

Seychelles: a hotspot of sea cucumber fisheries in Africa and the Indian Ocean region

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SUMMARY

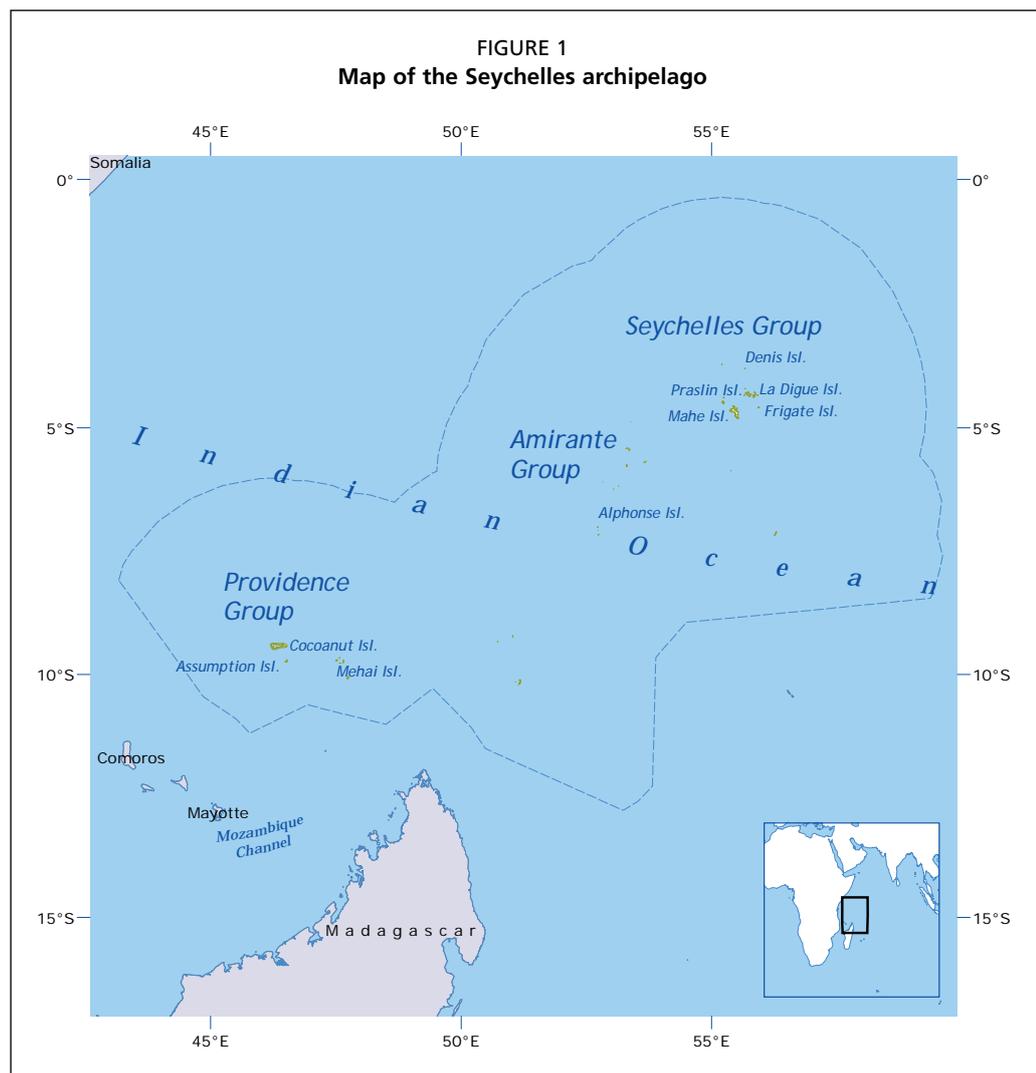
The Seychelles Archipelago, comprising 115 islands, is located in the middle of the Western Indian Ocean and has a large Exclusive Economic Zone (EEZ 1.4 millions km²). Sea cucumbers in Seychelles have been fished for more than a hundred years, but the fishery has recently seen a rapid development. Sea cucumbers are mostly collected by divers using SCUBA gear. They are processed for the export market. The population status is presented for the five main species caught (“pentard”, white teatfish, black teatfish, prickly redfish and sandfish) from the estimated stock and the overall density (ind./ha). Catch and effort data have been collected since 1999 by Seychelles Fishing Authority (SFA). The data are provided by the fishers as per the requirements of their fishing license conditions. The catch per unit effort (CPUE), expressed in numbers of sea cucumbers collected per diver per day, shows mostly a downward trend. The sea cucumber fishery in Seychelles was open-access until 1999. As part of a recent FAO-funded project, a management plan for the fishery has been prepared, based on the results of the resource assessment. Management measures were established through the Fisheries (Amendment) Regulations (1999) which provided some control over the fishery through licences for fishing and processing. The total allowable catch (TAC) has been calculated, based on the maximum sustainable yield (MSY) for each species. The trade data show that there are three main export markets, with China Hong Kong Special Administrative Region (SAR) being largely the dominant one. The socio-economic importance to the local fishing community appears from the three operations of harvesting which relates principally to the collection of the sea cucumbers, processing which involves cleaning and drying of the product, and trading which involves sales to different markets. Finally, recommendations for improving fisheries management and conservation through the involvement of all stakeholders are discussed. Evaluation of the pros and cons of listing in the Convention on the International Trade in Endangered Species of Wild Fauna and

Flora (CITES) is presented. This fishery in Seychelles is an example of recent management showing steps toward a sustainable exploitation of the resources.

