Pacific Community
Communauté du Pacifique

The Pacific Island sea cucumber and beche-de-mer trade and possible price-setting mechanisms:

A review and recommendations

The Pacific Island sea cucumber and beche-de-mer trade and possible price-setting mechanisms:

A review and recommendations

Garry L. Preston

Pacific Community
Communauté du Pacifique

Noumea, New Caledonia, December 2023

Original text: English

Pacific Community Cataloguing-in-publication data

Preston, Garry L.

The Pacific Island sea cucumber and beche-de-mer trade and possible price-setting mechanisms: a review and recommendations / Garry L. Preston

1. Sea cucumbers — Economic aspects — Oceania.

2. Trepang fisheries — Economic aspects — Oceania.

3. Commerce — Oceania.

4. Fish trade — Oceania.

5. Holothuria — Oceania.

I. Preston, Garry L. II. Title III. Pacific Community

593.96099595 AACR2

ISBN: 978-982-00-1532-6

Disclaimer

This report has been prepared by consultant Mr Garry Preston for the Pacific Community (SPC). The study includes views and recommendations of the consultant and does not necessarily reflect the views of SPC, or indicate a commitment to any particular policies or actions. While every effort has been made to ensure the accuracy and reliability of the material appearing in this report, SPC cannot guarantee that the information contained in the report is free from errors or omissions. SPC does not accept any liability for the contents of this report or for any consequences arising from its use.

Cover pictures: Kalo Pakoa, SPC.

Prepared for publication at SPC's headquarters,
B.P. D5, 98848 Noumea Cedex, New Caledonia, 2023
www.spc.int | spc@spc.int

Contents

Abbreviations

Acronym	Meaning
AUD	Australian dollar
BDM	Beche-de-mer[1]
CITES	Washington Convention on International Trade in Endangered Species
COVID-19	Coronavirus disease
Comtrade	United Nations commercial trade database
DRM	French Polynesian Direction des Ressources Marines
FJD	Fiji dollars
HS	Harmonised system of tariff nomenclature: Harmonised Commodity Description and Coding System
ISEE	Institut de la statistique et des études économiques de la Nouvelle-Calédonie
MFMR	Solomon Islands Ministry of Fisheries and Marine Resources
MFMRD	Kiribati Ministry of Fisheries and Marine Resource Development
MOF	Ministry of Fisheries
MOU	Memorandum of understanding
MSG	Melanesian Spearhead Group
MSSIF	Mekem Strong Solomon Islands Fisheries
NDF	Non-detriment finding
NFA	PNG National Fisheries Authority
NSCFMDP	Solomon Islands National Sea Cucumber Fishery Management and Development Plan
PGK	Papua New Guinea kina (currency)
PICTs	Pacific Island countries and territories
PNG	Papua New Guinea
SBD	Solomon Island dollars
SINSCFP	Solomon Islands National Sea Cucumber Fishery Policy
SPC	Secretariat of the Pacific Community / Pacific Community
TAC	Total allowable catch
TAEx	Total allowable exports
TOP	Tongan pa'anga (currency)
TOR	Terms of reference
USA	United States of America
USD	United States dollars
VFD	Vanuatu Fisheries Department
VUV	Vanuatu vatu (currency)
WCO	World Customs Organization
XPF	French Pacific franc

[1] The terms 'sea cucumber' and 'beche-de-mer' are both used frequently and often interchangeably in discussion of holothurian fisheries and their products. In this report, every effort has been made to use the term 'sea cucumbers' when referring to the live or freshly caught animals, while 'beche-de-mer', or BDM, usually means the processed, dried product.

1. Executive summary

The purposes of this study, as articulated in the terms of reference (TOR) were to produce a:

- review of updated sea cucumber and beche-de-mer (BDM) prices within the Pacific region and the main Chinese markets; and
- proposition of a practical price-setting methodology to Pacific countries, ensuring fair and equitable economic returns for local harvesters while maintaining the attractiveness of the market for exporters.

It is understood that price-setting means the establishment of legally binding minimum prices that buyers must pay to fishers for their product.

The study commenced at a time when COVID-19-related international border restrictions were still in force in some locations, making travel difficult or ill-advised, especially to China. The information used in the study was thus limited to what could be collected without travelling.

Section 3 of this report provides recent estimates of BDM production and exports from PICTs, and of imports by key market states. The information indicates increasing numbers of sea cucumber fishery moratoria in recent years, as a response to problems of overfishing. This of course has an impact on prices, since if a fishery is closed then (at least officially) there is no trade and therefore no prices. However, data from market states suggest that imports continued from several PICTs during periods when fisheries were supposed to be closed.

Section 4 of the report summarises price information at various points in the value chain – first sale, export (from PICTs), import (to market states) and wholesale/retail – with value (or at least cost) being added at each point. The first three sets of price data are based on information collected by national fisheries, customs and statistical agencies, and from trade databases. Wholesale/retail price information was sourced from internet marketing websites, and by applying estimated inflation factors to retail price data published in previous studies. Making some assumptions about inflation, retail BDM prices are taken to have increased by about 15% between 2016 and 2022, although the impacts of COVID-19 and associated lockdowns on the dietary and retail habits of Chinese communities are not known.

Section 5 reviews aspects of sea cucumber fishery economics and management. The nature of the fishery has led to a plethora of rules and regulations, all of which are difficult to enforce and most of which have consequently proven to be ineffective. Several sea cucumber species have been listed in Appendix 2 of the Washington Convention on International Trade in Endangered Species (CITES), including some that are among the most valuable, and this will have an impact on the degree to which these can be exported from PICTs in future. Section 5 also discusses the distribution of benefits in the BDM trade. In general, first-sale prices were found to be between 10% and 25% of final retail prices, depending on the market. Because final consumer markets are so variable, it is argued that retail prices may not be a good guide on which to base fishers' financial expectations.

Section 6 discusses the pros and cons of price-setting. The sea cucumber fishery involves at least 35 different species, which may be sold wet, semi-processed or fully processed, and whose prices depend on size and product quality. Setting minimum prices for all the possible combinations would be difficult, and subsequent enforcement would be practically impossible. The establishment of legally binding minimum sea cucumber prices that cannot be effectively enforced is therefore not recommended as a valid management approach.

Two PICTs have established lists of reference prices, intended to provide information to fishers and improve their ability to negotiate better prices. This would be a more useful approach to helping primary producers achieve a better return, but unfortunately in both cases the reference price has not been updated for 8 years and is no longer very relevant. It is recommended that SPC take an active role in obtaining and disseminating real-time BDM price information in key market states. This would involve stationing or contracting an agent in Hong Kong, feeding the price data received to PICTs national fishery agencies, and supporting its promulgation through newspapers, radio, social media, mobile text messages, and the SPC BDM Information Bulletin.

2. Holothurian fisheries

2.1 History

The importance of BDM in Pacific Islands economies dates back to the early days of European contact. Historical accounts describe visits to Northern Australia and Western Pacific locations by Malay vessels in search of BDM in the late 1700s. The eastward expansion of the trade began in the first years of the 19th century, with collecting expeditions by European or American trading vessels in New Caledonia, Palau and Papua New Guinea (PNG). The first BDM from Fiji was collected and cured in 1813, and the South Pacific trade became more or less fully established in the 1820s (Ward 1972)[2].

