

Actions to implement management

INFORMATION FOR MANAGEMENT

Overview of the harvested species

Definition: Simple surveys and literature searches to understand the ecology of sea cucumbers in the fishery, and the past and current exploitation by fishers.

This activity should be part of the “scoping phase” in developing a management plan (discussed earlier). The information should provide an understanding of the range of species harvested, their basic biology (e.g. size-at-maturity, behaviours and preferred habitats), their value and distribution in the fishery. Size limits and other regulatory measures can then be correctly chosen and local names can be matched to the scientific names of each species.

Limitations

- Some common names used by fishers may apply to two or more species.
- More species may be available in the wild than fishers currently collect.
- The local value of each species may poorly reflect the true international market value.

How to implement

- Find out what species can be found in the fishery. Contact taxonomists to help in identifying species.

- Find out whether each species is endemic or widely distributed.
- Review literature to understand the ecology and habitats of each commercial species (see Further Reading section).
- Find out why some species are more sought after by fishers and traders.
- Use simple indicators to roughly assess the stock abundance of species in the fishery (Friedman *et al.*, 2008).



Some guidebooks that illustrate various sea cucumber species are available, such as the FAO guide depicted.

Fishery-independent stock surveys

Definition: A process of collecting and analysing data on the sea cucumber populations through surveys independent of the animals collected by fishers. These can also be called “population surveys” or “censuses”.

Most often, fishery-independent surveys comprise underwater visual census (UVC) of sea cucumber densities and later analyses of abundance, diversity and distribution. These data can be used to show the relative “health” of the stocks and to evaluate the management strategy in relation to target reference points. Fishery-independent surveys conducted repeatedly over time can be a way to

monitor the response of stocks to a certain fishing pressure or management measures.



A skin diver holds to a “manta board” being towed behind a small boat to count sea cucumbers within a 2-m wide belt transect on a shallow tropical reef flat.

Limitations

- Relatively costly and time-consuming.
- Require experienced divers and a suitable boat.
- Misidentification of species will confound the correct abundances and distributions of species.
- Geographical Information Systems (GIS) may be needed, requiring technical competence.

How to implement

- Establish a list of species likely to be found.
- Decide what questions you hope to answer.
- Obtain advice from, or hire, specialists.
- Use methodologies from other reputable studies.
- Determine the number of sample units (e.g. transects) to obtain the desired precision.
- Define the area and frequency of the surveys.
- Choose the sampling design and methodologies.
- Count the number of, and measure, individuals for each species in the sample units.
- Calculate densities and abundance for each species.



M. LINCOLN-SMITH

Two SCUBA divers surveying sea cucumbers on soft sediments in deep water.

Fishery-dependent stock surveys

Definition: A process of collecting and analysing data on fishing activities and catches of sea cucumbers in the fishery.

Fishery-dependent surveys collect information on what, when, where and how animals have been caught in the wild by fishers. Most often, these surveys are based on data submitted by fishers (e.g. via logbooks) or data collected by fishery officers observing or inspecting the sizes and types of sea cucumbers caught, processed or traded.

These data will reveal a great deal about fishing activities, the catch structure, areas where animals are being caught and catch-per-unit-effort (CPUE) of fishing. Fishery-dependent data are relatively easy and cheap to collect. However, data like CPUE should be used cautiously

Data on catch-per-unit-effort are not a reliable indicator of stock abundance.

as indicators of stock abundance because fishers can deplete one fishing ground after another (termed “serial depletion”) and still maintain the same catch rate.

Limitations

- Data from the fishers’ logbooks may be incomplete or incorrect.
- Fishery-dependent data will give a biased indication of the composition, sizes and abundance of wild stocks due to selectivity by fishers.
- Catch rates can be stable or increase over time even though the resource is declining in abundance.