1. INTRODUCTION

The Seychelles Archipelago is located in the middle of the Western Indian Ocean (Figure 1). Its 115 islands are scattered over a wide area which explains its large Exclusive Economic Zone (EEZ 1.4 millions km²). The country has a total population estimated at 85 032 people as of June 2007 (Anon., 2007). Most of the population live on the main islands (Mahé and Praslin) and the rest of the islands are sparsely populated or remain uninhabited. This has left them relatively unexploited, and today they still have a rich biodiversity. The coral reefs of Seychelles have been described as being one of the most extensive networks in the Western Indian Ocean (Jennings *et al.*, 2000). Aldabra, the most remote atoll was designated as a World Heritage Site by UNESCO in 1982. The isolation of these islands in the middle of the ocean, the difficulties of accessing many of them and the low levels of exploitation due to a small population makes the Seychelles a safe haven for many of its natural resources.

Sea cucumbers in Seychelles have been fished for more than a hundred years, with reports of *bêche-de-mer* exports dating back to the late 1800s. However, quantities harvested were fairly low and it is only in the late nineties that the fishery has seen a rapid development (Aumeeruddy, 2007). Currently, in the Seychelles sea cucumbers are mostly collected by divers using SCUBA gear. The average depth of the Mahé Plateau,



which is one of the main fishing grounds, is around 50 m, and most of the harvesting of sea cucumbers takes place in depths ranging from 10 to 40 m. The hookah system (air supplied to the diver from a compressor at the surface) is not used in the Seychelles.

Sea cucumbers are collected mostly for the export market as there is no local consumption in the Seychelles. There are two categories of fishers: (i) those that use small outboard powered boats and operate mostly in the coastal areas around the three main populated islands (Mahé, Praslin and La Digue) (normally carrying out day trips); and (ii) fishers that use larger decked boats equipped with a diesel inboard engine, which can stay at sea for up to two weeks. These boats employ four divers (maximum authorized under the license conditions) and sea cucumbers are usually pre-processed onboard.

2. BIOLOGICAL AND POPULATION STATUS

2.1 Current species in trade

Very little research had been done on holothurians in the Seychelles. A synthesis by Clark (1984), based on previous publications by Clark and Rowe (1971) listed 151 Echinoderm species, including 35 sea cucumbers, and gives some brief information on the ecology of the most common ones such as *Holothuria atra*, *Stichopus chloronotus*, *Bohadschia marmorata*, *Actinopyga mauritiana* and *Holothuria nobilis*. Clark's work was restricted to the Aldabra atoll and Mahé Island, and out of the 35 species found, seven were observed only at Aldabra but are not endemic. Other observations and reports have been published on Aldabra by Sloan (1982).

A recently completed holothurian population survey has shown that out of the 35 sea cucumber species recorded previously in the Seychelles, there are more than twenty commercial species, some not currently exploited. These are predominantly from the Holothuriidae and Stichopodidae families. However, only about six species are regularly fished locally fetching the highest price on the market (Aumeeruddy and Payet, 2004). These comprise three species of teatfish: the black teatfish (*Holothuria nobilis*), the white teatfish (*H. fuscogilva*) and a teatfish yet to be described and locally named "pentard" (the export name of flower teatfish is used for this species). The two other species found in the catch are the prickly redfish (*Thelenota ananas*) and the yellow surfish (*Actinopyga mauritiana*). The sandfish (*H. scabra*) used to be collected in fairly large numbers, but in the past few years, landings of this species have dropped to very low levels compared to the other five species. Even though this species fetches a high price on the market, the fishers target it less because of its burying behaviour, hence making it more difficult to find. Other species like the lollyfish (*H. atra*) or the elephant trunkfish (*H. fuscopunctata*) are collected in small numbers. The five main species caught (pentard, white teatfish, black teatfish, sandfish and prickly redfish) represented respectively 46.2, 11.3, 4.9, 3.1 and 0.6 percent of the total catch in 2006.

2.2 Population status

The sea cucumber fishery has existed in the Seychelles for over a century, but it was unregulated because of its small size and low catch. The only data collected were exports quantities of dried sea cucumbers by the customs authorities (Marguerite, 2005). No catch and effort data prior to 1999 were collected compared to other artisanal fisheries. The fishery saw a rapid development in the late-1990s, mainly due to the high demand for bêche-de-mer on the Asian markets. This convinced the authorities to collect information on population status and more recently on the biology of the sea cucumbers, if the fishery was to continue on a sustainable level. The Seychelles Fishing Authority (SFA), which is responsible for the management of fisheries in the Seychelles, conducted a stock assessment of holothurians in 2003–2005 with funding obtained from the Food and Agriculture Organization (FAO) under a Technical Cooperation Project (Aumeeruddy *et al.*, 2005).

Due to the large size of the Seychelles' EEZ stock assessment surveys were carried out for the two main sea cucumber fishing grounds, the Mahé Plateau and the Amirantes Plateau, which together represent an area of 48 305 km² or 3.45 percent of the total (Aumeeruddy *et al.*, 2005). A total of 246 sites were surveyed throughout the study area in December 2003, March/April and November 2004 for a total of seven weeks. More than 20 species, having a commercial or potentially commercial value, were observed and counted. Table 1 provides the estimated biomass and stock status of sea cucumbers observed during the surveys.