Although by European standards it was an insignificant industry conducted by a small number of ships, the BDM trade in the Pacific had an enormous influence on the lives of Pacific Island communities, especially during the first half of the 19th century. BDM traders were the principal agents responsible for the introduction of firearms in many areas, as well as large quantities of trade goods, especially iron tools, fish hooks and the like, which reduced the time and labour required for subsistence tasks in agriculture, fishing, and the making of clothing. The resulting increase in 'leisure' time, plus the growing availability of firearms, resulted in higher levels of conflict and local warfare, which in turn led to major demographic and political change in some parts of the Pacific.

In more recent times, BDM has continued to be an important, although variable, source of revenue to the Pacific Islands. Output from the Pacific has varied widely during the last two centuries in response to changing demand for the product, and the relative value and availability of other trade commodities (especially sandalwood, with which the BDM business was originally linked) or opportunities. In addition, the attractiveness of the trade was greatly influenced by the ease of collecting the raw sea cucumbers: the returns from harvesting diminished greatly once the trade began in earnest, and overexploitation occurred in many areas. Macro-economic factors, including wars and swings in the economies of major nations, have also had important effects on BDM production in the Pacific and worldwide.

The BDM trade has had significant environmental consequences, some of which are probably irreversible. The most obvious of these is the deforestation of coastal areas, to provide much of the firewood, up to 10 tonnes of which is needed for smoking one tonne of BDM. Some islands of Fiji, such as Mali, were completely denuded of any useable firewood during the early 19th century, and the forests have not subsequently recovered. The destruction of forests, especially mangroves, for BDM production continues to be a matter of concern today.

[2] Ward R.G. 1972. The Pacific beche-de-mer trade, with special reference to Fiji. In Man in the Pacific Islands: Essays on geographical changes in Pacific, (R.G. Ward, ed.), pp. 91-123. Oxford University Press, 337 pp.

2.2 Fishing methods

Harvesting sea cucumbers, species of holothuria, which is usually by hand-collection or free-diving in PICTs, is straightforward and, although labour-intensive, requires little or no capital investment. In many situations holothurians can be harvested by gleaning at low tide. A small boat or floating container is normally required for collecting some of the more valuable species, such as *Holothuria whitmaei* (Black teatfish) and *H. fuscogilva* (White teatfish). These types are often found in water too deep for them to be collected by wading, but they can be gathered by free-diving with a face mask.

In the deepest waters, where free-diving is difficult or too tiring, some collectors use 'bombs' made of a lead or concrete weight with a steel barb protruding from the base. The weight is dropped onto the holothurians by divers swimming at the surface, usually alongside a small boat. Because the weight needs to be very heavy to pierce the tough holothurian skin, the hooked animal is usually hauled up by the boatman. This system is not widely used and is only practical in areas of weak current. Also of limited use is bottom trawling or dredging, which is now practised in Ontong Java in Solomon Islands (Ramofafia 2004)[3].

The advent of underwater breathing apparatus has made the task of collecting deeper-water holothurian species much easier. The use of self-contained underwater breathing apparatus for sea cucumber collection is still relatively limited due to the high capital costs involved in establishing and maintaining tank-filling facilities in remote areas. Hookah gear, however, became more widespread in the 1990s when small, relatively low-cost compact units entered the recreational diving market. The use of this type of equipment has the potential to significantly increase the likelihood of local over-harvesting and consequent adverse effects, as well as presenting a high risk of accidents to untrained users.

2.3 Processing

Traditional-style processing of holothurians into BDM requires the use of boiling containers (typically discarded oil drums), smoke-sheds or smoking racks, and large quantities of firewood, but is still well within the capacity of rural producers to carry out without the need for sophisticated or costly equipment. When properly processed, BDM will keep for many months without the need for refrigeration or other forms of preservation.

A typical BDM processing operation is described by an unknown author (1979)[4] and typically comprises the following steps. A number of animals are placed whole in a cooking basket, often improvised from galvanised wire mesh. This is placed into boiling seawater and left for a few minutes until the animals begin to swell, after which they are removed from the water and allowed to cool. A slit is made down one side of each animal and the bulk of the body contents removed and discarded. The animals are replaced in the boiling water and cooked for about a further half-hour until they become hard and rubbery. Care must be taken at this time to avoid under- or over-cooking, both of which will result in a product that is too soft and of low value. The animals are then removed from the cooking vessel and dipped into cool seawater, after which any remaining internal organs are removed. The tissues lining the interior of the body cavity are left in place.

[3] Ramofafia C. 2004. The sea cucumber fisheries in Solomon Islands: Benefits and importance to coastal communities. International Centre for Agricultural Research, Sydney, New South Wales, Australia.

[4] Anon. (1979) Beche-de-mer of the Tropical Pacific: A handbook for fishermen. Handbook No 18, South Pacific Commission, Noumea, New Caledonia.

After cooking, the animals are smoked and/or dried, by being placed with the split side facing down on a drying rack suspended above a low, smoky fire. Where copra processing is carried out, BDM may be smoked inside the copra driers. More usually, however, they are smoked in small purpose-built smoke-sheds or over open fires of mangrove wood close to the landing point. The smoking process typically lasts 24–48 hours, after which the finished BDM will have shrunk by between 45% and 68% in length, and lost between 88.8% and 97.4% of its original weight, depending on the species (Conand 1979[5]; Preston 1990[6]).

Purcell (2014a)[7] describes updated approaches to BDM processing that use more modern equipment and techniques, including chilling or salting the sea cucumbers prior to processing, cutting the animals and removing the guts before the first boiling, cutting some species on the dorsal rather than ventral side, and carrying out the first cooking at 70°C–90°C rather than allowing the water to boil.

The basic grading criteria for BDM are more or less universal. Price is first of all determined by species, with several large thick-bodied species (e.g. *H. scabra*, *H. lessoni* and *H. fuscogilva*) being considered high-value, small or thin-bodied species (e.g. *H. atra*, *H. fuscopunctata* and *Thelenota anax*) being low-value, and others (e.g. *Bohadschia argus*, *H. edulis* and *Pearsonothuria graeffei*) being intermediate (Pakoa et al. (2013)[8].

The relative ranking of species may change over time, and buyers in different markets may have different preferences. It is not unusual to find different prices offered for the same species by buyers in Hong Kong and in Singapore, the two main markets.

Within a given species, higher prices are generally paid for larger animals with a low moisture content (20%–30% by weight is desirable), a firm, hard texture, a regular, even shape, and smooth incisions without ragged edges. Product size has a bigger effect on price for high-value species than for low-value ones. Odour and colour are also taken into consideration, as both are used as indicators that the product has been processed correctly and is free of decomposition.

Low-grade product is still readily purchased by many buying agents and exporters, and is even sought after by some, because it can be reprocessed to convert it to a higher-grade product. The economies of scale achieved by doing this at a central location have made it a more profitable activity for some agents to purchase low-grade product whenever possible. Raw sea cucumbers may be sought for the same reason – the quality of BDM processed by fishers is often poor and it may be more cost-effective for both parties if the processing is done by the agent or exporter. Of course, this is not always feasible if fishers are located in remote areas far distant from any central processing facility.

Beche-de-mer processed in this way is exported in bulk from the country of production, usually packed in hessian sacks of 20–40 kg in weight. The product is received by importers who variously sell it on to wholesalers and retailers, some of whom may re-export it, sometimes after adding further value.