How to implement

- Choose one or more data collection methods. Data can be gathered through (a) landing surveys, (b) surveys at processing stations, (c) logbooks or logsheets returned by fishers, or (d) fishery observers on fishing boats.
- Prepare data sheets or logbooks using published examples.
- Arrange with fishers to go with them as an observer or record their catch once they return to shore.
- Give fishers simple identification guides with logbooks so species are correctly identified.
- Make the submission of logbooks a condition of licence renewal for fishers.
- Include in logbooks the number and total weight of each species collected, any animals discarded, fishing areas, fishing duration, number of fishers.
- Validate the accuracy of logbooks by inspecting catches at sea or comparing data with exports.



Collecting data on catches at an exporter's facility in Papua New Guinea.

J. P. KINCH

Socio-economic surveys

Definition: The collection of data on responses from fishers, and other actors in the fishery, to questions about factors that affect the exploitation of stocks.

The surveys would commonly entail questionnaire-based interviews with fishers, processors, exporters and other stakeholders of the fishery. The surveys should reveal important information about the different actors in

the fishery as well as how and where sea cucumbers are being collected.

Socio-economic surveys help to choose regulatory tools that will be accepted by stakeholders. Analyses of data of socio-economic indicators can also serve to evaluate the performance of management strategies.



A researcher recording responses of a Filipino fisher during a socio-economic survey.

Limitations

- Lack of capacity to design and conduct socio-economic surveys in a structured way.
- Data can be biased if sampling is not random.
- Fishers may give false information (even unintentionally) or be reluctant to give information.

How to implement

- Define the purpose of the survey and what information is required.
- Seek expertise to conduct surveys that will give reliable, non-biased data.
- Adapt an existing survey questionnaire for sea cucumber fisheries.
- Choose an appropriate sampling design.
- Try to cover a wide breadth of stakeholders, not just fishers.
- Conduct household surveys where there is subsistence fishing and many family members may be involved in fishing.
- Use visual aids and field identification guides.
- Validate the information and communicate to stakeholders on how data were used.



Price monitoring

Definition: Regular examination over time of the prices of sea cucumbers and beche-de-mer along the marketing chains: i.e. from fishers, collectors, exporters and consumers.

Price monitoring can show whether fishers are receiving a fair share of the export value of sea cucumbers. The information can also be used to assess the income generated by the fishery and the economic importance to various actors. Monitoring along the whole “market chain” allows government agencies to verify or set appropriate taxes and duties.

Limitations

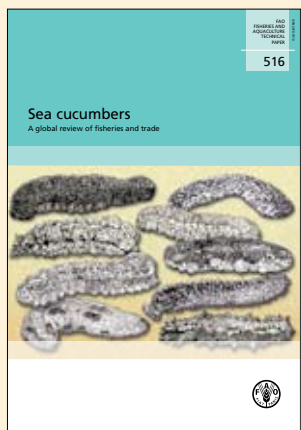
- Difficulty in persuading agents to provide reliable information on prices of sea cucumbers sold or exported.
- Remoteness of some fishers or buyers may make it difficult to gather price data.
- Custom officers may lack the training to identify species and grades of sea cucumbers.
- Data from overseas markets are hard to interpret.

How to implement

- Find out the relationships between sellers, exporters and importers along the market chain.
- Involve the local trade ministry and customs departments in monitoring of prices and grades.
- Establish a process to obtain prices from the international market.

Sea cucumbers

A global review of fisheries and trade



FAO Fisheries and Aquaculture Technical Paper No. 516. Rome, FAO. 2008.

This paper reviews the world-wide population status, fishery and trade of sea cucumbers through the collection 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 the Indian Ocean; Asia; and the Western Central Pacific. For each region, a case study of a “hotspot” country or fishery is presented to highlight critical problems and opportunities for the sustainable management of sea cucumber fisheries. The hotspots are Papua New Guinea, the Philippines, Seychelles, the Galapagos Islands (Ecuador) and the fishery for *Cucumaria frondosa* of Newfoundland in Canada. 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 in sea cucumber conservation and exploitation.

INSTITUTIONAL REQUIREMENTS

Support institutional arrangements for local-scale management

Definition: Aid for fishers or fisher groups to take joint, or full, authority in developing and implementing resource management.

