico Nacional (Mexico)
IQF	individually quick frozen
ITQ	individual transferable quotas
IUU	illegal, unregulated and unreported

IWP	International Waters Project
JPA	Joint Project Agreement
KNA	Kenya National Archives
LRFFT	Live Reef Fish Food Trade
MCS	monitoring, control and surveillance
MI	Marine Institute
MOA	Memorandum of Agreement
MOF	Ministry of Fisheries
MOU	Memorandum of Understanding
MPAs	marine protected areas
MSI-UP	Marine Science Institute, University of the Philippines
MSY	maximum sustainable yield
NAFO	Northwest Atlantic Fisheries Organization
NB	New Brunswick
NFA	National Fisheries Authority
NFC	National Fisheries Corporation
NFRDI	National Fisheries Research and Development Institute (Philippines)
NGO	Non-governmental Organization
NIPAS	National Integrated Protected Areas System
NL	Newfoundland and Labrador
NOAA	National Oceanic and Atmospheric Administration (USA)
NS	Nova Scotia (Canada)
NTZ	No-Take Zone
ONETH	The National Association of Sea Cucumber Producers
OSC	Ocean Sciences Centre (Memorial University, Canada)
PAMB	Protected Area Management Board
PAMS	Participatory and Adaptive Management Scheme
PCAMRD	Philippine Council for Aquatic and Marine Research and Development
PICT	Pacific Island Countries and Territories
PMB	Participatory Management Board
PNG	Papua New Guinea
PROCFish/C	Pacific Regional Oceanic and Coastal Development Project Coastal Component
RDA	Resource Development Associates
RZS	Rotational Zoning Scheme
SAR	Special Administrative Region
SCUBA	Self Contained Underwater Breathing Apparatus
SEAFDEC	Aquaculture Department of the Southeast Asia Fisheries Development Center
SEVE	Society for the Exploration and Valuing of the Environment
SFA	Seychelles Fishing Authority
SFAC	Sea-area Fishery Adjustment Commission
SFCA	Hokkaido Semposhi Fisheries Cooperative Association
SITC	Standard International Trade Classification
SOM	Size of Maturity
SPC	Secretariat of the Pacific Community (formerly the South Pacific Commission)
TAC	total allowable catch
TINRO	Pacific Fishery and Oceanography Research Institute (Russian Federation)
TL	total length

TNC	The Nature Conservancy
TOP	Technical Operational Procedure
UAE	United Arab Emirates
UICN	The World Conservation Union
UMAS	Unidad de Manejo para la Vida Silvestre
UPCH	Universidad Peruana Cayetano Heredia
USD	United States dollar
VMS	vessel monitoring system
WIO	Western Indian Ocean
WIOMSA	Western Indian Ocean Marine Science Association
WMCIP	Western Mindanao Community Initiatives Project
WTO	World Trade Organization
WWF	World Wildlife Fund

Executive summary

Sea cucumbers (Echinodermata: Holothuroidea), or their dried form (bêche-de-mer), have been a dietary delicacy and medicinal cure for Asians over many centuries. The collection of sea cucumbers to supply the market has seen a depletion of this resource in the traditional fishing grounds close to Asia and more recently the expansion of this activity to new and more distant fishing grounds. Currently, there are fisheries harvesting sea cucumbers across most of the resource range, including remote parts of the Pacific, the Galapagos Islands, Chile and the Russian Federation. This global review shows that sea cucumber stocks are under intense fishing pressure in many parts of the world and require effective conservation measures. It also shows that sea cucumbers provide an important contribution to economies and livelihoods of coastal communities, being the most economically important fishery and non-finfish export in many countries. Reconciling the need for conservation with the socio-economic importance of sea cucumber fisheries is shown to be a challenging endeavour, particularly for the countries with limited management capacity. Furthermore, no single management measure will work optimally due to the many idiosyncrasies of these fisheries, which are outlined in this document through a comprehensive review of their biological and human dimensions.

The present document reviews the population status, fishery, trade, management and socio-economic importance of sea cucumbers worldwide. It includes regional reviews and hotspot case studies prepared by leading experts on sea cucumber fisheries and their management. These documents were made available prior to the FAO Workshop on Sustainable Use and Management of Sea Cucumber Fisheries, held in Puerto Ayora, Galapagos Islands, Ecuador, from 19 to 23 November 2007 (workshop agenda, list of participants and their profiles are appended).