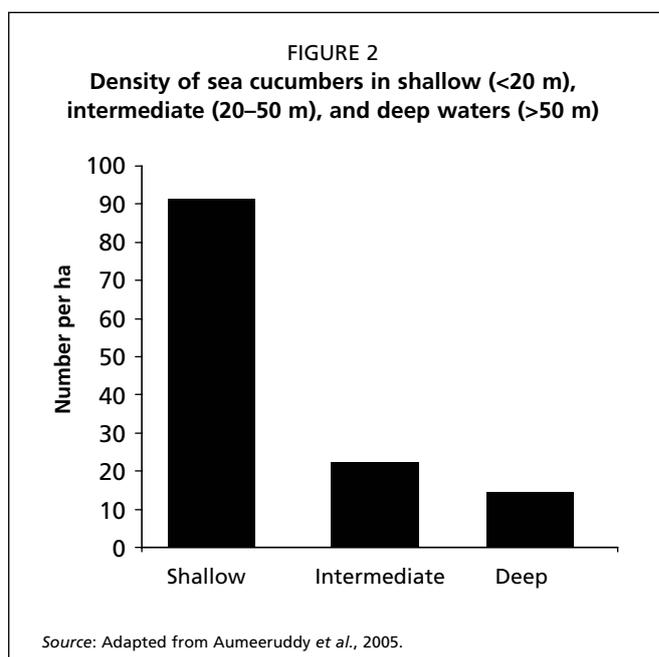
The overall density of commercial species in the study area was 19.78 ind. ha⁻¹, which equated to a standing stock of 95.5 million individuals (\pm 21.5%; 90% CI)

TABLE 1

Estimated stock, overall density and status of sea cucumber species. Exploited species are shaded

Species name	Common name	Stock (tonnes)	Overall density (ind./ha)	Status
<i>Holothuria nobilis</i>	Black teatfish	11 588.9	1.98	Underexploited
<i>H. fuscogilva</i>	White teatfish	5 178.1	0.63	Fully exploited
<i>Holothuria</i> sp.	Pentard	3 909.5	0.48	Fully exploited
<i>H. fuscopunctata</i>	Elephant trunkfish	7 876.7	1.03	Underexploited
<i>H. atra</i>	Lollyfish	12 721.7	5.61	Unexploited
<i>H. edulis</i>	Pinkfish	951.4	0.35	Underexploited
<i>H. scabra</i>	Sandfish	ND	ND	Overexploited
<i>H. pervicax</i>	Dark papillae	69.4	0.07	Unexploited
<i>Actinopyga mauritiana</i>	Surfish	233.8	0.11	Overexploited
<i>Actinopyga</i> sp.	White belly	41.1	0.01	Exploited
<i>A. miliaris</i>	Blackfish	4 980.2	1.09	Exploited
<i>A. echinites</i>	Deep water redfish	1 154.4	0.64	Exploited
<i>A. echinites hybrid?</i>	Redfish hybrid	261.5	0.14	Unknown
<i>Bohadschia marmorata</i>	Brown sandfish	12 016.9	1.79	Unexploited
<i>B. atra</i>	Tigerfish	13 105.2	1.62	Unexploited
<i>B. subrubra</i>	Bohadschia white belly	486.4	0.13	Unexploited
<i>Pearsonothuria graeffei</i>	Flowerfish	186.1	0.08	Unexploited
<i>Thelenota ananas</i>	Prickly redfish	6 349.9	0.52	Fully exploited
<i>T. anax</i>	Amberfish	235.6	0.02	Unexploited
<i>Stichopus herrmanni</i>	Curryfish	718.9	0.11	Unexploited
<i>S. chloronotus</i>	Greenfish	203.9	0.21	Unexploited

Source: Adapted from Aumeeruddy *et al.*, 2005.



of sea cucumbers (Aumeeruddy *et al.*, 2005). The most abundant species was the lollyfish (*Holothuria atra*) (5.61 ind. ha⁻¹), followed by the black teatfish (*H. nobilis*) (1.98 ind. ha⁻¹), brown sandfish (*Bohadschia marmorata*) (1.70 ind. ha⁻¹) and tigerfish (*B. atra*) (1.62 ind. ha⁻¹). Converted to weight, the highest biomass was that of the tigerfish (*B. atra*) at 13 105 tonnes, followed by the lollyfish (*H. atra*) at 12 722 tonnes, the brown sandfish (*B. marmorata*) at 12 017 tonnes and the black teatfish (*H. nobilis*) at 11 589 tonnes.

The highest density of sea cucumbers was in the shallow habitats (<20 m) and the lowest in the deep habitats (>50 m) (Figure 2). Habitats in the intermediate depths (20–50 m) had an intermediate

density of sea cucumbers, but due to the comparatively large size of that habitat, it had the bulk of the overall standing stock (61.2%). During the surveys size structures and biological data were not collected.

2.3 Catches

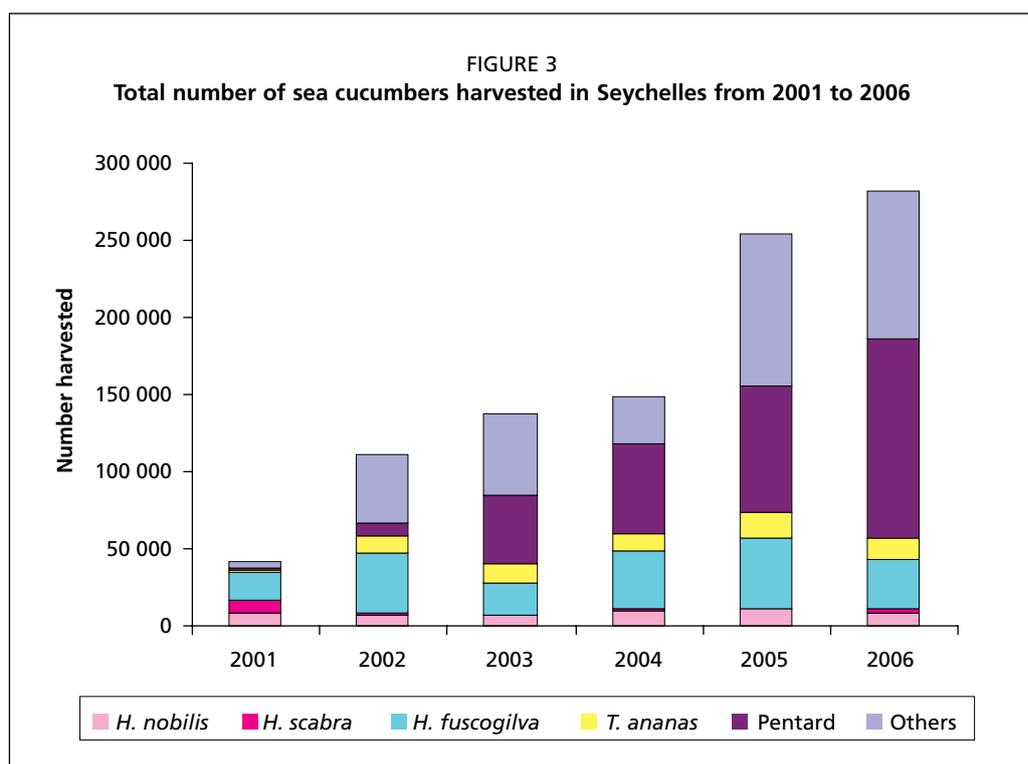
Catch and effort data have been collected since 1999 by the SFA. The data are provided by the fishers as per the requirements of their fishing license conditions. The responsibility has been placed on the fishers to provide their catch data, as they normally unload their catch at odd hours and the fishery authority does not have the necessary manpower. Failure to provide catch data may result in the revocation of the fishing licence. Catch data (in numbers) are recorded separately for the five main species. The other species are grouped as “Others”. Table 2 gives the total catch per species from 2001 to 2006 and shows a regular increase in the total catch, with the sharpest increase in 2005 (SFA, 2006). This is particularly the case for the “pentard”, which is one of the highest valued sea cucumbers on the market making it a prime target for the fishers (Table 2 and Figure 3). The prickly redfish and the “pentard” were not recorded as separate species before year 2001 (grouped with “Others”), but they were considered separately when their importance in the catch increased.