The support could be by way of assistance to establish community organizations, cooperatives or customary groups. The establishment of institutions for resource management by fisher groups is part of co-management and community-based management and encouraged within an EAF (FAO, 2003).

Local-scale management improves accountability and compliance of fishery regulations.

Co-management and community-based management arrangements will be particularly useful in small-scale fisheries where top-down, centralized systems have proved inefficient. Within communities, fishery regulations can be

better understood because they are developed through wide participation.

Limitations

- The group/community may not act in its self-interest and the management decisions may lead to poor outcomes.
- Potentially poor understanding of biological processes to aptly manage the resource.
- Financial resources may be lacking for proper monitoring or surveillance.

- The fishing practices in one community may affect the sustainability of sea cucumber stocks in a neighbouring community.

How to implement

- Assess existing institutions in place and the merits of alternative management systems.
- Meet with the fishers and fishing communities to see how best these institutions can be formed.
- If appropriate, assist in the formalization of the local-level institution.
- Map out how the different organizations or stakeholders are linked.
- Define the decision-making process.
- Describe and support the legal frameworks.
- Try to match the spatial jurisdictions of management institutions with the spatial scale at which ecological processes operate in the fishery.
- Devolve other management activities, like surveillance, enforcement and monitoring.

Establish management advisory committees

Definition: Support to enable the formation of multidisciplinary bodies of stakeholders that provide information and advice on the best practices for the management of the fishery.

MACs can achieve broader acceptance and ownership of management decisions than top-down systems.

A management advisory committee (MAC) may be made up of fishing cooperative representatives, fishery managers, scientists, local representatives, decision-making authorities and social workers. MACs can serve to bring a wider range of views and aspirations into the decision-making process. Consultative committees (CCs) are similar to MACs, and tend to be used for smaller or developing fisheries. MACs and CCs provide a forum for assessing the potential consequences, costs and practicality of various scenarios of management regulations.

Limitations

- Advisory bodies may not act in the best interests of the resource or fishers. Members may have vested interests.
- The expertise for certain roles may be lacking.
- Consensus about management decisions may be difficult to achieve. Disputes, or differences of opinion, can stall the decision-making process.
- Consultation can be time-consuming.
- MACs may lack the authority for decision-making.

How to implement

- Develop a list of credible and skilled stakeholders and experts.
- Decide on who will best be part of the committee, with around 5–10 members.
- Assign a chairperson.
- Define and decide on committee purpose, objectives and protocols (e.g. meeting schedules).
- Publicize the contact details of all representatives on the committee.
- Develop a process to circulate information from the MACs to other stakeholders.
- Provide MACs with information on the fishery, existing legislation and the legal framework for decisions.
- Ensure adequate funding for MAC meetings.



LEGAL REQUIREMENTS

Legislation of management regulations

Definition: Facilitate and support processes that enable fishery management measures to be formalized into effective legal instruments or documents.

Support from fishery managers could include help to write conditions of local ordinances or international conventions such as the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Management decisions must be properly set into the legal framework of the managing institution so that they are duly respected and can be legally enforced. Setting regulations into the legislative framework promotes responsible action.

Limitations

- Inadequate legal support for placing management regulations into legislation in a timely fashion.
- Management institutions may lack the motivation to place management decisions into law.
- Political manipulation and corruption.

How to implement

- Assess policy and planning needs for the fishery.
- Find out how resource management is placed into legislation, at the level of the managing institution.
- Find out what the requirements of the legal system and expected timeframes are.
- Draft the fishery regulations in simple terms.
- Seek technical and legal advice.
- Seek the endorsement of decision-makers.

Managing sea cucumber fisheries with an ecosystem approach



FAO Fisheries and Aquaculture Technical Paper No. 520. Rome, FAO. 2010.

Sea cucumbers are important resources for coastal livelihoods in more than 40 countries. However, 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 “road map” 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.

International agreements and the CITES

Definition: Binding or non-binding arrangements between governments that promote cooperation towards common interests and objectives.