[5] Conand, C. (1979). Beche-de-mer in New Caledonia: weight loss and shrinkage during processing in three species of holothurians. SPC Fisheries Newsletter #19, pp 14-17. South Pacific Commission, Noumea, New Caledonia.

[6] Preston, G. L. (1990a). Beche-de-mer recovery rates. SPC Beche-de-mer Information Bulletin #1, p7. South Pacific Commission, Noumea, New Caledonia.

[7] Purcell, S.W. (2014a). Processing sea cucumbers into beche-de-mer: A manual for Pacific Island fishers. Southern Cross University, Lismore, Australia, and Secretariat of the Pacific Community, Noumea, New Caledonia.

[8] Pakoa, K, W. Saladrau, W. Lalavanua, D. Valotu, I Tuinasavusavu, M. Sharp and I. Bertram (2013). The status of sea cucumber resources and fisheries management in Fiji. Secretariat of the Pacific Community, Noumea, New Caledonia.

2.4 Adding value

Figure 1: Beche-de-mer on sale in Sydney's Chinatown in February 2023 (Author photo)

At the point of retail most BDM is sold by weight or as individual pieces. Methods of presentation typically involve displaying the BDM in glass jars or large polythene sacks, with customers picking the number or weight of product that they want (Figure 1).

As with many other consumer foodstuffs, however, there is an increasing trend towards more elaborate packaging and presentation as a way of adding value and increasing prices. These include ready-to-eat, shelf-stable pouches of cooked and sliced product in various types of sauce, as well as gift or presentation packs of dried BDM (Figure 2).

Figure 2: Vacuum-packed braised ready-to-eat sea cucumbers (Source: https://www.seacucumberconsultancy.com.au)

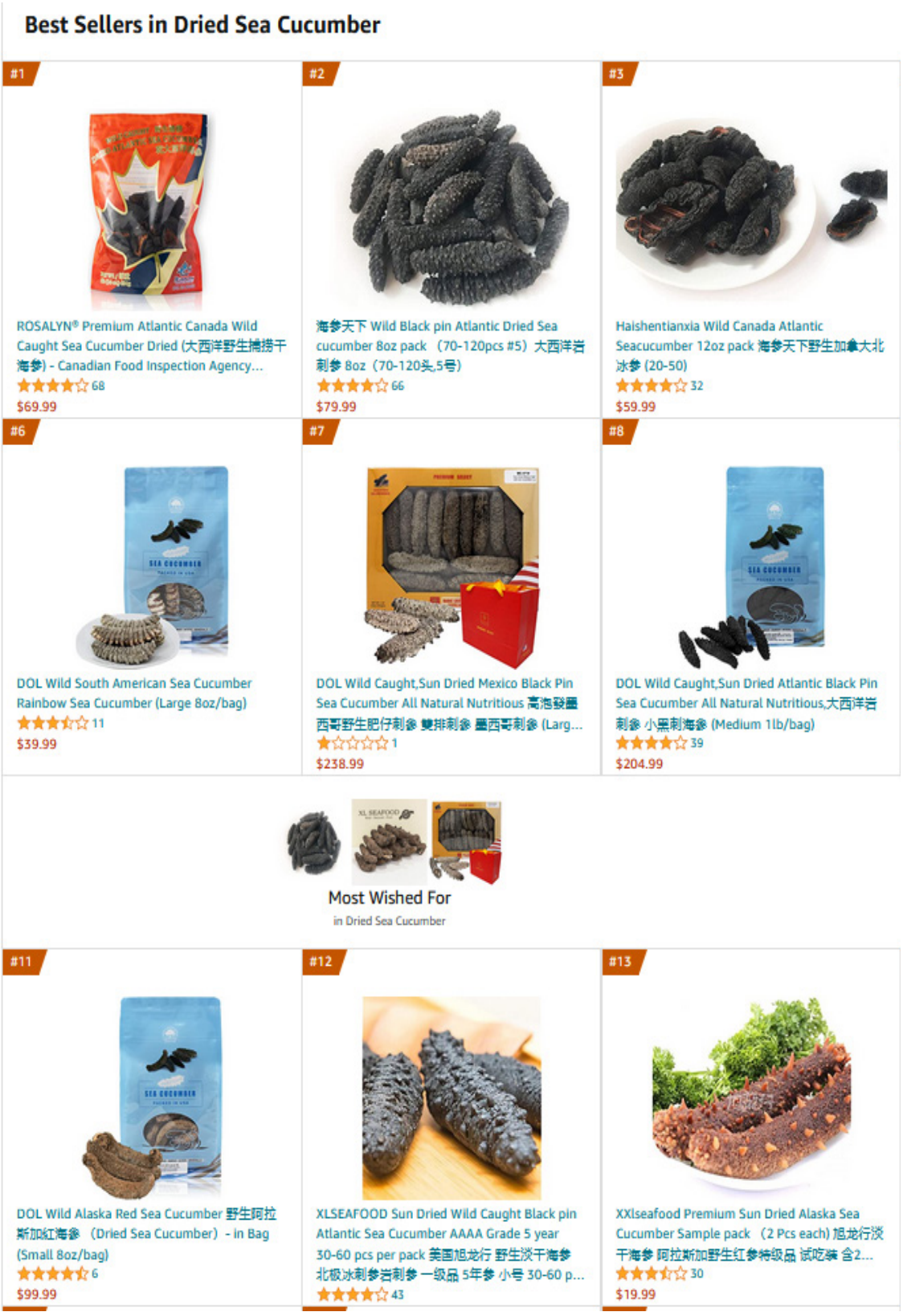

Figure 3: Some of Amazon's dried sea cucumber bestsellers (www.amazon.com)

These pre-prepared BDM product forms have become much more popular since 2020 when lockdowns imposed as part of the COVID-19 pandemic response led to an increase in internet shopping in many urban locations worldwide.

The packs of dried sea cucumber shown in Figure 3 range in price from USD 154/kg to USD 526.73/kg depending on the sophistication of the presentation. Many are based on *Stichopus japonicus*, a temperate-water species harvested extensively on the west coasts of Canada and the USA, and packed for sale in those countries.

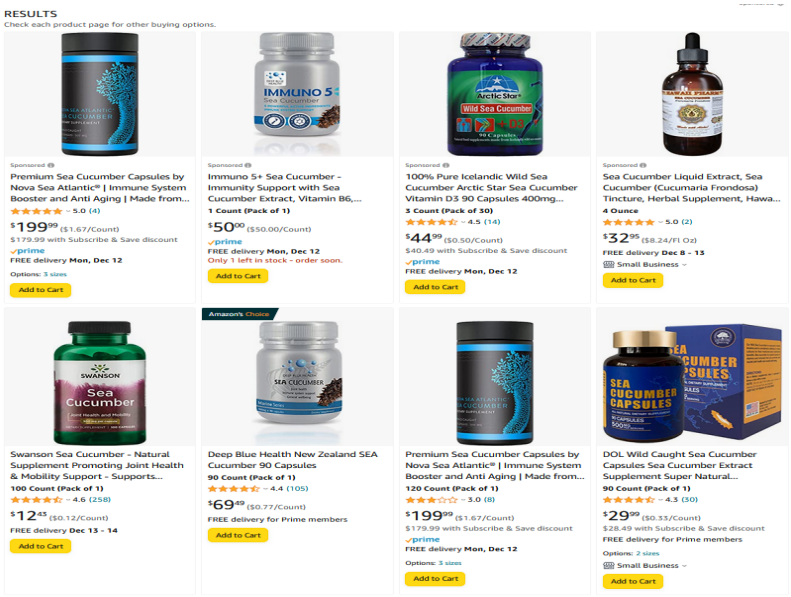

Figure 4: Partial results of a search for 'Sea Cucumber capsules' on Amazon (www.amazon.com)

Sea cucumbers are now also increasingly being sold as dietary supplements and pharmaceuticals as a way of capitalising on their supposed nutritional value and health benefits. These products are typically made from sea cucumbers that are harvested fresh, freeze-dried, finely powdered, and then packed into capsules or sachets. Beche-de-mer capsules are often made from low-value sea cucumber species such as *H. atra*, but the final product retails at prices equivalent to thousands of dollars/kg.

