

Putting into practice an ecosystem approach to managing sea cucumber fisheries



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Preparation of this document

This document is an abridged version of the FAO Fisheries and Aquaculture Technical Paper No. 520, entitled “*Managing sea cucumber fisheries with an ecosystem approach*”. It is intended to provide a more concise and less technical outline of processes and principles to implement an ecosystem approach in the management of sea cucumber fisheries.

The document was written and prepared by Steven Purcell. It draws on outcomes of the 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. The group of experts convened for this purpose consisted of Jun Akamine, Poh Sze Choo, Chantal Conand, Eduardo Espinoza, Kim Friedman, Ruth Gamboa, Jean-François Hamel, Alex Hearn, María Dinorah Herrero-Pérezrul, Jeff Kinch, Alessandro Lovatelli, Priscilla C. Martínez, Annie Mercier, Steven Purcell, Verónica Toral-Granda, Sven Uthicke, Marcelo Vasconcellos and Matthias Wolf. Valuable comments and contributions to earlier versions of this document were made by Alessandro Lovatelli and Yimin Ye, both officers of the FAO Fisheries and Aquaculture Department. The image on the cover was prepared by Emanuela D’Antoni (FAO) from photographs by Steven Purcell and the layout done by José Luis Castilla.

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Abstract

Artisanal and industrialized fishers from more than 40 countries harvest more than 60 species of sea cucumbers. These low-food-chain resources play important roles in nutrient recycling and sediment health in marine habitats.

Owing to ease of capture and vulnerable biological traits, sea cucumbers have been easily overexploited in most countries, sometimes to local extinction. Few sea cucumber fisheries are currently managed sustainably. They differ greatly in the scale of the fishing activities, status of stocks and management capacity.

This document summarizes general management principles and a general framework for developing and implementing a management plan. Through a few questions and simple indicators, managers are guided to choose appropriate sets of regulatory measures and management actions for different sea cucumber fisheries.

Safeguarding sea cucumber stocks for current and future generations will require an ecosystem approach to fisheries (EAF) that applies precautionary measures with the participation of stakeholders. Success in applying an EAF will require consideration of the reproductive productivity of stocks, ecosystem health and the socio-economic systems that drive exploitation.

FAO.

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Acronyms

CC	consultative committee
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CPUE	catch-per-unit-effort
EAF	ecosystem approach to fisheries
FAO	Food and Agriculture Organization of the United Nations
GBRMP	Great Barrier Reef Marine Park
GIS	geographical information systems
IUU	illegal, unreported and unregulated
MAC	management advisory committee
MPA	marine protected area
MSY	maximum sustainable yield
TAC	total allowable catch
TURF	territorial user rights to fish
UVC	underwater visual census

Contents

Preparation of this document	iii
Abstract	v
Acronyms	vii
Background	1
Characteristics of sea cucumber fisheries	3
Management principles	13
The ecosystem approach to fisheries	15
The management process, indicators and reference points	17
A road map for choosing the right tools	21
Fishery regulations	24
Actions to implement management	44
Glossary	73
Further reading	78

Background

Sea cucumbers (Class: Holothuroidea) are a significant source of income to many coastal communities worldwide and fulfil an important roles in marine ecosystems. Sustaining these resources through effective management is of paramount importance to biodiversity of the ecosystems in which they live and the livelihoods of people who depend on them.

The current grave status of sea cucumber stocks in numerous countries can be attributed to excessive exploitation, ever-increasing market demand and inadequacy of fishery management and governance. The vulnerability of sea cucumber populations to local extinction and the risk of long-term loss of fishery productivity have prompted recent international and regional meetings of expert scientists and fishery managers. A common recommendation from these meetings is to help improve national fisheries management through advice on appropriate management regulations and activities for sea cucumber fisheries.

To meet these challenges, the Food and Agriculture Organization (FAO) carried out a global programme to improve information support for managing sea cucumber fisheries. An international workshop was convened in November 2007 in Puerto Ayora, Santa Cruz Island, Galápagos (Ecuador) to identify management measures best suited to sea cucumber fisheries. A principal output

from the workshop was a FAO Fisheries and Aquaculture Technical Paper entitled “*Managing sea cucumber fisheries with an ecosystem approach*” (Purcell, 2010). The present booklet summarizes that document with a goal to contribute to improved and effective management and governance of sea cucumber fisheries around the world through successful implementation of an ecosystem approach to fisheries (EAF).

This document summarizes best-practice management measures applicable to most fisheries and situation-specific measures that may be used in some scenarios. Drawing on lessons described in the regional reviews of sea cucumber fisheries (Toral-Granda, Lovatelli and Vasconcellos, 2008), practical examples are presented across a diverse array of fisheries from tropical and temperate regions.

The aim of this document is to assist fisheries managers in choosing regulations and action plans to maintain and restore the productive capacity and biodiversity of sea cucumber stocks and fishery ecosystems, while considering their role in the livelihoods of fishers. This document is meant for fishery managers and fishery officers. It embraces an EAF (FAO, 2003) by recognizing the importance of sea cucumbers to rural coastal livelihoods and the socio-economic impacts of management measures.