Management and conservation of sea cucumbers might need international support because the geographic distribution of most species goes beyond political boundaries and trade involves international markets. The CITES aims to ensure that trade in wild animals is ecologically sustainable. Listing of species under one of the three Appendixes will give certain levels of control on trade:

Appendix I: offers the highest protection for species that are threatened with extinction;

Appendix II: offers moderate protection for species that could become threatened if their trade is not effectively regulated;

Appendix III: provides assistance to countries in the enforcement of its national trade regulations.

A CITES listing could help to protect some rare or depleted sea cucumber species from extinction. International agreements may place requirements for trade reporting, thus helping to enforce national regulations.

International agreements may be useful in preserving critically depleted, rare or endemic species.

Limitations

- Lack of political will to pursue agreements.
- Conflicts of interests between potential partner countries.

- Agreements may not be put into practice at the national level.
- Financial or technical constraints to follow the requirements of CITES listings.
- Identifying the listed species in international trade.
- Socio-economic problems if countries apply CITES listings more strictly than required.

How to implement

- Support the development of international agreements for exploitation and trade.
- Check national and international legal frameworks by which agreements can be made and enforced.
- Obtain reliable assessments of the national and global status of the species being fished.
- Find out if any of the species in the fishery are threatened with extinction locally.
- Examine the advantages and disadvantages of an international agreement, like the CITES, including likely costs.
- Implement monitoring to assess whether the agreement conditions are being met.

ASSIGN ACCOUNTABILITY

Definition: Assigning to somebody the obligation to demonstrate and take responsibility for performance of the fishery.

Assigning accountability provides a foundation for the decision-making process.

Assigning accountability promotes more commitment to act responsibly and take ownership of the consequences of poor judgement in fisheries management. Accountability helps to identify mistakes and errors so that they can be remedied. There may be official accountability for research and the communication or enforcement of regulations. For example, fisheries officers may be made accountable for ensuring that all fishers and processors are aware of the regulations, whereas customs officers can be made accountable for checking shipments of beche-de-mer.

Limitations

- Turnover of decision-makers erodes clarity about who is accountable for fishery performance.
- Those accountable may be reluctant to take hard decisions.
- Lack of political will to take actions against those accountable for decisions, scientific information, surveillance or enforcement.

How to implement

- Find out the legal framework by which people can be held accountable and penalized.
- Define clear reference points by which accountability can be judged.
- Define duties and responsibilities of participants.
- Set clear performance indicators at various levels: ecosystem, wild stocks and economics.
- Politicians should be accountable for ensuring adequate funding and the governance structure.
- Define and implement meaningful sanctions, or remedial action, for breaches of responsibilities.
- Promote transparency by making the accountability public.



ENFORCEMENT

Definition: Intervention to ensure that users comply with management regulations and enable penalties to be applied to offenders.

Enforcement seeks to ensure that all actors in the fishery comply with management regulations.

Enforcement may entail physically checking catches, gear used on boats, or the areas being fished, and imposing fines or other sanctions if the catch or fishing gear are not in accord with the

regulations. Some form of enforcement is usually needed in order for the management measures to be adhered to.

Enforcement can also enhance compliance by providing an example that offenders will be prosecuted for breaches.

Limitations

- Lack of financial and human resources set aside for adequate enforcement.
- Limited technical capacity of the fishery officers to conduct inspections and understand the laws.
- Conflict with fishers if they do not understand or have not been made aware of the regulations.
- Lack of political will to prosecute offenders.
- Penalties may not be appropriate or severe enough to discourage offenders.
- Corruption of the enforcement process.

How to implement

- Make simple and consistent fishery regulations in the first instance, for ease of enforcement.
- Assess the financial, technical and human-resource capacity of the management institution.
- Provide sufficient funds for the enforcement (FAO, 1995).
- Assign the authority (to persons or a group) for enforcement.
- See how stakeholders can be involved.
- Train enforcement officers so they understand the regulations and methods of inspection.
- Decide how the regulations will be enforced and set out the penalties.
- Inform stakeholders about the regulations, inspections and penalties.

Inspecting sea cucumbers at processing centres will generally be easier than inspecting landings of fishers.



