

## 7. Conclusions

The development of this paper and management guidelines was prompted by the poor status of sea cucumber fisheries management in numerous countries and the recognition of an urgent need for technical guidance in the development of management strategies and for good governance.

Like many other fisheries, the present management approaches and systems in sea cucumber fisheries are struggling to achieve sustainability. One important step towards improvement is to define clear objectives, reference points and indicators of sustainability. Managers need to then conduct periodic assessments of how the stocks and fishers have responded to the management measures and adapt management measures in the light of poor performance.

Sea cucumber fisheries have widely different characteristics and unique management issues. Their sustainable management requires practical regulatory measures and joint effort from different sectors. In elaborating best practices management measures in this document, efforts were made to distinguish the different settings under which some measures are likely to be more applicable than others.

To build a management plan based on the regulatory measures and actions for implementing management advised in this technical paper, managers need to adopt measures that can work in the specific circumstances of the fishery. They must also respond in a balanced way to the need to maximize the long-term benefits to fishers and to conserve resource biodiversity. In this context, the following are some key “take-home” messages for managers when developing management plans for sea cucumber fisheries:

1. Generally, a suite of management regulations should be used to control fishing.
2. Establishing some form of user rights, or privileges, helps to avoid the “race for fish” to promote better stewardship of sea cucumber stocks.
3. Promoting local-level management institutions improves many aspects of compliance, surveillance and accountability, but centralised fishery agencies must continue to support these systems and may need to retain authority over some management roles.
4. Management regulations should be strict enough so that stocks of high, medium and low value species are maintained at productive levels and drastic interventions can be avoided.
5. If the fishery is depleted, managers must instigate a ban for several years and weigh up the costs and benefits of various methods for rebuilding the stock.
6. Managers should oblige fishers, processors and exporters to provide data of catches and exports in all fishery situations.
7. Size limits are strongly recommended in any active fishery and enforcement through inspections of processors and exporters will be more efficient than inspections of fishers.
8. Marine protected areas that exclude fishing of sea cucumbers (i.e. no-take reserves) should serve as a valuable safeguard, in most scenarios, for maintaining some recruitment in the fishery, but should be accompanied by other regulations.
9. Industrialized fisheries often have greater resources for the development and enforcement of management regulations. For this reason, they can have a greater number of management regulations and actions for implementing management than small-scale fisheries.

10. Small-scale fisheries that involve poor and low-income fishers can suppress stocks to extirpation because fishers can still maintain some profitability at low stock densities. For this reason, instigating bans early and having no-take zones to safeguard some breeding groups, is a stronger imperative than in industrialized fisheries.
11. Almost all of the potential management tools can be applied in small-scale and industrial (high-tech) sea cucumber fisheries. However, it is better to choose a subset of companion tools (see Annex 10.2 for examples).
12. The overriding actions by sea cucumber fishery managers in any situation are to:
  - 1) invest in education programmes to give fishers and exporters an understanding of management principles; 2) ensure strong enforcement of the regulations; 3) conduct some socio-economic surveys; 4) carry out underwater visual censuses to monitor stocks; and 5) monitor the national catches and exports.

Some, perhaps most, of the regulatory measures discussed in this paper are unproven as tools to ensure the sustainability of sea cucumber fisheries. One research priority, therefore, is to critically evaluate the efficacy of management measures. Studies could compare the sustainability of stocks between locations with different management systems and/or regulations within a fishery or monitor densities of sea cucumbers before and after new regulatory measures are imposed (see Section 6.1.2).

Lack of enforcement is a continual problem in many developing and low-income, countries. There is little benefit of a well-developed management plan if fishers do not comply with it. To tackle this problem, management agencies need to invest more resources in compliance officers and have the backing of a vigilant system to enforce penalties on fishers and processors for non-compliance. Alternatively, managers may decide to devolve the management authority and accountability to fishing communities and hope that access rights and local-level management will provide incentives for responsible stewardship of sea cucumber resources. Government agencies will probably still need to help local-level management systems, through some form of co-management. Such cooperation allows support to implementing local-scale management and a conduit for informing fishers and communities about the science needed for sustaining stocks and the ecosystems in which they live.