Reviews were prepared for five regions: temperate areas of the Northern Hemisphere (including Canada, Iceland, Russian Federation and the United States of America); Latin America and the Caribbean; Africa and Indian Ocean; Asia; and Western Central Pacific (including Australia). In each region, specialists conducted a case study of a "hotspot" country or fishery to highlight topical or critical problems and opportunities for the sustainable management of sea cucumber fisheries. The five hotspots are: Papua New Guinea (Western Central Pacific); Philippines (Asia); Seychelles (Africa and Indian Ocean), Galapagos Islands (Latin America and the Caribbean); and the *Cucumaria frondosa* fishery of Newfoundland in Canada (Temperate areas of Northern Hemisphere).

A multitude of sea cucumber species are being exploited worldwide, with new species being placed on the market whilst valuable species become scarcer and more difficult to find. Across the five regions, the number of commercially exploited species varies widely, with the highest number of species exploited in the Asia (52 species) and Pacific (36 species) regions partially due to the higher natural diversity in these areas. Still, little is known of the ecology, biology and population status of most commercial species, and in many cases, species are being commercialised without a clear taxonomic identification (e.g. the "pentard" in the Seychelles, *Actinopyga* sp. in Yap). Information on catches is also scarce, as these fisheries operate over large scales in often remote locations. In view of the importance of international trade, export and import statistics of bêche-de-mer are in many cases the only information available to quantify the magnitude of fisheries catches. Based on the most recent available catch and trade data, Asia and the Pacific are the top producing regions despite the long history of exploitation. Depending on the conversion factor used for the dry:wet weight of sea cucumbers, it is possible

to infer that the combined catches for the Asia and Pacific regions are in the order of 20 000 to 40 000 tonnes/year. The temperate areas of the Northern Hemisphere are also responsible for a substantial share of the world catches (in the order of 9 000 tonnes/year); catches being sustained almost exclusively by one species (*Cucumaria frondosa*). Sea cucumber catches are relatively less important in Africa and in the Indian Ocean (2 000–2 500 tonnes/year) region and, particularly low in Latin America and the Caribbean region (<1 000/year).

Sea cucumber capture fisheries generally target a large variety of species, which adds complexity to management and trade reporting; and those that commenced as single-species fisheries have now progressed to include "new" species in their catches (i.e. fisheries in Peru and Chile). Four of the five hotspots reviewed in this document present multi-species fisheries, and in all cases they have moved from low quantity-high value to high quantity-low value ventures, as the more valuable species become fully-exploited or overexploited. Some regions have seen a dramatic increase in the number of species under commercial exploitation (e.g. Galapagos Islands, Philippines, Papua New Guinea, Solomon Islands), yielding more species to fishery pressure, as well as masking overexploitation and species-specific decreases in catches.

The majority of sea cucumbers are exported for the bêche-de-mer market and few species for the live trade (aquarium) market, which is currently underreported. There is also an emerging market for the use of sea cucumbers in the pharmaceutical, nutriceutical and cosmetic industries. The type of fishery varies by region and the species under exploitation. Examples of different fishery types, ranging from artisanal (Papua New Guinea and Philippines), to semi-industrial (Galapagos Islands) and industrial (*Cucumaria frondosa* fishery in northern Canada), are described in the hotspot case studies. Hand collecting, gleaning, lead bombs, SCUBA diving, hookah and dredging are examples of fishing methods used.

Effective management plans for sea cucumber fisheries are uncommon. For example, the Seychelles and Papua New Guinea have adopted management plans for their fisheries, which came into place following concerns about declines in catches caused by unregulated harvesting. The Galapagos Islands sea cucumber fishery also started as an open-access activity, but after a long ban it re-opened in 1999 with an adaptive and participatory management scheme. The Philippines do not have a management plan in place despite some species now becoming locally endangered through overfishing. The *C. frondosa* fishery in Newfoundland (Canada) is still under an exploratory stage but aims at being managed through ecosystem-based guidelines. This fishery, unlike other sea cucumber fisheries, has the advantage of using a precautionary approach at the start of commercialisation, and has some of the most complete set of biological and population information on which to base a management plan. In spite of the lack of management plans in most locations described in the regional reviews, some management measures have been adopted to regulate fishing pressure, including closed seasons, minimum sizes, total allowable catches, gear restrictions, spatial and temporal closures and the establishment of marine protected areas. However, the lack of enforcement capacity has posed considerable constraints on the effectiveness of such management measures. The lack of enforcement and compliance is a common denominator for the majority of the fisheries reviewed in this document, and has exacerbated illegal, unreported and unregulated fishing and trade.