The catch per unit effort (CPUE) expressed in numbers of sea cucumbers collected per diver per day (ind. diver⁻¹ day⁻¹) shows mostly a downward trend from 2001 to 2006

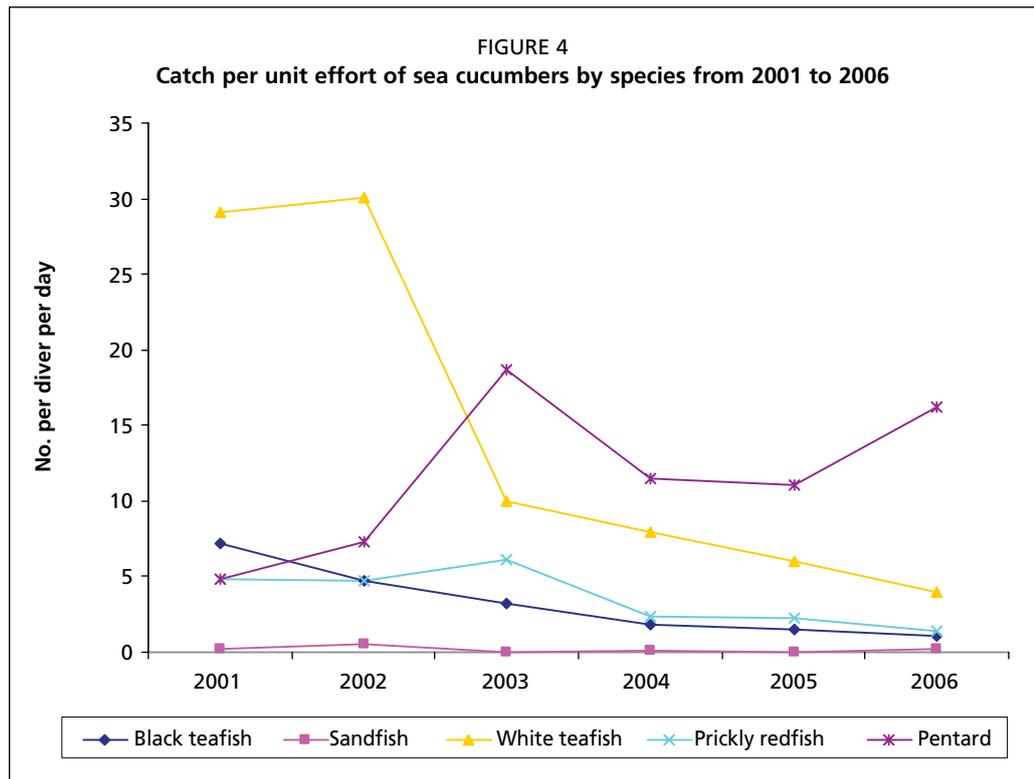
TABLE 2

Total number of sea cucumbers harvested in the Seychelles from 2001 to 2006

Year	Black teatfish	Sandfish	White teatfish	Prickly redfish	Pentard	Others	Total
2001	7 794	9 114	17 202	2 517	330	4 978	41 935
2002	7 391	728	38 868	10 987	8 807	43 788	110 569
2003	6 982	22	21 398	12 241	44 185	52 853	137 681
2004	9 897	611	38 162	11 468	57 489	30 582	148 209
2005	11 488	100	44 943	17 142	82 291	98 055	254 019
2006	8 753	1 851	31 899	13 842	130 046	94 970	281 209



(Figure 4). The only exception is for “pentard” for which the CPUE has kept increasing over the years, except for a drop in 2004 and 2005. The “pentard” has become the main species targeted by the fishers and some of them have reduced their effort on other species to concentrate on this highly demanded species. This was confirmed by fishers during a socio-economic survey conducted in May 2007 (Pinault and Conand, 2007). This fishing strategy could explain why the CPUE has decreased for the other species. Landings of the “pentard” have been above the proposed total allowable catch (TAC) of 71 000 individuals (82 291 were harvested in 2005 and 130 046 in 2006) which is raising some concern for the population status of the species.