Amidst the trend of stock depletion through excessive fishing, it is encouraging that some countries have taken drastic action to prevent extirpation of breeding populations. National sea cucumber fisheries have been recently closed in Costa Rica, Solomon Islands, Vanuatu, Papua New Guinea, Panama, mainland Ecuador, Venezuela, India and Tonga (recently re-opened). The application of moratoria shows that fisheries management agencies are willing to take stringent actions for the long-term interest of the fisheries. Unfortunately, some severely depleted stocks may take decades to recover to productive levels (Battaglene and Bell, 2004). Managers should be acutely mindful that a moratorium underscores inadequacy of past management strategies, or enforcement, and a responsibility to develop radically different approaches to circumvent repeated stock depletion after the moratoria are lifted.

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## 9. Glossary

<i>Beche-de-mer</i>	meaning “spade of the sea”, this term refers to dried sea cucumbers after earlier stages of gutting and boiling, and in some cases after salting and smoking.
<i>Benthic</i>	in relation to, or living in close association with, the sea bottom.
<i>Capacity</i>	( <i>capacity in fisheries</i> ) – the ability, or potential, to take the maximum amount of animals out of the sea over a period of time by all the fishers.
<i>Capacity</i>	( <i>capacity in management institution</i> ) – the level of competence, skills and resources to develop and implement the management plan.
<i>Decision control rules</i>	Rules agreed at the onset of developing a management plan about what management actions will be taken in light of the level of performance relative to reference limits.
<i>Depleted stock</i>	Populations of sea cucumbers within a fishery that have decline to levels whereby the rate of natural reproduction and population replenishment is poor, or unable to keep pace with mortality losses, due to low densities of breeding adults.
<i>Effort</i>	the total amount of fishing activity over a period of time.
<i>Exploitation</i>	use of the resource for personal gain, whether for subsistence or commercial purposes.
<i>Fishery</i>	the sum of all fishing activities on a given resource (e.g. a sea cucumber fishery), or the activities of a certain style of fishing on a particular resource (e.g. a dive fishery).
<i>Fishing</i>	this term is used interchangeably with “collecting” and “harvesting” to describe the act of removing sea cucumbers from the wild for commercial or subsistence purposes.
<i>Gonad</i>	male or female reproductive organ that produces sperm or oocytes.
<i>Hookah</i>	equipment to allow divers to breath underwater using hoses delivering compressed air from compressors onboard a boat above them.
<i>Indicator</i>	a variable that can give a measure of the state of the system at any one time, instead of measuring a response directly. For example, declining exports is an indicator that stocks have decreased, even though the stock itself is not measured.



	In the context of reviewing the effectiveness of a management strategy, an indicator is a variable that shows the present state of a component of the fishery, e.g. abundance of valuable sea cucumbers in fishing grounds.
<i>Management measure</i>	specific control or action applied to the fishery towards the objectives, including technical measures, input controls, output controls and user rights.
<i>Management tool</i>	another term for <i>management measure</i> , because these are “instruments” used by managers to achieve the fishery objectives.
<i>Manager</i>	here, refers to the person charged with, or responsible for, the stewardship of the fishery, including the formation of management regulations, monitoring and enforcement. They generally would be the leader of the <i>Managing institution</i> .
<i>Managing institution</i>	the group of people in charge of developing management plans for the fishery and responsible for monitoring, and adapting to, changes in the status of resources. It could be the fishery service of the country or province, in the case of centralized management, or a group of community leaders in the case of community-based management.
<i>Marine protected area</i>	a portion of the marine benthos and water, with its associated biota, reserved to protect part or all of the designated environment. The protection may allow for regulated levels of extraction (fishing) of plants and animals.
<i>Maximum sustainable yield</i>	the highest theoretical limit at which sea cucumbers can be harvested without significantly affecting the reproductive process or the natural replenishment of the population.
<i>Mortality</i>	death of sea cucumbers in the population due to fishing or natural events.
<i>No-take zone</i>	used in the same sense as “marine reserve” to denote an area of subtidal or intertidal habitat, and its occupants, fully protected by law from the removal or harm of animals, plants and habitat.
<i>Objective</i>	statements that defines and quantifies the fishery management goals. It is a broad statement about what the management strategy is trying to achieve.
<i>Oocytes</i>	female sexual cells or unfertilized eggs released from females.
<i>Overfishing</i>	a state where fished populations are not able to easily recover to the pre-harvest number of animals or to levels where the populations can increase in numbers, i.e. a state of negative per-capita population growth.