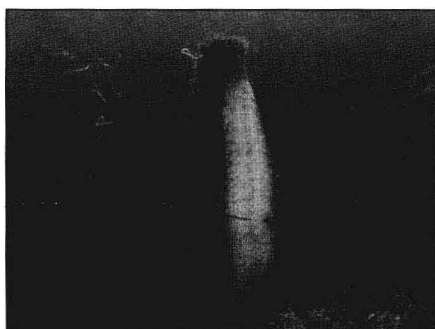
Characteristics of sea cucumber fisheries

Sea cucumbers are echinoderms, Phylum Echinodermata, along with sea stars and sea urchins. Within this Phylum, they belong to the taxonomic Class Holothuroidea, so are sometimes referred to as holothurians. At present, 66 species of sea cucumbers are commercially exploited worldwide. Harvested sea cucumbers are usually gutted, boiled and dried before being exported to Asian markets. It is the dried product that is called “*beche-de-mer*”, meaning “spade of the sea”, or “*trepang*” or “*haishen*”.

BIOLOGICAL TRAITS IMPORTANT FOR MANAGEMENT

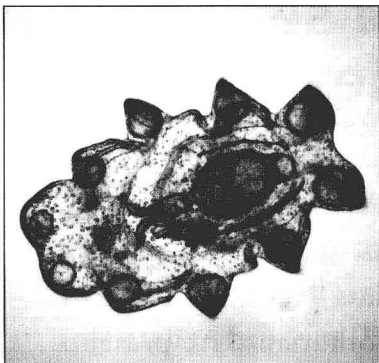
Several life-history traits of holothurians make them especially vulnerable to overfishing: the rates of population turnover are often low, they can be long lived, and populations need to be dense to achieve good reproductive success.

Commercially exploited sea cucumbers mostly have separate sexes. They are broadcast spawners; the sperm released from



A. DESURMONT

A male Bohadschia marmorata releases sperm into the water column which may find oocytes released from females to form an egg.



A fully developed auricularia larval stage of the sea cucumber Isostichopus fuscus about 1 mm long.

males must swim in the water column and find the oocytes released from females to form fertilized eggs. Fertilization success, therefore, depends on mates being in close proximity. So, managers must ensure that populations remain dense for reproduction.

The eggs can develop into free-swimming larvae in less than one day. The larvae then spend weeks in the water column

before transforming into the final larval stage that settles on surfaces, like rocks, dead corals or seagrasses.

Genetic studies indicate that the larvae of some species can be transported large distances, e.g. hundreds of kilometres or more. Dispersal in some other species is relatively restricted, resulting in genetic differences in populations over much shorter distances. This is important for the design of marine reserve systems and for restocking.

In addition to sexual reproduction, about ten species reproduce asexually by dividing in the middle of the body. Both halves re-grow necessary organs and form clones of the original animal.

Sea cucumber populations can be slow to recover from moderate to high rates of exploitation. For the Pacific black teatfish, *Holothuria whitmaei*, a fishing rate of just 5 percent of virgin biomass per year still led to depletion

of breeding stocks in Australia. In some locations, populations of sea cucumbers have failed to recover even 50 years after heavy fishing pressure.

Growth rates of sea cucumbers have been difficult to assess. Some species may reach a good market size in 2–3 years, while others may take many years to reach commercial sizes. For example, *Cucumaria frondosa* from the North Atlantic reaches commercial size after ten years.

Decades ago, research indicated that sea cucumbers could live for 5–15 years. More recently, studies indicated that some species have low rates of natural mortality and are rather long-lived, potentially several decades or more. Consequently, fisheries models should apply conservative estimates of longevity or natural mortality when determining a sustainable fishing rate.

Sea cucumbers can be regarded as sedentary. Some species can move from juvenile habitats to adult habitats. Most animals within populations of reef species probably do not move more than 50–100 m in a year. Marine reserves and no-take zones are therefore a useful tool for protecting breeding populations and may not need to be very large (e.g. 0.5–3 km²).

Growth in many sea cucumber species is slow and some species may be quite long lived.

ARE SEA CUCUMBERS IMPORTANT TO ECOSYSTEM FUNCTIONING?

Most of the commercial sea cucumbers are deposit feeders that consume fine organic matter (detritus), bacteria and diatoms mixed with sediments on the seabed. Those species on hard reef surfaces “mop up” the particulate



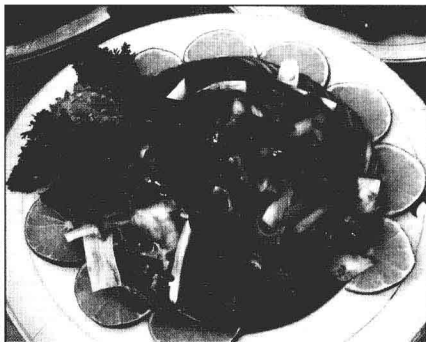
S.W. PURCELL

Pearsonothuria graeffei with black tentacles extended to collect microalgae and detritus on a hard reef surface.

organic matter that coats rocks and vegetation. Just a few commercial species are suspension feeders. Holothurians are therefore a low-food-chain group and help to recycle organic matter. Some species bury in sand and mud, so are believed to help oxygenate and mix the upper sediment layers (bioturbation).