The first item in Figure 4 of sea cucumber capsules costs USD 199.99 for a pack of 120 capsules of 500 mg each, which equates to a price of USD 3333.16 per kg of freeze-dried powder.

Vanuatu has a local company manufacturing a liquid dietary supplement from sea cucumbers (combined with other marine product extracts) which is marketed via a US retailer (Figure 5), and there are probably others in other PICTs. A one-month supply of SeaCare dietary supplement contains approximately 1120 ml of liquid supplement (most of which is water) and retails for USD 795.

Figure 5: Left: www.seacarehealth.com, Right: author photo

Irrespective of the species of sea cucumber being used, all these goods result in a much higher product end price than those produced using the handling and processing methods traditionally used in PICTs.

There are almost certainly further business opportunities for value-added sea cucumber products in PICTs, but realising these opportunities may require considerable technical research and support, coupled with significant investments in processing equipment, training, hygiene control systems, packaging and marketing. For example, a freeze-dryer used to produce sea cucumber powder for packing into capsules may cost around USD 350,000–400,000 to establish.[9]

3. PICTs BDM production

3.1 General

Information on PICTs BDM production is theoretically available from at least four sources:

- data collected by national fishery agencies;
- records maintained by exporters, importers and others directly involved in the BDM trade;
- data collected by customs or other authorities that track exports from producer countries; and
- data collected by customs or other authorities that track imports into recipient countries.

Each of these sources has inherent problems that make the data incomplete, unreliable and difficult to reconcile with that from other sources. Data collected by national fisheries agencies is often produced for resource assessment and management purposes, and focuses more on fine details (such as species composition and size frequencies) but may rely on sampling rather than covering the totality of production. In addition, the remoteness of many fishing areas means that fishery agency data collection programmes are rarely comprehensive. BDM traders and exporters collect information needed for the effective running of their businesses, and the data they hold is probably the most comprehensive and reliable; however, they are often reluctant to share this with fisheries or other agencies and, if forced to do so, may falsify records in order to avoid fees, levies, fishery closures or other consequences that they perceive to be negative. In this regard Pakoa et al. (2014)[10] comment:

> Total export value of BDM is one of the least accurate pieces of information on sea cucumber fisheries in the Pacific Islands. The exported value of BDM is a closely guarded secret of Chinese exporters who dominate BDM exporting activities in the Pacific Islands. Most often the declared value in the export permits and export information recorded by Customs and Statistics Officers are underpriced and not consistent.

BDM produced in PICTs is almost all exported, so customs agencies should be in a position to collect comprehensive information on the BDM trade. However, apart from having to contend with deliberate falsification of records by national exporters, customs agencies are also limited by the Harmonised System of tariff nomenclature, which provides limited scope for documenting BDM exports (see below). In this regard, Gillett and Fong (in press)[11] state:

[9] Dr. B. Azari, Seacucumber Consultancy Pty Ltd, QLD, Australia, pers. comm.
[10] Pakoa, K., R. Malu, J. Teri, J. Leqata, P. Tua, D. Fisk and I. Bertram (2014). Solomon Islands
[11] Gillett, R. and M. Fong (in press). Fisheries in the Economies of Pacific Island Countries and Territories (Benefish 4). Secretariat of the Pacific Community, Noumea, New Caledonia.

> In most PICTs the government fisheries agency monitors fishery exports independently of the government customs agency. However, in many countries these fisheries agency export data systems are not functional – they produce inaccurate information on exported fishery commodities, especially for coastal fisheries. The information is supposed to be made available to the public, but in several countries it is difficult to obtain the data. As a general observation the customs departments produce more accurate summaries of the volume of total fish exports, while the fisheries divisions/departments are better at producing summaries of the species exported.

These authors further note that customs data from exporting countries tend to be aggregated to the point of being difficult to interpret, and that some PICTs customs agencies record large exports of fishery products that do not even exist in the PICTs concerned.

As with national data on BDM production, challenges also exist in regard to data on international trade (imports and exports). These are recorded primarily using the Harmonised Commodity Description and Coding System, also known as the Harmonised System (HS) of tariff nomenclature, which came into effect in 1988 and has since been developed and maintained by the World Customs Organization (WCO) based in Brussels, Belgium.

The HS is an internationally standardised system of names and numbers used to classify traded products under 21 different broad headings, ranging from *Live Animals and Animal Products* (Section I) to *Works of Art, Collectors Pieces and Antiques* (Section XXI). Each section is broken into chapters, and HS codes consist of six digits: the first two of which indicate the HS chapter that describes the broad commodity type, the second two the HS product heading for that product, and the last two the product subheading. The current version of the HS (which was reviewed in 2022) identifies 96 broad commodity types, 1228 headings and 5612 subheadings. However, the number of products traded internationally far exceeds this number and the HS codes applicable to unique products are limited mainly to merchandise that is important to developed countries. Many HS codes apply to product groups, rather than individual items.

In the case of BDM the relevant codes under Section I are:

- **Chapter 03**: Fish and crustaceans, molluscs and other aquatic invertebrates;
  - **Heading 0308**: Aquatic invertebrates other than crustaceans and molluscs, live, fresh, chilled, frozen, dried, salted or in brine; smoked aquatic invertebrates other than crustaceans and molluscs, whether or not cooked before or during the smoking process;
    - **Sub-heading 030811**: Sea cucumbers (*Stichopus japonicus*, Holothuroidea) live, fresh or chilled;
    - **Sub-heading 030812**: Sea cucumbers (*Stichopus japonicus*, Holothuroidea) frozen;
    - **Sub-heading 030819**: Sea cucumbers (*Stichopus japonicus*, Holothuroidea) dried, salted or in brine; smoked, whether or not cooked before or during the smoking process.

Unfortunately, the HS recognises only one species of sea cucumber, *Stichopus japonicus*. This is a temperate water species exported primarily by the USA and Canada, and it does not occur in the Pacific Islands region. There is no specific code for any other type of sea cucumber, only the generic heading 0308 – which also includes aquatic invertebrates such as sea urchins and jellyfish.

In order to make sense of PICTs export and import data, several assumptions must therefore be made.