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<i>Recruitment</i>	the addition of young sea cucumbers to the population, here considered as the addition of juveniles to a population after post-settlement mortality.
<i>Reference point</i>	a benchmark against which to assess the performance of management in achieving the objectives. A <i>limit reference point</i> is a level of a certain parameter to avoid going beyond.
<i>Spatial</i>	referring to things, or processes, in geographic space.
<i>Sperm</i>	male sexual cells.
<i>Stakeholder</i>	any person with a legitimate interest in the use and future of the resource. It includes but is not limited to fishers, processors, buyers, resource stewards, conservationists and conservation agencies, tourism agents, scientists and resource managers.
<i>Status of stocks/resource</i>	the abundance and sizes of individual sea cucumbers in wild populations within the fishery relative to healthy levels at which the animals would be breeding successfully and at which populations could withstand some losses from fishing without undermining population recovery. Stock status can be defined relative to fishing impacts, i.e. underexploited, fully exploited or depleted.
<i>Stock</i>	a group of individual sea cucumbers occupying a well-defined spatial range independent of other populations of the same species. A stock would normally be regarded as an entity for management or assessment purposes – thus, populations in different areas (e.g. individual reefs) that are normally connected through dispersal would be considered a single stock.
<i>Trepang</i>	a term used in Indian Ocean countries for dried sea cucumbers; a synonym of <i>beche-de-mer</i> .



## 10. Annexes

### 10.1 Main species of sea cucumbers commercially exploited and traded around the world

	Species	Family	Commercial value	Common name
1	<i>Actinopyga agassizi</i>	Holothuriidae	Medium	
2	<i>Actinopyga echinites</i>	Holothuriidae	Medium	Deep water redfish
3	<i>Actinopyga lecanora</i>	Holothuriidae	Medium	Stonefish
4	<i>Actinopyga mauritiana</i>	Holothuriidae	Medium	Surf redfish
5	<i>Actinopyga miliaris</i>	Holothuriidae	Medium	Blackfish
6	<i>Actinopyga palauensis</i>	Holothuriidae	Medium	Panning's blackfish
7	<i>Actinopyga spinea</i>	Holothuriidae	Medium	Burying blackfish
8	<i>Bohadschia argus</i>	Holothuriidae	Low	Leopard fish, Tiger
9	<i>Bohadschia atra</i>	Holothuriidae	Medium	
10	<i>Bohadschia bivittata</i>	Holothuriidae	Low	
11	<i>Bohadschia marmorata</i>	Holothuriidae	Low	
12	<i>Bohadschia similis</i> *	Holothuriidae	Low	Brownspotted sandfish
13	<i>Bohadschia subrubra</i>	Holothuriidae	Medium	
14	<i>Bohadschia tenuissima</i> *	Holothuriidae	Low	
15	<i>Bohadschia vitiensis</i> *	Holothuriidae	Low	Brown sandfish
16	<i>Pearsonothuria graeffei</i>	Holothuriidae	Low	Flowerfish
17	<i>Holothuria arenicola</i>	Holothuriidae	Low	
18	<i>Holothuria atra</i>	Holothuriidae	Low	Lollyfish
19	<i>Holothuria cinerascens</i>	Holothuriidae	Low	
20	<i>Holothuria coluber</i>	Holothuriidae	Low	Snakefish
21	<i>Holothuria edulis</i>	Holothuriidae	Low	Pinkfish
22	<i>Holothuria flavomaculata</i>	Holothuriidae	Low	
23	<i>Holothuria fuscocinerea</i>	Holothuriidae	Low	
24	<i>Holothuria fuscogilva</i>	Holothuriidae	High	White teatfish
25	<i>Holothuria fuscopunctata</i>	Holothuriidae	Low	Elephant trunkfish
26	<i>Holothuria hilla</i>	Holothuriidae	Low	
27	<i>Holothuria impatiens</i>	Holothuriidae	Low	
28	<i>Holothuria kefersteini</i>	Holothuriidae	Low	
29	<i>Holothuria leucospilota</i>	Holothuriidae	Low	White threadfish
30	<i>Holothuria mexicana</i>	Holothuriidae	Low	Donkey dung
31	<i>Holothuria nobilis</i>	Holothuriidae	High	Black teatfish
32	<i>Holothuria</i> sp.	Holothuriidae	High	Pentard
33	<i>Holothuria notabilis</i>	Holothuriidae	Low	
34	<i>Holothuria pardalis</i>	Holothuriidae	Low	
35	<i>Holothuria pervicax</i>	Holothuriidae	Low	