2.4 Management of the fishery

The sea cucumber fishery in Seychelles was open-access until 1999 and therefore no catch and effort data were collected before then. The only information available was exports data (which included dried shark fins) provided by the customs department. Furthermore, no information was available on the number of fishers involved in the fishery or on specific fishing grounds. There were also no quotas or size limits in place. The only no-take zones were the designated marine national parks, where no fishing activity is allowed. Some of the main marine parks (e.g. Sainte Anne, Curieuse, Bay Ternay and Port Launay) are regularly patrolled by rangers from the Marine Parks Authority, which results in some control on the ban of fishing activities. Other smaller parks such as Silhouette are patrolled irregularly due to lack of resources. Enforcement in these parks is poor, and there is the possibility that some fishing activity takes place (Bijoux, J., Seychelles Centre for Marine Research and Technology, Marine Parks Authority, Seychelles, personal communication).

In 1999, with the rapid development of the fishery, there was a need for management measures. Since there was no baseline data on the sea cucumber population, its distribution and abundance, some management measures were taken as a precautionary approach. These precautionary measures were expected to last until a resource assessment of sea cucumbers was done and management measures could then be established based on the population status. Management measures were established

through the Fisheries (Amendment) Regulations (1999) which provided some control over the fishery through the following conditions:

- Fishing and processing sea cucumbers require a specific license issued under the licensing law;
- A sea cucumber licence (for fishing or processing) shall be independent of any other licence required by law;
- The holder of a licence shall not fish in protected areas defined by law;
- The holder of a licence shall furnish information related to fishing or processing as required by the SFA;
- A yearly fee of SR 300 (USD 55) is payable in respect of each licence issued under this regulation.

As a precautionary measure, the number of fishing licences was limited to 25 in 2001. A licence is attached to a specific boat, and each boat can have a maximum of four registered divers. The licence holders were also required to complete catch and effort logbooks that need to be submitted to the SFA on a monthly basis.

As part of the FAO-funded project referred to earlier, a management plan for the fishery was also prepared, and is based on the results of the resource assessment. Stakeholders were consulted several times during the preparation of the management plan, and it was completed in August 2005 during a final stakeholders' workshop. This plan is based on a mix of input (limited number of fishing licences) and output controls (TAC for each commercial species) (Payet, 2005). It was agreed to continue with the limit of 25 fishing licences that had been implemented as a precautionary measure in 2001.

The TAC was calculated based on the maximum sustainable yield (MSY) for each species (Aumeeruddy *et al.*, 2005). The total TAC for all species was calculated at 1 707 tonnes landed weight (gutted), from which the high value species (e.g. black teatfish, white teatfish, "pentard", prickly redfish) represent 425 tonnes, which equated to approximately 50 tonnes dry *bêche-de-mer* using a 14 percent recovery rate; medium value species (e.g. blackfish) made up 121 tonnes and low value species (e.g. lollyfish) made up the remaining 1 161 tonnes. The TAC was calculated for a wide area which is not fully exploited by the fishers. Today fishers say that they have to move further away from the coastal fishing grounds because these areas are fully or overexploited. The Management Plan also made provision for an increase of the licence fees which would help cover some of the management costs. An advisory management committee, composed of representatives of government departments, professionals involved in the sea cucumber industry (boat-owners, divers, processors and exporters) and environmental NGOs was set-up to oversee the implementation of the management plan.

Discussions on the management plan have not been finalized yet, and several other issues are being taken into consideration. These include the possibility of increasing the number of fishing licences, due to the high demand by fishers who are interested in accessing the fishery, as well as introducing a closed season.

One of the main problems in the management of the fishery is the timely provision of catch and effort data by fishers and processing data by processors. While this is a requirement of the license, most do not submit data on time. Sometimes it is only when a license is due for renewal that the licensee provides the required data, as failure to do so could result in the non-renewal of the licence. This makes it difficult to assess the level of catch in a timely manner, and it will be even more difficult to do that assessment when TACs are introduced. Since there are no observers on board, it is also difficult to ascertain whether the fishing location and the amount of catch reported by the fishers are accurate. Fishers also very often land their catch very late in the evening, which makes it difficult for the fishing authority to have field technicians present to record the catch being unloaded. So for the time being management of the fishery relies mostly on the data provided by the fishers regardless whether it is accurate.

It has also proved difficult to reconcile the amount of sea cucumbers sold by fishers to processors and the amount of *bêche-de-mer* produced by the processors. This would help check whether processors are producing more dried sea cucumbers compared to the amount they bought from licensed fishers, hence laundering illegally caught sea cucumbers. A sales receipt book was introduced where all sales of sea cucumbers from a licensed fisher to a processor are to be recorded, and each receipt needs to be counter-signed by both the seller and the buyer. This has proved difficult to implement, as both the fishers and processors were reluctant to give price information. A new version that requires only quantities sold was introduced in 2006, and this seems to be better accepted by those concerned. Random inspections are carried-out by inspectors from the Monitoring, Control and Surveillance section of SFA to control the stocks of sea cucumbers at the processing factories. Since May 2006, the same inspectors also verify all consignments of *bêche-de-mer* before export.

The management of sea cucumber fishing licences may sometimes prove problematic. A fishing license is allocated to a specific vessel and is not transferable between vessels. Because of the imposed quota of 25 fishing license, they are all allocated at any one time, with a waiting list that has reached a total of 35. There are times when some of the licensed vessels are not active in the fishery, either because the boat needs repairs or a crew is unavailable and in some cases this can last for several months. Those on the waiting list then complain that the license should be revoked and be allocated to the first on the waiting list. As a temporary measure, the SFA has allowed a boat-owner to use another boat if his boat is unavailable (e.g. boat under repair), with the provision that he uses the same crew.