- All exports classified under heading 0308 are sea cucumbers. This is a reasonable assumption, as there are few if any PICTs exports of sea urchins and jellyfish.
- Data recorded by customs agencies in both exporting and importing countries under all 0308 categories refer to the entire range of sea cucumber species from PICTs. Again this is a reasonable assumption because *S. japonicus* does not occur in PICTs, and customs agencies mostly have no alternative ways of categorising BDM exports.[12]
- Data recorded under subheadings 030811 (live fresh or chilled sea cucumbers) and 030812 (frozen sea cucumbers) are erroneous and should be considered as 030819. This is thought to be a safe assumption since exports of fresh, chilled or frozen sea cucumbers from PICTs are currently thought to be close to zero.[13] However some countries (including Australia) are now exporting chilled or frozen sea cucumbers and this trade may ultimately commence in PICTs.

These assumptions have been made in interpreting the import data shown in section 3.3.

3.2 PICTs production data

Information provided by SPC in the terms of reference (TOR) for the present assignment includes BDM production data from selected PICTs during the period 1997–2017 as shown in Table 1. Supplementary data gathered during the present study are also shown, based on the more detailed information contained in Appendix 1. Some of this data is from fisheries agencies and some from customs or statistics agencies. For the most part the information runs to 2021 at the latest: only a couple of PICTs were able to provide 2022 data, and this was generally partial or provisional.

These data are variously from fishery agency sampling, BDM traders' records, export data held by customs or statistical agencies, a combination, or a 'best guess' estimate based on multiple sources.

Blue shaded cells up to 2017 indicate years when national fishery moratoria were in place, for all or part of the year, as advised by SPC. Green shading also indicates years when sea cucumber fisheries were closed, either for the full year (dark shading) or part of it (light shading) as advised by correspondents during the present study. Some exports took place during these periods in some countries, either because the moratoria were not respected, or because exports consisted of product that had been stockpiled from prior to the harvesting bans.

The first PICTs moratorium on sea cucumber fishing was introduced by Tonga in 1998. Since that time the number of countries closing sea cucumber fisheries has increased so that by 2012 four of the eight PICTs listed in Table 1 had moratoria in place. Since that time there have never been less than three PICTs with sea cucumber fishery closures for at least part of the year, and sometimes as many as five.

[12] An exception may be New Caledonia, whose customs agency has designated additional HS sub-codes under the 030811, 030812 and 030819 subheadings to represent several key sea cucumber genera (not individual species).

[13] One company in Kiribati has previously exported frozen sea cucumber to Brisbane, Australia for packing a ready-to-eat meals in shelf-stable pouches, but the Kiribati sea cucumber fishery has been closed since 2013.

Table 1: BDM production (tonnes) since 1997 by main producer PICTs[14]

Year	Fiji	French Polynesia	Kiribati	New Caledonia	Papua New Guinea	Solomon Islands	Tonga	Vanuatu
1997	862	0	39	57	505	203	35	48
1998	369	0	11	39	679	254		25
1999	141	0	8	49	395	375		18
2000	246	0	55	66	562	161		29 (26)
2001	245	1	54	62	503	375	1	48 (38)
2002	171	0	21	45	398	178		8
2003	254	0	10	69	492	409		25
2004	174	1	10	133	484	28	1	14
2005	378	0	9	51	612	21		18 (9)
2006	258	0	76	57	666	0		27 (8)
2007	260	0	269	94	790	223		30 (15)
2008	219	3	140	77	522	8	15	
2009	168	28	77	46	534	213	370	
2010	195	56	98	26 (3♣)	4	14	313	
2011	398	125	74	34 (33♣)		4	80	
2012	309	125	63	31		35	68	
2013	323	7	21	42		305	56	
2014	166	5	0*	52 (50♣)		0*	143	2
2015	200	6	0*	45 (38♣)		328 (287⊗)	0	19
2016	289	9	0*	49♣		0⊗	0	59
2017	191	6♠	0*	66♣	764 (791*)	311 (258⊗)	0	0⃠
2018	0*	2♠	0*	47♣	1,108*	315⊗	0	0⃠
2019	0*	3♠	0*	37♣	0*	83⊗	0	0⃠
2020	-	<1♠	0♦	21♣	919❤	0⊗	102◯	10⃠
2021	-	0♠	0♦	13♣	-❤	27/45⊗	91◯	0⃠
2022	-	-	0♦	3♣	-❤	23/31⊗	-	0⃠

Blanks in the period 1997–2017 are assumed to be zero production/exports because moratoria were in place.

Blue shaded cells indicate fishery moratoria as advised by SPC.

Green shaded cells are additional to the SPC data, and indicate years when the fishery was closed for all or part of the year (dark green = full-year, light green = part-year).

- dashes indicate 'no data' or 'unknown'.

* asterisks indicate data from Govan and Bertram (2020)[15]. (Some data differ from that provided by SPC as part of the TOR).

⚙ Fiji: No data available since 2020. Some exports were made in 2022 but the quantity is not known.

♠ French Polynesia: data from Direction des Ressources Marines (DRM).

♦ Kiribati: data from Kiribati Ministry of Fisheries and Marine Resource Development (MFMRD).

♣ New Caledonia: data from Institut de la statistique et des études économiques de la Nouvelle-Calédonie (ISEE). 2022 data is incomplete.

❤ PNG: value of exports has been obtained from National Fisheries Authority (NFA)[16] but not any information on volumes yet.

⊗ Solomon Islands: data from Ministry of Fisheries and Marine Resources (MFMR). Note that after 2015 MFMR data differ significantly from that provided by SPC as part of the TOR, and from Govan and Bertram (2020). Also, MFMR provided two different production estimates for 2021 and 2022 (see Appendix 1 for details).

◯ Tonga: data from Ministry of Fisheries (MOF).

⃠ Vanuatu: 2000–2001 and 2005–2007 from Vanuatu Fisheries Department (VFD) (2019). 2020–2022 from VFD (2021, 2022 and 2023). Apparently, some production took place in 2021 and 2022 but none was exported.

See Appendix 1 for more details of recent production data in each country.

[14] Data up to and including 2017 provided by SPC as part of the assignment terms of reference.

[15] Govan, H. and I. Bertram (2020). Update of beche-de-mer exports in the Pacific Islands to 2019. Informal spreadsheet managed by SPC, Noumea, New Caledonia.

[16] NFA (2022). Fisheries Sector Executive Overview. Port Moresby, Papua New Guinea.

Figure 6 illustrates the combined total production from all of the eight PICTs listed in Table 1. The figure also shows the 5-year moving average (MA) production, commencing in 2001.