## Annex 10.1 (continued)

	Species	Family	Commercial value	Common name
36	<i>Holothuria rigida</i>	Holothuriidae	Low	
37	<i>Holothuria scabra</i>	Holothuriidae	High	Sandfish
38	<i>Holothuria lessoni</i> †	Holothuriidae	High	Golden sandfish
39	<i>Holothuria spinifera</i>	Holothuriidae	Medium	Sandfish
40	<i>Holothuria theeli</i>	Holothuriidae	Medium	
41	<i>Holothuria whitmaei</i>	Holothuriidae	High	Black teatfish
42	<i>Astichopus multifidus</i>	Stichopodidae	Low	
43	<i>Isostichopus badionotus</i>	Stichopodidae	Medium	
44	<i>Isostichopus fuscus</i>	Stichopodidae	Medium	Brown
45	<i>Parastichopus californicus</i>	Stichopodidae	Medium	Giant red
46	<i>Parastichopus parvimensis</i>	Stichopodidae	Low	Warty
47	<i>Stichopus chloronotus</i>	Stichopodidae	Medium	Greenfish
48	<i>Stichopus horrens</i>	Stichopodidae	Medium	Dragonfish or Warty
49	<i>Stichopus herrmanni</i>	Stichopodidae	Medium	Curryfish
50	<i>Stichopus monotuberculatus</i>	Stichopodidae	Low	
51	<i>Australostichopus mollis</i>	Stichopodidae	Low	
52	<i>Stichopus naso</i>	Stichopodidae	Low	
53	<i>Stichopus ocellatus</i>	Stichopodidae	Low	
54	<i>Stichopus pseudohorrens</i>	Stichopodidae	Low	
55	<i>Stichopus vastus</i>	Stichopodidae	Low	Brown curryfish
56	<i>Stichopus (Apostichopus) japonicus</i>	Stichopodidae	High	
57	<i>Thelenota ananas</i>	Stichopodidae	Medium	Prickly redfish
58	<i>Thelenota anax</i>	Stichopodidae	High	Amberfish
59	<i>Thelenota rubralineata</i>	Stichopodidae	Low	
60	<i>Athyonidium chilensis</i>	Cucumariidae		Pepino de mar
61	<i>Cucumaria frondosa</i>	Cucumariidae	Low	Pumpkins, Orange footed
62	<i>Cucumaria japonica</i>	Cucumariidae	Low	
63	<i>Pattalus mollis</i>	Cucumariidae		Pepino de mar
64	<i>Pentacta quadrangulis</i>	Cucumariidae		
65	<i>Pseudocolochirus axiologus</i>	Cucumariidae	Aquaria	Sea apple
66	<i>Pseudocolochirus violaceus</i>	Cucumariidae	Aquaria	Sea apple

\* species with taxonomy to be revised.

† previously described as *Holothuria scabra* var. *versicolor*.



### Annex 10.2 Examples of issues to take into account when considering regulatory measures and actions for implementing management