Sea cucumber populations are in dire straits in many parts of the world. This unfortunately includes high profile conservation sites such as the Great Barrier Reef Marine Park and the Galapagos Islands National Park (both World Heritage listed). These locations have well documented cases of sea cucumber population collapse, and subsequent population surveys showed no recovery of overfished stocks. The temperate areas of the Northern Hemisphere offer perhaps the few exceptional cases of abundant stocks still moderately exploited and with some potential for expansion.

Despite the limited information available on sea cucumber fisheries in Latin America and the Caribbean, it appears that high valued commercial species have been depleted and the risk of fishery collapses is high due to the small size of stocks, the strength of market forces and the unregulated nature of these fisheries. In Africa and the Indian Ocean region, at least 12 out of 17 countries, where sea cucumber fisheries have been documented, indicate evidence of overfishing of sea cucumber stocks. Species are under heavy fishing pressure throughout the Asian Pacific region, whilst the most sought-after species in the western Pacific are largely depleted.

Recognizing the importance of international trade as a threat to the conservation of sea cucumber species, consideration has been given to the possible role of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) as a complementary measure for regulating the sustainable use of sea cucumber fisheries. One species is currently listed in a CITES Appendix (*Isostichopus fuscus* in Appendix III by Ecuador) and the Galapagos Islands hotspot case study (see report in this document) lists advantages and disadvantages based on this experience. The analysis of the situation in the Seychelles, Papua New Guinea and the Philippines asserts the possible benefits of CITES to sea cucumber populations, but indicate that a listing could lead to socio-economic impacts as well as an increased administrative burden where institutional capacity is limited.

In many countries, particularly in the Western Pacific region, some sea cucumbers, and their organs, are considered as delicacies and a protein component to traditional diets. However, in the majority of countries reviewed in this document, sea cucumbers are harvested to supply the Oriental market of bêche-de-mer. Indonesia is the major exporter of sea cucumber from capture fisheries. Of all importing countries and territories, China Hong Kong Special Administration Region (SAR), is the most important, with products arriving from most countries worldwide; whilst some countries, such as the United Arab Emirates in the Indian Ocean, have become "intermediate" markets.

Although in most current fishing grounds, sea cucumber fishing is not a traditional activity the majority of rural coastal communities are dependent on it, as alternative opportunities for income are often limited. High prices and the increasing consumer demand have seen the expansion of the range covered by marine products agents, the development of capacity in these fisheries and an ongoing search for new species. In many regions, the socio-economic dependency on bêche-de-mer is so vast that fishers continue collecting sea cucumbers despite scant catches, further affecting the stocks capacity to reproduce and repopulate the fishing grounds. Generally, when one commercial species is depleted, or "economically extinct", traders will encourage fishers to search for new species, or fish deeper or further a field, in order to continue their business.

Aquaculture, sea ranching and restocking have been evaluated as possible solutions to wild sea cucumber overexploitation, and some countries have started such ventures (e.g. Australia, China, Kiribati, Philippines, Viet Nam and Madagascar). Restocking has been considered an expensive remedy to overfishing. Presently, China is successfully producing an estimated 10 000 tonnes, dry weight, of *Apostichopus japonicus* from aquaculture, mainly to supply local demand. This value, when converted into wet weight, is in the same order of magnitude of the total world wild catches. A feasibility study is presently being carried out in Chile to evaluate the possible introduction of *A. japonicus,* as an alternative to capture fisheries of two wild species of sea cucumbers. In the Asia Pacific region aquaculture is still in the early development stages, with one species of sea cucumber (*Holothuria scabra*) in trials to ascertain the commercial viability of culture and farming options.

Many additional threats have been identified for sea cucumber populations worldwide, including global warming, habitat destruction, unsustainable fishing

practices (e.g. blasting), the development of fisheries with little or no information on the species, and lack of natural recovery after overexploitation. Illegal, Unregulated and Unreported (IUU) fisheries are widespread in all regions, representing an indirect threat as it fuels unsustainable practices and socio-economic demand.

The critical status of sea cucumber fisheries worldwide is compounded by different factors including i) the lack of financial and technical capacity to gather basic scientific information to support management plans, ii) weak surveillance and enforcement capacity, and iii) lack of political will and socio-economic pressure exerted by the communities that rely on this fishery as an important source of income. The fast pace of development of sea cucumber fisheries to supply the growing international demand for bêche-de-mer is placing most fisheries and many sea cucumber species at risk. The pervasive trend of overfishing, and mounting examples of local economic extinctions, urges immediate action for conserving stocks biodiversity and ecosystem functioning and resilience from other stressors than overfishing (e.g. global warming and ocean acidification), and therefore sustaining the ecological, social and economic benefits of these natural resources.