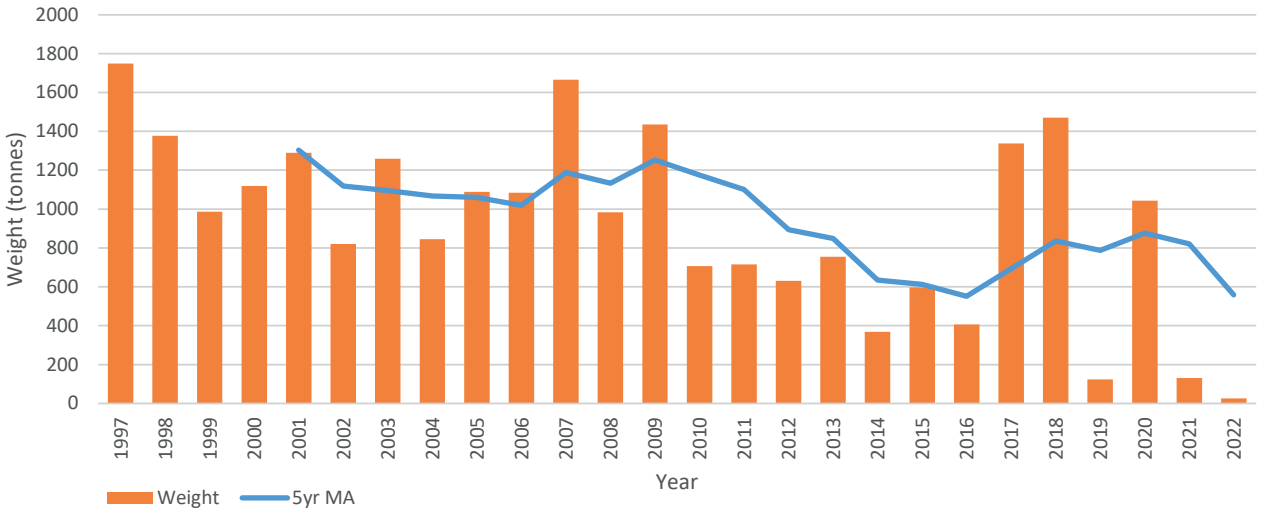

Figure 6: Combined BDM production in the eight PICTs listed in Table 1[17]

Annual production was highest in 1997, and has varied significantly since that time, but with a clear downward trend. The 5-year moving average exceeded 1000 t from 2001 to 2011, but fell below this level in 2012 and has remained below ever since. The 5-year moving average in 2022 was 559 t, about 42% of that in 2001.

3.3 Market states import data

Data on BDM imports from the listed PICTs were obtained from the UN Comtrade database, which provides aggregated global trade statistics by product and trading partner[18]. Table 2 shows total quantities of BDM (tonnes) imported from the countries concerned based on HS categories 0308, 030811, 030812 and 030819 (see section 3.1). The table shows imports by all 37 reporting entities listed in Comtrade, which is said to represent 99% of the world's trade.

Table 2: Global BDM imports from eight PICTs 2012–2021[19]

Year	Fiji	French Polynesia	Kiribati	New Caledonia	PNG	Solomon Islands	Tonga	Vanuatu	Total
2012	369.1	<0.1	76.8	0	<0.1	5.7	43.6	0.1	495.3
2013	341.6	0.4	17.2	0.2	3.4	339.5	89.5	0.1	791.9
2014	330.0	0.1	7.2	0.3	0	1.2	51.1	1.5	391.4
2015	345.5	0	0	2.8	14.0	342.4	6.8	10.7	722.2
2016	373.4	0	0	3.3	3.4	0	4.3	46.7	431.0
2017	316.7	0.1	0	5.0	570.4	5.6	3.6	0	901.4
2018	18.1	0	0	4.1	194.8	31.4	6.8	0	255.2
2019	18.4	0.1	0	0.1	383.3	285.9	25.8	0	713.5
2020	30.4	0.6	0	1.1	147.8	7.4	147.5	9.9	355.5
2021	47.2	6.4	0	0.5	337.8	33.6	126.7	1.8	554.1

[17] 2022 excludes Fiji due to data unavailability.
[18] https://comtradeplus.un.org/
[19] Data downloaded from Comtrade on 28 November 2022.

The Comtrade data in Table 2 differ markedly from the production data shown in Table 1.

- For **Fiji** the quantities shown by Comtrade between 2012 and 2017 are higher than (sometimes double) the production data shown in Table 1. After 2018, when the Fiji fishery was closed, Comtrade data still show imports to market states of 18–47 t each year.
- BDM exports from **French Polynesia** were said to be 125 t in 2012, when Comtrade data shows imports of 6 kg. Exports supposedly continued at the level of 5–9 t per year from 2013–2017, when Comtrade data shows little or zero imports.[20]
- The **Kiribati** fishery has been closed since 2013. Comtrade data indicate that imports continued in 2014, and that the amounts were slightly greater than those shown in Table 1.
- Comtrade records of imports from **New Caledonia** are a small fraction of the production data shown in Table 1.[21]
- Comtrade data for **Papua New Guinea** shows continuous but small imports between 2012 and 2016, when the fishery was closed. Imports increased substantially after the fishery reopened in 2017, and then continued from 2018–2021 even though the fishery was reclosed for most of that time;
- The **Solomon Islands** Comtrade data show import peaks at roughly similar times to the production peaks shown in Table 1, but of sometimes higher and sometimes lower amounts.
- For **Tonga**, Comtrade data are again mostly somewhat higher than the quantities shown in Table 1, and indicate that imports continued to take place throughout the 5-year period of fishery closure from 2015–2019. When the fishery reopened in 2020, the import quantities shown in Comtrade are considerably greater than the exports shown in Table 1.
- Comtrade data for **Vanuatu** seems to correctly reflect periods of fishery closure and shows production peaks at similar times to those shown in Table 1.

Overall, the Comtrade data for Solomon Islands and Vanuatu are the most closely correlated with the production data shown in Table 1, and those from French Polynesia are known to be inaccurate due to reporting issues. Data for other countries show significant variation. The reasons for these discrepancies are not entirely clear, but may arise for several reasons.

- Much of the data in Table 1 is from PICT production estimates that may be incomplete or possibly based on false information. Table 2 data come from customs agencies in importing countries that often have more rigorous systems and more comprehensive data.
- Shipping between PICTs and market states may take several weeks or months, so exports made from a PICT in one year may not be recorded as imports to the market state until the following year.

The primary markets for BDM are Hong Kong and China, with China being the final destination for much of the product initially landed in Hong Kong. Historically Singapore has also been a key market for BDM, although in recent years its importance has declined considerably. Table 3 shows imports into Hong Kong and Singapore from each of the eight listed PICTs.

[20] In 2016 French Polynesia began reporting BDM data under the heading 030890. This heading refers to *aquatic invertebrates other than crustaceans, molluscs, sea urchins, sea cucumbers and jellyfish, live, fresh, chilled, frozen, dried, salted or in brine, cooked or not before or during smoking* and its use has resulted in some French Polynesia Comtrade data being excluded (F. Magron, SPC, pers. comm.)

[21] New Caledonia stopped reporting to Comtrade in 2016 (F. Magron, SPC., pers. comm). However market states still report their imports from New Caledonia, so there should be at least some correspondence between New Caledonian export data and Comtrade import data.

Table 3: BDM imports into Hong Kong (H) and Singapore (S), 2012–2022[22]

Year		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Fiji	H	342	304	297	307	325	278|*272*	7|*22*	9	27	45	102
	S	<0.1	0	0	0	0	0	0	0.2	0.3	0.1	<1
French Polynesia	H	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	<0.1	0	<0.1	<1
Kiribati	H	77	17	7	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	0	0	0	0
New Caledonia	H	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	<0.1	0	0	0	0	0
PNG	H	0	3	0	0	0	459|*485*	121|*559*	300|*382*	66|*80*	82|*230*	29
	S	0	0	0	0.6	0	53.1	18.1	4.8	19.4	20.7	6
Solomon Islands	H	6	338	0	339	0	6|*8*	30|*325*	217	0	34	504
	S	0	0.4	1.0	2.1	0	0	0.8	1.7	7.4|*4*	0	0
Tonga	H	32	88	47	2	3	2	1	10	84|*42*	72	57
	S	0	0	0	0	0	0	0	<0.1	2.5|*1*	1.1	1
Vanuatu	H	0	0	1	11	45	0	0	0	10|*5*	2	5
	S	0	0	0	0	0	0	0	0	0	0	0

As noted earlier, the importance of the Singapore market has declined and it receives relatively few imports from PICTs. Of the imports into Hong Kong and Singapore from PICTs, 96.7% went to Hong Kong and only 3.3% to Singapore.