Regulatory measures	Particularly useful when	Good companions	Hard to implement when	Good alternatives	Sections
Area and user access rights	<ul style="list-style-type: none"> <li>Pressure from external users</li> <li>Boundaries can be defined.</li> <li>Establishing a new fishery</li> <li>Relatively few fishers or fishing groups</li> </ul>	<ul style="list-style-type: none"> <li>Support institutional arrangements for management by fisher groups</li> </ul>	<ul style="list-style-type: none"> <li>Excluding users will lead to social conflict</li> <li>Strong political manipulation</li> <li>Legal framework not in place</li> </ul>	<ul style="list-style-type: none"> <li>Catch controls by limiting effort, gears and catch quotas, where conditions allow</li> <li>MPAs</li> </ul>	5.2; 5.3; 5.4; 5.7.1; 5.7.3; 6.2.1
Effort and capacity control	<ul style="list-style-type: none"> <li>Social structure allows it (e.g. target group well identified)</li> <li>Other income generation is possible</li> <li>Can stop new entrants (especially at start of new fishery)</li> </ul>	<ul style="list-style-type: none"> <li>“Market chain” licensing and reporting</li> <li>Socio-economic surveys</li> </ul>	<ul style="list-style-type: none"> <li>Small-scale fisheries</li> <li>Enforcement is weak (i.e. for controlling effort)</li> </ul>	<ul style="list-style-type: none"> <li>Short-term closures</li> <li>Catch controls by limiting gears and catch quotas, where conditions allow</li> </ul>	5.2; 5.3; 5.4; 5.5; 5.6.1; 6.1.4
Gear limitation and development	<ul style="list-style-type: none"> <li>Stocks depleted in shallow areas</li> <li>No training for compressed air use</li> <li>Objective to protect sensitive habitat and limit bycatch (e.g. by trawl fisheries)</li> </ul>	<ul style="list-style-type: none"> <li>“Market chain” licensing and reporting</li> <li>Enforcement</li> </ul>	<ul style="list-style-type: none"> <li>Weak or lack of enforcement</li> <li>Gear used at time or places difficult for surveillance</li> </ul>	<ul style="list-style-type: none"> <li>Catch controls by limiting effort and access</li> </ul>	5.2; 5.3; 5.5; 6.5
Size limits	<ul style="list-style-type: none"> <li>In most cases.</li> <li>Poor control over amount of catch</li> </ul>	<ul style="list-style-type: none"> <li>Short-term closure</li> <li>Enforcement</li> <li>Market chain licensing and reporting</li> <li>Training to improve processing quality</li> </ul>	<ul style="list-style-type: none"> <li>No legal framework</li> <li>Weak enforcement</li> </ul>	<ul style="list-style-type: none"> <li>Limiting catches through quotas</li> <li>MPAs</li> <li>Area and user access rights</li> <li>Gear limitation (e.g. mesh size, SCUBA ban)</li> </ul>	5.1; 5.2; 5.4; 5.6.1; 5.7.1; 5.7.3; 6.5; 6.7
Seasonal and short-term closures	<ul style="list-style-type: none"> <li>Need to periodically review status of fishery</li> <li>Well defined spawning season or other sensitive seasonal process</li> <li>Demand is seasonal</li> </ul>	<ul style="list-style-type: none"> <li>Reduction of total catch</li> <li>Restrict effort so catch rates do not increase in fishing season</li> <li>Size limits</li> </ul>	<ul style="list-style-type: none"> <li>Weak or lack of enforcement (e.g. remote areas)</li> <li>Target group depends on fishery for regular income</li> </ul>	<ul style="list-style-type: none"> <li>Limiting catches through quotas and effort control</li> </ul>	5.3; 5.6.1; 5.4

## Annex 10.2 (continued)

Regulatory measures	Particularly useful when	Good companions	Hard to implement when	Good alternatives	Sections
Rotational closures	<ul style="list-style-type: none"> <li>Well segregated fishing grounds</li> <li>Relatively few fishers</li> <li>Rotational plots can be large</li> <li>Stock surveys not easy to do</li> <li>Local decline of catches</li> <li>Effective enforcement or strong compliance exists</li> </ul>	<ul style="list-style-type: none"> <li>Effort control (setting minimum target value for CPUE)</li> <li>Local institutions for co-management of rotational plots</li> </ul>	<ul style="list-style-type: none"> <li>Access rights in place</li> </ul>	<ul style="list-style-type: none"> <li>MPAs</li> <li>Limiting catches through quotas and effort control</li> </ul>	5.3; 5.4; 5.7.1; 5.7.2; 5.7.3; 6.2.1; 6.5
Bans	<ul style="list-style-type: none"> <li>Stocks are depleted</li> </ul>	<ul style="list-style-type: none"> <li>Enforcement</li> <li>Fishery-independent stock surveys</li> <li>“Market chain” licensing and reporting</li> <li>Trade agreements like CITES</li> </ul>	<ul style="list-style-type: none"> <li>Usual</li> </ul>	<ul style="list-style-type: none"> <li>No good alternatives</li> </ul>	5.5; 5.6.2; 6.1.2; 6.3.2; 6.5
MPAs	<ul style="list-style-type: none"> <li>Should be always present</li> <li>Understanding the effects of fishery on stocks and ecosystem</li> <li>Well defined source populations and nursery areas</li> </ul>	<ul style="list-style-type: none"> <li>Fishery-independent stock surveys</li> <li>Short-term closures</li> <li>Size limits</li> <li>Gear limitation</li> </ul>	<ul style="list-style-type: none"> <li>Weak or lack of enforcement</li> <li>Area used for multiple purposes that alter the environment</li> <li>Multispecies fisheries, as they would require a diverse number of areas under protection</li> </ul>	<ul style="list-style-type: none"> <li>No good alternatives (high priority)</li> </ul>	5.6.1; 5.7.1; 6.1.2
Catch quotas	<ul style="list-style-type: none"> <li>Industrialized fishery</li> <li>Few fishers and/or landing sites</li> <li>Well organized fishery</li> </ul>	<ul style="list-style-type: none"> <li>“Market chain” licensing and reporting</li> <li>Fishery-independent stock surveys</li> </ul>	<ul style="list-style-type: none"> <li>Many small-scale fishers</li> <li>Multispecies fisheries.</li> <li>Poor monitoring of population status</li> <li>Fishery operating in large areas</li> </ul>	<ul style="list-style-type: none"> <li>Market licensing and access rights</li> <li>MPAs</li> <li>Gear limitation and other measures limiting catches or effort</li> </ul>	5.1; 5.2; 5.3; 5.4; 5.5; 5.7.1; 5.7.3; 6.1.2
“Market chain” licensing and reporting	<ul style="list-style-type: none"> <li>Usual (priority for products monitoring)</li> </ul>	<ul style="list-style-type: none"> <li>Institutional arrangements for management by fisher groups</li> <li>Training, including on quality of processing</li> <li>Enforcement</li> <li>International trade agreements, e.g. CITES</li> </ul>	<ul style="list-style-type: none"> <li>Many trade licenses (or many middlemen)</li> <li>Competition between collectors</li> <li>Trade routes not clear</li> </ul>	<ul style="list-style-type: none"> <li>No good alternative (high priority)</li> </ul>	5.5; 6.2.1; 6.3.2; 6.5; 6.7