EDUCATION AND COMMUNICATION WITH STAKEHOLDERS

Only when stakeholders are educated about the regulations will they comply unreservedly.

Definition: The exchange of information (both ways) with stakeholders about the management of the fishery.

Communication strategies include dissemination of leaflets, radio programmes, roving theatrical presentations, local presentations and newspaper articles or comics. Stakeholders can then be informed about the fishing regulations, the biology of sea cucumbers, the status of wild

stocks and management principles and objectives. An understanding of these aspects will foster better compliance of regulatory measures.

A communication programme also allows feedback to identify issues of stakeholders and traditional knowledge, which should be used in management (FAO, 2003).



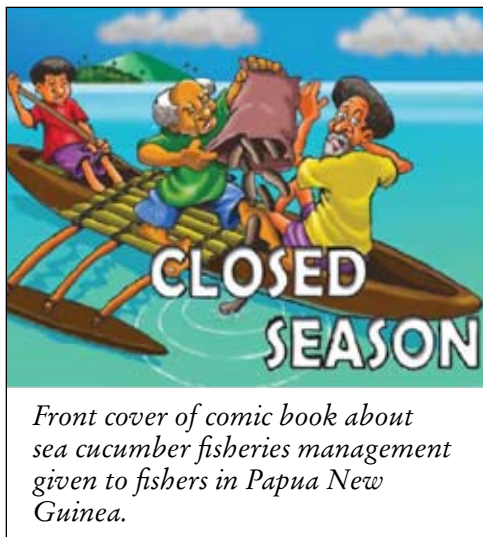
S. W. PURCELL

Scientists communicating sea cucumber fisheries management with artisanal fishers in the Philippines.

Limitations

- Skills in effective communication about sea cucumber biology and management principles may be lacking in fisheries agencies.

- Language – in countries with many local dialects.
- Lack of adequate and appropriate education materials.



How to implement

- Develop a communication and education strategy – what methods and materials will be most effective?
- Set the periodicity at which fishery officers and other agents interact with fishers and how.
- Set aside funding for the activities.
- Train fishery officers in communication techniques.
- Develop education materials or adopt those used in other fisheries. Simple materials, like comic books in local languages, may prove most effective.
- Trial the educational material on some fishers and adapt them as needed.
- Evaluate the effectiveness of the programme.

IMPROVE QUALITY OF PROCESSING THROUGH TRAINING

Definition: Support, or facilitation, of training for fishers and processors in best practices for processing sea cucumbers into beche-de-mer or other marketable forms.

Processing means the transformation of live sea cucumbers into a product form that can be exported or sold for consumption (e.g. salted, frozen, dried and canned). Sea cucumbers are most commonly processed into the dried form, called “beche-de-mer” or “trepang”.

Building skills in processing can shift income generation from harvesting to value-adding.

Helping fishers to improve the quality of processing allows them to make more money out of the sea cucumbers they harvest and reduces the number of poorly processed animals that have to be discarded. Such training can also ease fishing pressure because fishers may then



S. W. PURCELL

Left: small, poorly processed sandfish (Holothuria scabra) from the Philippines. Right: large, well-processed sandfish in New Caledonia.

make sufficient money out of fewer well-processed animals (Purcell, 2010).

Limitations

- Reluctance of processors to share their techniques.
- Buyers may prefer different processing methods.
- The market can change over time, requiring new processing methods.
- Management agencies may lack the resources or expertise to train fishers.



Children boiling sea cucumbers in Papua New Guinea.

J. P. KINCH

How to implement

- Find out which processing modes are preferred by traders or overseas importers.
- Help to improve the contacts between experienced processors and fishers.
- Assess the quality of exported sea cucumbers.
- Identify where poor processing is occurring.
- Support training workshops – hire expert processors if needed.
- Provide information sources, like simple manuals.
- Promote environmentally friendly methods (e.g. ways to reduce deforestation for fire wood).

RESTOCKING

Definition: The translocation of adults, or release of juveniles, to create protected breeding populations that naturally rebuild stocks in the fishery.