About 45 million ethnic Chinese, many of them recent migrants, live in communities outside China, including the USA, Canada, Europe, Southeast Asia, Latin America, Africa and Oceania. These are important secondary markets for BDM exported by PICTs, especially Malaysia, which was insignificant until 2015 but whose imports have grown rapidly over the past 5 years (Table 4).

Table 4: BDM imports (tonnes) from eight PICTs into main markets, 2012–2021[23]

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020
Hong Kong	456.7	0.0	352.1	659.2	373.9	744.0	158.8	536.7	187.0
Singapore	<0.1	0.4	1.0	2.7	0.0	53.2	18.8	6.7	29.6
Malaysia	0.0	0.2	0.0	13.5	3.2	55.8	54.1	141.2	101.5
China	0.1	0.4	0.9	0.0	0.0	0.3	0.0	0.7	8.2
Other	38.3	40.6	37.3	47.5	53.9	48.3	25.7	30.7	18.2
Total	**495.2**	**41.6**	**391.4**	**722.9**	**431.0**	**901.6**	**257.5**	**715.4**	**344.5**

Much BDM from PICTs transits Hong Kong before being re-exported, but significant volumes are imported directly by secondary markets, as shown in the 'other' row. Direct imports by China have also grown considerably since 2020, after previously being relatively small.

In percentage terms, over the period 2012–2022 Hong Kong has absorbed 76.3% of production (by weight) from the eight listed PICTs, with Singapore at 1.4%, Malaysia 11.8% and other markets 7.8%.

[22] Data from UN Comtrade website except for numbers in *italic* which were provided by INFOFISH. INFOFISH obtains its data from Trade Data Monitor (https://www.tradedatamonitor.com/), a commercial company which mostly serves institutional clients.

[23] Data from UN Comtrade. Note that Comtrade data for French Polynesia and New Caledonia are incomplete due to reporting under an erroneous HS code and non-reporting respectively.

4. BDM price information

4.1 The BDM value chain

The typical sea cucumber / BDM value chain comprises the following participants:

Inside PICTs

- fishers/harvesters, who may be opportunistic or dedicated (i.e. having invested in boats and equipment). Fishers may process their own product or may sell it fresh;
- middlemen, often based in rural areas, who purchase product (fresh or processed) directly from fishers;
- exporters, usually based in national or provincial capitals, who purchase product either directly from fishers or from middlemen;

Outside PICTs

- importers, usually based in the main urban centre of the market state, which for the majority of PICTs product is Hong Kong;
- wholesalers, who purchase in bulk from importers and either resell locally or re-export the product to other markets;
- retailers, who purchase in smaller quantities from wholesalers and display their product for sale on a retail basis;
- consumers, the end customers who buy small quantities of BDM for commercial (restaurants, further processing) or personal use.

The exact structure of the value chain within PICTs depends on the size, geography and population of the PICT concerned, sea cucumber resource endowment, the degree of connectedness to international markets, availability of alternative resources and income-earning opportunities, and other factors. Bigger countries with large populations dispersed over numerous islands and coastal areas will have larger fisheries and more complex local industry structures, involving greater numbers of fishers, middlemen and exporters operating at several levels. Small countries with more limited sea cucumber resources are likely to have smaller fisheries, fewer participants in the industry and a simpler industry structure. Irrespective of location, however, "these value chains are notoriously complex and fragmented" (Purcell et al. 2017)[24].

These authors illustrate a representative BDM value chain as shown in Figure 7. The diagram is based on observations in Fiji and Kiribati, both of which had more than 1000 fishers supplying fewer than 100 middlemen and around 10–20 exporters. The authors note that these proportions are probably common among all PICTs: very large numbers of fishers supplying a limited number of middlemen who in turn supply a handful of exporters. In some PICTs the number of exporters (and

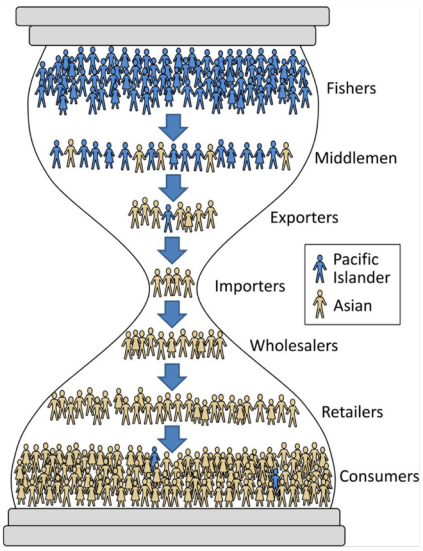

Figure 7. Schematic of BDM value chain structure in Fiji and Kiribati (from Purcell et al. 2017)

[24] Purcell, S., B. I. Crona, W. Lalalvanua and H. Eriksson (2017). Distribution of economic returns in small-scale fisheries for international markets: A value-chain analysis. Marine Policy 86 (2017) 9-16.

sometimes middlemen) is restricted through licence limitation, which results in a great deal of market power being concentrated in just a few hands. It is also notable that, while most sea cucumber fishers are Pacific Islanders (again sometimes a result of fishery management arrangements), increasing numbers of non-Pacific Islanders (mostly Chinese or other Asian nationalities) are to be found among the middlemen and exporters. Where exporters are Pacific Islanders, they often work in partnership with Chinese or Asian partners who have good market knowledge and connections, and may also provide financing for business operations.

Exporters from PICTs in turn supply a limited number of importers: Purcell et al. (2017) state that there are in the order of 100 BDM importers in China but the majority of imports are channelled through fewer than 10 main importing countries.

There are multiple points along the BDM value chain where prices may be measured, each of which is a stage where value may be added and prices increase:[25]

- the first sale price paid by buyers and exporters to fishers, which may be for processed, semi-processed or unprocessed product
- prices paid by importers in market states to exporters in PICTs
- prices paid by wholesalers and retailers to importers in market states
- retail prices paid by consumers in market states.

Additional price points exist in many cases. Some BDM is repackaged by wholesalers and retailers in order to cater for luxury markets. Some product is re-exported from the importing country to secondary markets, where more wholesalers may distribute it to retailers. There may therefore be several intermediaries between the fisher and the final consumer, each of which adds a margin that is absorbed into the final product price. This is one reason why retail prices to BDM consumers in market states may not be a good reference point on which to base price expectations by fishers.

Table 5 shows possible sources of information for each of the major price points.

COVID-19 travel restrictions during the present study made it infeasible to visit either producer or market states, so the price information that follows is based on data that could be collected without travelling. This includes statistics supplied by PICT fishery and other agencies, trade databases, wholesale and retail websites, and publications containing historical price data.

4.2 First-sale prices

Fisheries agencies in several PICTs either collect information on prices paid to fishers for sea cucumbers, or have regulations or fishery management plans that stipulate minimum prices that buyers are expected to pay. The types of data available for each country are shown in Appendix 1 and summarised in Table 6, which also indicates the source table or text in Appendix 1.