WHY IS THE MARKET DEMAND STRONG FOR SEA CUCUMBERS?

Chinese and other Asians have eaten sea cucumbers for centuries for their curative and dietary properties. They were recorded as a tonic food as early as the Ming dynasty, around 500 years ago.



S.W. PURCELL

Sea cucumbers served as a sauced dish in China.

They are a rich source of compounds known in western medicine as treatments for arthritis and joint ailments (see articles in Lovatelli *et al.*, 2004).

In the past, sea cucumbers were eaten by wealthy Asians for health treatments, or as delicacies during festive periods. Nowadays, Chinese and other Asians eat sea cucumbers more regularly, owing to increased affluence. Increased demand for beche-de-mer is the main cause of inflated prices of sea cucumbers globally.

The main import markets are China, Hong Kong Special Administrative Region, Singapore and Taiwan Province of China (see Lovatelli *et al.*, 2004). Recently, the United Arab Emirates has also become important. All of these markets are also major re-exporting centres.

WHAT DETERMINES THE VALUE OF SEA CUCUMBERS?

The price of beche-de-mer varies greatly among species and also within species depending on the size of the animal and the care with which it was processed. Larger animals generally command a higher price per kilogram than smaller ones (Friedman *et al.*, 2008). The Japanese sea cucumber, *Apostichopus*



J. AKAMINE

Tropical sea cucumbers, as beche-de-mer, displayed at various prices in a dried seafood markets in Taipei, Taiwan Province of China.

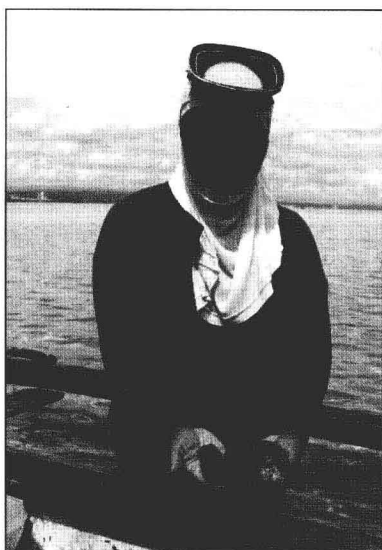
japonicus, can fetch more than USD 300 per kilogram (dried) at retail markets if the animals are in a perfect, presentable state.

Some tropical species can fetch almost an equivalent price for large, well-processed specimens. However, some other species or animals poorly processed would attract only modest prices.

WHERE AND HOW ARE SEA CUCUMBERS FISHED?

Sea cucumber fisheries have different ecological attributes of species, modes of exploitation, history and socio-economic structures (see Toral-Granda, Lovatelli and Vasconcellos, 2008). The fisheries are often small-scale in the way the animals are harvested; fishers collect sea cucumbers by wading or skin diving in shallow waters. On the other hand, fisheries in developed countries are commonly industrialized; teams of fishers use large boats and sophisticated fishing gear.

The problems facing small-scale and industrial fisheries are different (Purcell, 2010). Small-scale fisheries often comprise many low-income fishers who collect sea cucumbers out of tradition or as an occupation of



Artisanal small-scale fisher in the Philippines with three species of sea cucumbers collected by skin diving from a canoe.

last resort. Fishers are reluctant or unable to cease fishing, even when stocks become depleted.

In comparison, industrial-scale fishers are more commonly capable of switching to fishing other resources and are easily contactable. However their capital investment in boats and fishing gear means they must continue high rates of exploitation to cover loans and operating costs.

Most sea cucumber fisheries are multispecies in nature. In the tropical Indo-Pacific, up to 20 or 30 species can be exported from a single country. In contrast, temperate fisheries usually concern one or two species, fished in deeper waters (> 50 m) by divers using compressed air or using “drag” nets from large vessels.

HOW ARE SEA CUCUMBERS CURRENTLY MANAGED?

In developing countries, the limited capacity of fishery institutions hinders the ability to develop or effectively implement complex management measures.

In some countries, access to fishing sea cucumbers is open to all fishers, whereas in other countries access is restricted. For example, fishing grounds in western Canada and the Great Barrier Reef in Australia are divided into fishing plots allocated among a small number of licensed fishing companies. Fishers can leave smaller adults, knowing that they have sole rights to collect them in following years. In contrast, open-access fisheries such as the Philippines or Madagascar are plagued with the “tragedy of the commons”, whereby fishers collect even small sea cucumbers because they will be fished by their neighbour if left behind.