Restocking aims to form nucleus populations of adult sea cucumbers that breed so that their offspring can repopulate neighbouring fishing grounds. This means that the released animal must be fully protected from fishing.

Restocking should be used only as a “last resort” and not as a substitute for a precautionary management.

Culturing juveniles in hatcheries and releasing them for restocking is expensive. So, managers should prevent fishing pressure that depletes stocks

to the point where restocking is needed (FAO, 1995). Restocking may be appropriate when wild stocks have been depleted far too low to expect natural recovery of the stock using other management measures (Bell, Purcell and Nash, 2008).

Restocking may arise, inadvertently, from breeding populations of adults created by sea-based aquaculture of sea cucumbers.

Broodstock and juvenile sea cucumbers should not be translocated among regions or countries.

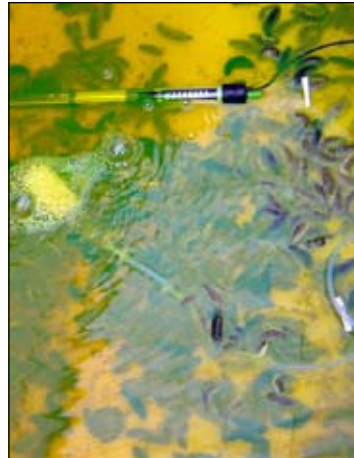
Limitations

- Difficulty in finding enough broodstock for culture-based restocking.
- Translocating juveniles from one region, or country, to another can cause irreversible genetic problems.

- Availability of hatchery technology (see Lovatelli *et al.*, 2004).
- High costs of producing juveniles.
- Optimal restocking methods may not yet be developed to achieve good survival of juveniles.
- Difficulty in guaranteeing the protection of released juveniles or adults.

How to implement

- Determine the abundance of animals in the wild.
- Consider the costs and time frames for restocking and whether aggregating wild adults or releasing cultured juveniles will be most cost-effective (Bell, Purcell and Nash, 2008).
- Are methods well established for culturing and restocking the target species?
- Mark the juveniles to allow monitoring to verify survival rates and to identify restocked animals.
- Determine the best sites for stocking and ensure they are protected from fishing.
- Implement better enforcement and management of the fishery to avoid the need for restocking.
- Monitor populations of the stocked species outside the stocked areas before and after stock rebuilding.



Juvenile Holothuria scabra being chemically marked in a hatchery tank prior to release in the wild.

Commercial holothurians of the tropical Pacific

Posters and field ID cards are useful in determining what species are found in the fishery. Species identification is greatly aided by examining microscopic spicules from samples of body tissues. Species names may change over time. Since this poster was printed (Purcell *et al.*, 2008), a study has shown that *Bohadschia similis* should now be called *Bohadschia marmorata*.

COMMERCIAL HOLOTHURIANS OF THE TROPICAL PACIFIC

Actinopyga

- Actinopyga lemaneiformis* (Lacepede, 1801)
- Actinopyga lemaneiformis* (Lacepede, 1801)
- Actinopyga lemaneiformis* (Lacepede, 1801)
- Actinopyga lemaneiformis* (Lacepede, 1801)

Actinocypha

- Actinocypha* sp.
- Actinocypha* sp.
- Actinocypha* sp.
- Actinocypha* sp.

Bohadschia

- Bohadschia* sp.
- Bohadschia* sp.
- Bohadschia* sp.
- Bohadschia* sp.

Buthaster

- Buthaster* sp.
- Buthaster* sp.
- Buthaster* sp.
- Buthaster* sp.

Stichopus

- Stichopus* sp.
- Stichopus* sp.
- Stichopus* sp.
- Stichopus* sp.

Thaliaster

- Thaliaster* sp.
- Thaliaster* sp.
- Thaliaster* sp.
- Thaliaster* sp.

Spicules and other structures

Species: *Actinopyga lemaneiformis*, *Actinocypha* sp., *Bohadschia* sp., *Buthaster* sp., *Stichopus* sp., *Thaliaster* sp.

Authors: Purcell, J.H., & others.

Funding: [Logos of funding agencies]