Having considered all the constraints that hinder the good management of the fishery, the fishing authority has made amendments to the original management plan that was proposed in 2005, and this has now been submitted to the government for endorsement. The main points of the proposed plan are as follows:

- The number of fishing licences will be capped at 25 and be valid for the period of the open fishing season (i.e. 1 October – 31 May), and will be renewable. It is proposed to introduce a close season from 1 June to 30 September, which is usually the period when the sea is too rough for boats and divers to operate safely;
- The management plan will introduce an output quota limit on the amount of catch that can be taken from the fishery. The proposed TAC based on a recent stock assessment is 1 707 tonnes per year. The five most valuable species would represent only 425 tonnes (24.9%) of the TAC. The TAC would be monitored via the catch and effort forms submitted by all fishing licence holders to ensure that they match the sales receipts;
- Real time monitoring will be undertaken at landing sites and SFA will be issuing receipts to fishermen upon verification of their catch which will be done each time a sea cucumber fishing vessel enters into port; vessel monitoring system (VMS) data when available will be used to validate the fishing locations;
- The quota monitoring will also be done through the processors and through export figures. The processors would be required to keep detailed records of their purchases and stocks in a logbook and report on a monthly basis to SFA. The SFA will also do random inspections of sales to processors;
- Boat-owners need to inform SFA of each fishing trip conducted by a vessel licensed to fish sea cucumber (i.e. when the vessel is leaving port and when it is coming back). All licensed sea cucumber fishing vessels with the capacity to have a VMS onboard will have it installed, and this will be a condition of the licence;
- All landings of sea cucumbers must be done within the hours of 6 a.m. to 6 p.m. to facilitate control;

- A licence will only be issued to an individual with a valid local fishing vessel licence and who has the capacity to undertake such an activity. No person can have two sea cucumber fishing licences at the same time. A registered company would be allowed to possess only one sea cucumber fishing licence;
- Any licence which is revoked will be allocated on a first come-first serve basis as per SFA's waiting list. Licences may be revoked if they are inactive for more than four months and also if the catch and effort data are not submitted to SFA on a monthly basis, except for circumstances under *force-majeure*;
- Mothership operations will not be allowed;
- It has been argued that because of the natural closure of the fishery during the South-East Monsoon, there is no need for a specific closed season. However, to manage a quota system it is better to introduce a closed season of four months from 1 June to 30 September. This will allow SFA to analyse the logbooks returned by the fishermen and processors to estimate catch and export levels during the fishing period, and to determine whether quotas have been exceeded. If exceeded, the excess catch will be deducted from the next fishing season's quota;
- Fishing of sea cucumbers inside reef lagoons around the inner islands will be prohibited. Marine parks will continue to be no-take zones;
- All purchases of sea cucumbers must be from licensed sea cucumber fishermen only. Similarly, exporters must purchase only from licensed processors and licensed fishermen. In order to promote value addition, it is proposed that all sea cucumbers must be processed (i.e. dried) for export. Therefore, there shall be no export of fresh sea cucumbers. Prices offered for export of fresh sea cucumbers are very low compared to those offered for the dried product;
- The licence fee, which costs currently RS 300 (USD 55) per year for fishing and processing activities, will be increased. For a fishing vessel it will depend on the size of the vessel. The proposed fee structure per year is as follows:

– Small boats	RS 1 000 (USD 182)
– Medium-size boats	RS 2 000 (USD 364)
– Large-size boats	RS 2 500 (USD 455)

The processing licence fee is proposed at RS 5 000 (USD 909).

Note that all the proposed measures may not be accepted by the government authorities, but most of them are expected to be. The management plan could be implemented in 2008.

3. TRADE

Most of the sea cucumbers harvested are processed to a dried state and exported to the main Asian markets. There is a very small market for local consumption of sea cucumbers, due mostly to the small Chinese community present in the country. Sales for local consumption can be considered as negligible when compared to exports. China Hong Kong Special Administrative Region (SAR), Malaysia and Singapore represent the three main export markets in terms of importance (Table 3), with China Hong Kong SAR, being largely the dominant one. Small quantities may be exported to other countries, but this is on an irregular basis. Dried sea cucumbers are exported mostly by air cargo to the destination markets. One of the local processors also exports small amounts of sea cucumbers in a semi-dried state by sea freight. The export figures when compared to the catch figures given in Table 2 show that there is a discrepancy between them. For example total exports in 2006 amounted to 61 538 kilograms; using an average weight of 167 grams per sea cucumber, this would equate to 368 491 sea cucumbers. In 2006 the reported catch was 281 209 sea cucumbers (see Table 2). The export figures can be considered as accurate, as all shipments of dried sea cucumbers are weighed. This means that reported catch is underestimated by nearly one third, the main reasons for this being that some fishers still do not report or under-report their catch.

TABLE 3
Exports of dried sea cucumbers from the Seychelles (in kg)

	China Hong Kong SAR	Malaysia	Singapore	Others
2001	4 662	2 387	1 729	0
2002	22 805	8 995	2 170	2 625
2003	30 467	13 085	1 075	0
2004	12 555	0	2 605	0
2005	22 858	2 415	6 030	1 725
2006	46 794	8 742	5 762	240

TABLE 4
Export price of bêche-de-mer from the Seychelles (USD/kg)

Species	Export name	Price range (USD/kg)
<i>Holothuria nobilis</i>	Black teatfish	15–25
<i>Holothuria fuscogilva</i>	White teatfish	18–30
<i>Holothuria</i> sp.	Flower teatfish (“pentard”)	17–26
<i>Holothuria atra</i>	Lollyfish	5–7
<i>Holothuria fuscopunctata</i>	Elephant trunkfish	3–4
<i>Thelenota ananas</i>	Prickly redfish	6–15
<i>Actinopyga mauritiana</i>	Surf redfish	5–6
<i>Actinopyga echinites</i>	Yellow surf fish	4–5

At present there are 25 vessels licensed to fish sea cucumbers, three licensed processors and one licensed exporter. While there is a quota of 25 licenses for fishing, there are no limits on the number of processors or exporters of sea cucumbers. The fishers usually sell their catch to the processors on a unit price basis. The price depends on the species, the size and the grade of the product but it is not easy to obtain the pricing structure from the fishers or the processors. The high valued species such as white teatfish, “pentard” and black teatfish fetch respectively a maximum of USD 17.3, USD 13.8 and USD 8.6 per piece for the best grade and large size individuals. The processors usually export their products themselves or they can also sell to a local exporter. These processors are also involved in the processing of shark fins, and often export both shark fins and bêche-de-mer in the same consignment. Table 4 gives the price range (USD/kg) obtained by the exporters for a number of species, and is based on declarations made on export permits. These are prices for bêche-de-mer exported by air cargo.