## Annex 10.2 (continued)

Actions for implementing management	Particularly useful when	Good companions	Sections
Assessment and collection of basic information about stocks	<ul style="list-style-type: none"> <li>• All scenarios</li> </ul>	<ul style="list-style-type: none"> <li>• “Market chain” licensing and reporting</li> <li>• Fishery-independent stock surveys</li> <li>• Fishery-dependent stock surveys</li> <li>• Socio-economic surveys (including market surveys)</li> </ul>	5.5; 6.1.1; 6.1.2; 6.1.3; 6.1.4
Socio-economic surveys	<ul style="list-style-type: none"> <li>• Preparing or evaluating management plans and measures</li> </ul>	<ul style="list-style-type: none"> <li>• Fishery-independent stock surveys</li> <li>• Fishery-dependent stock surveys</li> <li>• Establish advisory committees</li> <li>• Education and communication with stakeholders</li> </ul>	6.1.2; 6.1.3; 6.1.4; 6.2.2; 6.6
Price monitoring	<ul style="list-style-type: none"> <li>• Many agents involved</li> <li>• Fishers not well informed</li> <li>• Market prices fluctuating</li> </ul>	<ul style="list-style-type: none"> <li>• Fishery-dependent stock surveys</li> <li>• Education and communication with stakeholders</li> <li>• Support institutional arrangements for management by fisher groups</li> </ul>	6.1.3; 6.1.5; 6.2.1; 6.6
Support institutional arrangement for management by fisher groups	<ul style="list-style-type: none"> <li>• Limited fishing area</li> <li>• Weak regulatory framework</li> </ul>	<ul style="list-style-type: none"> <li>• Market chain licensing and reporting</li> <li>• Education and communication with stakeholders</li> <li>• Socio-economic surveys</li> <li>• Fishery-independent stock surveys</li> <li>• Fishery-dependent stock surveys</li> <li>• Management advisory committees</li> </ul>	5.5; 6.1.2; 6.1.3; 6.1.4; 6.2.1; 6.2.2; 6.6;
Establish advisory committees	<ul style="list-style-type: none"> <li>• To prepare or evaluate management plan/measures</li> <li>• Assist with communication strategy</li> </ul>	<ul style="list-style-type: none"> <li>• Education and communication with stakeholders</li> <li>• Training, including improving quality of processing</li> <li>• “Market chain” licensing and reporting</li> </ul>	5.5; 6.2.2; 6.6; 6.7;
Improve quality of processing through training	<ul style="list-style-type: none"> <li>• Low or decreasing quality of products</li> <li>• Change of species</li> <li>• Change of market demand</li> </ul>	<ul style="list-style-type: none"> <li>• Price monitoring</li> <li>• Education and communication with stakeholders</li> </ul>	6.1.5; 6.6; 6.7
Education and communication with stakeholders	<ul style="list-style-type: none"> <li>• Usual (high priority)</li> </ul>	<ul style="list-style-type: none"> <li>• Socio-economic surveys</li> <li>• Fishery-independent stock surveys</li> <li>• Fishery-dependent stock surveys</li> <li>• Price monitoring</li> </ul>	6.1.2; 6.1.3; 6.1.4; 6.1.5; 6.6;
Promoting regulatory measures and interventions into legislation	<ul style="list-style-type: none"> <li>• Informal regulations not effective</li> <li>• New regulations can be added</li> </ul>	<ul style="list-style-type: none"> <li>• Enforcement</li> <li>• Operating legal system</li> <li>• International agreements and CITES</li> <li>• Education and communication with stakeholders</li> </ul>	6.3.1; 6.3.2; 6.5; 6.6;
Enforcement	<ul style="list-style-type: none"> <li>• Usual</li> </ul>	<ul style="list-style-type: none"> <li>• Market chain licensing and reporting</li> <li>• Legalizing regulatory measures</li> <li>• Education and communication with stakeholders</li> <li>• Fostering sense of ownership by users through access rights</li> <li>• International agreements like CITES</li> </ul>	5.5; 5.7.3; 6.5; 6.2.1; 6.6; 6.3.1; 6.3.2