In order to reduce the risk of illegal fishing by local fishers, the SFA has introduced a system whereby the processors have to certify that they have bought sea cucumbers only from licensed fishers. For each sale, the seller and the buyer have to complete a form stating the amount of sea cucumbers in the transaction, which is then submitted to the fisheries authority. This information helps the authority check the sale against the catch declaration by the fishers and against the exports declared by the processors. This system was put in place recently because of the potential for processors to buy sea cucumbers collected by unlicensed fishers. Some of the islands in the southern group are isolated and quite far from the main inhabited islands and are thus difficult to control. Some of these islands are uninhabited (e.g. Astove and Cosmoledo atolls), which makes it easy for poachers to fish around these islands. It is known that there are instances where fishers from countries in the region fish illegally around some of the southern islands. In April 2001, a vessel from Madagascar was apprehended while it was fishing illegally near Farquhar Atoll. It had on board 110 fishers and several tons of sea cucumbers (Le Quotidien, La Réunion, 2001).

4. SOCIO-ECONOMIC IMPORTANCE TO LOCAL FISHING COMMUNITY

The sea cucumber fishing and trade business in the Seychelles can be classified into three distinct operations and interrelated groups (Marguerite, 2005). The different operations are namely:

- harvesting, which relates principally to the collection of the sea cucumbers;
- processing, which involves cleaning and drying of the product into the form and quality acceptable to be traded; and
- trading – this involves sales to different markets, both local and overseas.

The groups or operators associated with the harvesting can be further divided into two distinct sub-groups.

- The single boat operators, which fish from small boats between 5–8 m in length, equipped with outboard engines. Fishing trips last usually for one day in the case of undecked boats. Harvesting operations normally take place in the coastal areas around the three most populated islands (Mahé, Praslin and La Digue) of the archipelago.
- The second group concerns those licensed harvesters operating larger vessels (whalers to schooners). Fishing trips last for more than one day and trips usually involve some form of mothership/dory type operation, i.e. where the bigger vessels are accompanied with a smaller dinghy which is used to move around the fishing ground and from which diving normally takes place. These harvesters normally operate on grounds further from the main island of Mahé or in the outer islands. Some form of pre-processing is also done on board which includes eviscerating the sea cucumbers and preserving them in salt.

This fishery has the potential to create employment for a maximum of 170 people, if all licenses are taken and the bigger vessels have an average crew of 6 persons. This would amount to between 9–10 percent of the total employment in the artisanal fisheries sector or about 3 percent of total employment in fisheries and related activities.

Compared to the overall formal employment, the sea cucumber business could be classified as insignificant as it would account for only about 0.4 percent of total formal employment in the country. Fishing and fisheries related employment as estimated by the SFA in 2004 accounted for about 15 percent of total formal employment in the country (SFA, 2004).

Based on the results of the socio-economic survey carried out in 2004, it can be estimated that between 120 to 125 households were to various degrees dependent on the sea cucumber harvesting and processing business (Marguerite, 2005). The potential number of household that can directly or indirectly benefit from this fishery can be estimated at around 180 households. While the revenue from the sea cucumber industry may be insignificant compared to total revenue generated by the fisheries sector, this industry may have a significant importance for those whose livelihood depend mostly or entirely on this business.

The earnings for the fishery vary widely depending on the boat category (small or big), but even within one category the earnings can vary considerably. However the results of the socio-economic survey have shown that in general, it is the smaller boats, doing day trips, which are more profitable.

A recent development in the fishery is the fact that the processors who have access to foreign currency are supplying equipment to some of the fishers, in particular diving equipment. These in turn are then forced to sell their catch to their suppliers at a lower price. There is thus a risk that the whole fishery can end up being controlled by the processors.

5. ADDITIONAL THREATS TO LOCAL SEA CUCUMBER POPULATIONS

Habitat degradation, in particular in the coastal areas would create additional threats to local sea cucumber populations. One of the main causes of habitat degradation is the loss of coral reefs. During the El Niño event of 1998, 50–95 percent of corals died in the coastal areas across the archipelago (Ahamada *et al.*, 2002). Coral recovery has been very slow and most of the carbonate reefs have lost their three dimensional structure, which has thus reduced the habitat for some species that live in these areas. The risk

of further coral bleaching and mortality is very much present. There was an episode in 2003 that caused some coral mortality, and in 2007 there are signs of coral bleaching caused by a combination of high water temperatures and strong light penetration in the sea during the months of April and May. It is assumed that the habitat degradation will have an impact on sea cucumber populations also.

Due to the limited amount of flat coastal land available for development purposes on the main islands (Mahé and Praslin), the government has reclaimed land from the sea in the vicinity of the coast. Several small islands were thus created, totalling more than a hundred hectares in area. This was done by building a bund at the perimeter of each island and filling with material pumped from the bottom of the sea. While precautions were taken to limit siltation through the use of filtering cloths (geotextiles) placed inside the bunds, there is now a large area around these newly created islands that have a much heavier load of silt. Even though the total area involved is not that big compared to the total coastal areas, it is still a habitat loss for sea cucumbers (and other invertebrates).

Coastal pollution is not a threat today as the country has very few industries and most of it is light industry. However, the area around the capital Victoria on Mahé Island is where most of the industries are concentrated. These comprise power generating plants using heavy oil, a tuna canning factory which is one of the largest in the world, sewerage treatment plants and other factories. These industries could pose a potential threat if for example raw or partially treated effluents are released either on purpose or by accident in the sea. There have already been cases of fish mortality in that area due to the release of effluents, little information is available on whether other organisms such as sea cucumbers have been also affected. The use of explosives for fishing or bottom trawl is banned by law (Fisheries Act, 1986) and the trade of wild caught fish (both for aquarium and for consumption) is not allowed. This was legislated through a Fisheries Regulations in 2005.

6. RECOMMENDATIONS FOR IMPROVING FISHERIES MANAGEMENT AND CONSERVATION

There are several ways for improving fisheries management and conservation of sea cucumbers. One of the aspects is for the stakeholders' involvement in order to create a sense of ownership of this fishery. Traditionally in the Seychelles, fisheries have been accessible to all people, and there are no community rights to fishing grounds. Except for the lobsters and sea cucumbers fisheries, that require a fishing license and for which there is a restricted number of licenses, there is no limit to the number of fishers who can access the other resources. With this open-access system, fishers have little incentive to conserve the resource, or at least it is more difficult to make them understand the need for conservation.

In the Seychelles, fisheries management has used a top-down approach, where the fisheries authority would take management decisions and impose it on the fishing community, without necessarily consulting the stakeholders. This approach is now changing, and in the case of the sea cucumber fishery, a first step has been taken with the creation of an advisory management committee with representation from the stakeholders. The committee is composed of representatives from the fishery authority, the Department of Environment, the Department of Natural Resources, representatives of sea cucumber boat owners, divers and processors as well as a representative of an environmental NGO. This new system seems to give a higher sense of responsibility to the fishers who better understand the need to fish in a sustainable way.

The recommendation is to control effort on the higher value species and spread effort to the lower value ones while keeping the catch within the recommended TAC. At present, most of the lower value species, which have the highest abundance, are either fished in very low numbers (e.g. *Holothuria atra*) or not fished at all (e.g. all the

species from the genus *Bohadschia*). Increased demand for bêche-de-mer products will see a continued increase in the value of this commodity, extending to low value species (Conand, 2004). There is also a need to control fishing effort in areas close to the main islands on the Mahé Plateau for high value species, to alleviate the risk of local depletion. There is at present no minimum size limits for species in the catch. Minimum size limits could be designed to protect individuals until they have spawned once; this will require research on size of maturity. Implementing minimum size limits will not necessarily be an easy task because there are no observers on board the fishing vessels and would require improved monitoring and enforcement capabilities. The fishery authority has begun collecting size information of processed sea cucumber and once sufficient information is available, a minimum processed size could be implemented for some of the species (Aumeeruddy and Conand, 2007). The idea is for fishers to also target the lower valued-species for which a MSY has been determined and a TAC agreed, and not species that were not assessed during the population survey.

There is a need to improve enforcement through controls and patrols, in particular around the outer islands. Most of these islands are far from the populated islands, and some of them are uninhabited. Poaching by both unlicensed local fishers and foreign fishers could cause a lot of damage to sea cucumber populations around these islands, with a threat of local depletion.

7. EVALUATION OF THE PROS AND CONS OF CITES LISTING

There is an ever increasing demand for sea cucumbers on the Asian market and reports from several countries show that sea cucumber populations are suffering from overexploitation and depletion. This has triggered a discussion on whether sea cucumbers from the Holothuridae and Stichopodidae families should be considered for listing by CITES, and the Animals Committee of CITES was asked to review the outcomes of a technical workshop, develop appropriate recommendations, and prepare for consideration at CoP13 a discussion document on the biological and trade status of these sea cucumbers (Anon., 2004). At a CITES meeting in 2005, the Working Group on sea cucumber of the CITES's Animals Committee did not feel that it was appropriate to comment on the value of a CITES listing because there was insufficient information and evaluation at this stage (Pourkazemi, 2005; Bruckner, 2006).

To manage the international trade of holothurians, one alternative would be to include species belonging to these two families in CITES Appendices, and in that case decide if all species should be listed, or only those that are considered threatened; another alternative would be to consider that the conservation of holothurians is the responsibility of national fisheries management, in line with FAO's guidelines for sustainable fisheries.

In the Seychelles, the procedure in place for exports of sea cucumbers is well established. The exporter submits an application for an export permit to the Export Control Division of the Ministry of Finance. The exporter lists the species, their quantities and price, as well as the name and address of the buyer. Before an export certificate is issued, a copy of the application is sent to the SFA whose inspectors physically check that the consignment corresponds to what is declared on the application form. The export permit is issued by the Export Control Division only after SFA has given its approval. CITES permits are issued by the Nature and Conservation Division of the Department of Environment. If sea cucumbers are listed by CITES, then staff from that Division will also have to be involved in checking every consignment for export before the export certificate is issued.

In the case of the Seychelles, a CITES listing in Appendix II may be appealing as most of the sea cucumbers harvested are traded internationally and many populations are under threat. However, considering the small size of the country and the limited

human resources, a CITES listing would place increased pressure on these limited resources, without making any major difference in terms of export control on sea cucumbers. There are enough control conditions in place through the management plan to ensure that sea cucumbers are exploited on a sustainable level. The people involved in the sea cucumber industry already consider that there are too many controls in place that hinders their operations. Adding another layer of control through a CITES listing would possibly make them even less willing to cooperate with the authorities. Some may decide to drop out of the business or try to export their products outside the official circuit. Considering the administrative burden that would be placed on local authorities if sea cucumbers were listed either in Appendix II or III, the authors do not see the need for any listing as the populations do not seem under threat. The conservation of sea cucumbers in the Seychelles would be more easily done as part of fishery management in consultation with other national and international expert bodies.

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