**Appendix 2****Data sheet for recording landings of fishers (Purcell, Gossuin and Agudo, 2009a).**

Data are recorded by researchers or fishery officers for fishery-dependent assessments

Date:						Fisher name:						Recorder:																	
Collection sites or area:																													
No. Fishers:						Total catch (kg):						Hours spent fishing: Hours diving/day: Hours spent travelling to site:																	
Form of product:						Fresh: <input type="checkbox"/>						Salted: <input type="checkbox"/>						Dried: <input type="checkbox"/>						Gutted: <input type="checkbox"/>					
																					Species								
																					Est: kg of catch								
Len	Wid	Wt	Len	Wid	Wt	Len	Wid	Wt	Len	Wid	Wt	Len	Wid	Wt	Len	Wid	Wt	Len	Wid	Wt	Len	Wid	Wt						
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Len= length (cm±0.5cm) Wid=width (cm ±0.5cm) Wt.=weight (grams)																													
Comments:																													

**Appendix 3**

**A logsheet used in the sea cucumber fishery in Newfoundland and Labrador, Canada.**

Data are recorded by fishers, who submit the form to the Department of Fisheries and Oceans after each landing

**Sea Cucumber Fishing Log**

Sea Cucumber Trip # \_\_\_\_\_ Date of Sailing \_\_\_\_\_ Page # \_\_\_\_\_  
 Vessel Name/CFV # \_\_\_\_\_ Time of Sailing \_\_\_\_\_ Observer \_\_\_\_\_  
 # Crew Onboard \_\_\_\_\_ Port of Sailing \_\_\_\_\_ Port of Landing \_\_\_\_\_ Skipper Signature \_\_\_\_\_

Activity/ Tow #	Grid #	Date M/D	Tow (hrs)/GPS Position		Course	Depth (fms)	Speed	Distance Covered (GPS)	Bottom Type	# Tote Pans cucumbers	# Tote Pans Discarded Cucumbers	Sea State	Bycatch #	Bycatch Species	Bycatch Wt. (lbs)	Remarks, hook-ups, problems with gear, etc.	
			Start Tow	Position (GPS)													Finish Tow
			Start Latitude	End Latitude													
			Start Longitude	End Longitude													
			Start Latitude	End Latitude													
			Start Longitude	End Longitude													
			Start Latitude	End Latitude													
			Start Longitude	End Longitude													
			Start Latitude	End Latitude													
			Start Longitude	End Longitude													



Sea cucumbers are important resources for coastal livelihoods in more than 40 countries. Sadly, widespread overexploitation of wild stocks risks biodiversity loss and the long-term viability of fisheries. Spawned from an FAO international workshop of experts, this document presents a “roadmap” to guide fishery managers in choosing appropriate regulatory measures and management actions for sea cucumber fisheries. It elaborates on their use, limitations and modes of implementation, with *Examples and lessons learned* from various fisheries. Achieving sustainable management of sea cucumber fisheries requires an ecosystem approach to fisheries (EAF), precautionary regulations, improved enforcement and stronger commitment of fishery managers and policy makers.