[25] This text refers only to the sale of dried beche-de-mer as traditionally produced in PICTs. It does not cover frozen, freeze-dried, shelf-stable, pharmaceutical or other BDM products described in section 3.4.

Table 5: Data considerations at key price points in the BDM value chain

Price point	Information sources	Comments
First sale price	Records kept by sea cucumber buyers and exporters	Most are reluctant to divulge information that is commercially confidential. Usually species-specific.
	Buying records and data collected by fisheries agencies	Available for some countries but not all. Varying levels of accuracy and comprehensiveness. May be subject to confidentiality provisions. Usually species-specific.
	Minimum buying prices established by regulation or in fishery management plans	Established in some PICTs but not all. Regulated minimum prices hard to enforce and may not be applied by traders. Usually species-specific.
Export/import prices	Records kept by sea cucumber buyers and exporters	Most are reluctant to divulge information that is commercially confidential. Usually species-specific.
	Export prices recorded by PICT fisheries, customs or statistical agencies	Declarations may be falsified by exporters in order to avoid taxes and levies, and for other reasons. Usually not species-specific. Sometimes available online via trade databases.
	Import prices recorded by relevant agencies market states	Probably the most reliable but rarely species-specific. Usually available online via trade databases.
Prices paid by wholesalers and retailers in market states	Interviews and surveys in market states	Most wholesalers are reluctant to divulge information that is commercially confidential. Requires physical presence in market states.
	Internet trading websites	Some data available from wholesale websites like Alibaba. Sometimes difficult to determine species.
Prices paid by consumers in market states	Interviews and surveys in market states	Many retailers are reluctant to divulge information. Requires physical presence in market states.
	Retail shopping websites	Some data available from retail websites such as Amazon. Mostly applies to high-end/up-market products. Usually difficult to determine species.

Table 6: PICTs from which sea cucumber buying prices are available

PICT	Data available	App 1 source
New Caledonia[26]	Historical data on average first sale price (wet weight), XPF/kg, 2000–2004, where XPF are Pacific francs	NC5
	Aggregate volume and value of sea cucumber harvest (wet weight) in North and South Provinces, 2016–2020 (average price in XPF/kg can be extrapolated)	NC2, NC3
	Species-specific first-sale prices (wet weight) for 16 sea cucumber species plus a 'miscellaneous' category, XPF/kg, 2020.	NC6
Papua New Guinea	Species-specific average first sale price (dry weight), PGK/kg in Milne Bay and West New Britain Provinces, 2020, where PGK are PNG kina.	PNG2
Solomon Islands	Species-specific minimum buying prices (dry weight) for 27 sea cucumber species, SBD/kg, from 2015 BDM fishery management plan and still in force, where SBD are Solomon Island dollars.	SOL3
Tonga	Summary data on export volumes and payment to fishers from which average price (TOP/kg) can be estimated, 2020–2021, where TOP are Tongan pa'anga.	Text
Vanuatu	Species-specific minimum buying prices (wet and dry weights) for 24 sea cucumber species, VUV/kg, from 2015 BDM fishery management plan and still in force, where VUV are Vanuatu vatu.	VAN3

[26] Table NC4 in Appendix 1 also shows average first sale price (wet weight) for sea cucumbers, XPF/kg, 2020 in the South and North Provinces. These numbers differ from those that result from simply dividing the value by the volume, so have not been used. However the weighted average price that can be calculated from these data is higher than that shown in Table 7 (608 XPF/kg rather than 407 XPF/kg).

Two PICTs (New Caledonia and Tonga) provide information that allows the calculation of average sea cucumber first-sale prices in selected years, as shown in Table 7. Prices have been converted from local currencies to USD/kg using period-average annual exchange rates published on the SPC Pacific Data Hub.[27]

Table 7: Average sea cucumber first-sale prices in New Caledonia and Tonga, USD/kg

Year	2000	2001	2002	2003	2004	2016	2017	2018	2019	2020	2021
New Caledonia (wet)											
Harvest (t)	-	-	-	-	-	225	327	198	279	189	-
Value XPF (M)	-	-	-	-	-	62	89	79	82	77	-
Price XPF/kg	518	313	176	259	687	276	272	399	294	407	-
Exchange rate (XPF/$)	130	133	127	105	96	108	105	101	106	104	-
Price USD/kg	3.99	2.35	1.39	2.46	7.14	2.56	2.59	3.95	2.76	3.91	-
Tonga (dry)											
Harvest (t)	-	-	-	-	-	-	-	-	-	102	91
Value TOP (M)	-	-	-	-	-	-	-	-	-	4.0	4.4
Price TOP/kg	-	-	-	-	-	-	-	-	-	39.21	48.35
Exchange rate (TOP/$)										2.30	2.27
Price USD/kg	-	-	-	-	-	-	-	-	-	17.05	21.35

The table indicates that in New Caledonia, first-sale prices paid to fishers for wet product have not evolved very much over the past 20 years. As in other countries, this is likely to be at least partly due to decreasing populations of high-value species and a growing proportion of low-value species in the catch. No obvious conclusions can be made from the Tonga data, except that the estimated prices for dry product are consistent with the more detailed data shown in Table 8.

Four PICTs provide a total of six sets of species-specific information on first-sale prices for sea cucumbers: two wet and four dry, as shown in Table 8. Data for New Caledonia and Papua New Guinea (grey) are actual prices paid, based on records submitted by licensed fishers or buyers. For Vanuatu and Solomon Islands (green), the numbers are government-stipulated minimum buying prices contained in national sea cucumber fishery management plans. These have been converted to USD equivalents using exchange rates from the SPC Pacific Data Hub.[28]

Some observations on the data include:

- first sale prices for wet sea cucumbers seem disproportionately high compared to prices for dried BDM. This is evident both from the actual prices paid, and for the reference prices stipulated in management plans. Given the amount of product shrinkage that occurs during processing, it would be logical for dry-weight prices to be at least five times higher than wet-weight prices, but this is seldom the case. Other reviewers have also noted the same trend;[29]
- prices for wet product in New Caledonia are quite high relative to prices paid for dry product in PNG, and in one case even exceeds them;
- the first-sale reference prices contained in the Vanuatu and Solomon Islands sea cucumber management plans are generally somewhat higher than the prices actually being paid in New Caledonia (wet product) and PNG (dry product).

[27] https://pacificdata.org/

[28] 2020 exchange rates used against the USD were: XPF – 0.0096; PGK – 0.2890; SBD – 0.1218; VUV – 0.0087.

[29] For example Purcell, S., D. H. Williamson and P. Ngaluafe (2018). Chinese market prices of beche-de-mer: Implications for fisheries and aquaculture. Marine Policy 91 (2018) 58-65.

Table 8: Species-specific sea cucumber first-sale prices in four PICTs, USD/kg, 2020

Scientific name[30]	English common name	PNG (dry)		New Cal (wet)	VAN		SOL (dry)
		Milne Bay	West New Britain		Wet	Dry	
Actinopyga echinites	Deepwater redfish	3.53	-	2.29	-	-	16.44
Actinopyga lecanora	Stonefish	13.87	10.51	1.67	4.79	17.40	40.44
Actinopyga mauritiana	Surf redfish	11.33	7.02	3.46	2.61	34.80	30.45
Actinopyga miliaris	Blackfish	6.99	-	2.94	-	-	34.47
Actinopyga palauensis	Deepwater blackfish	5.26	-	4.26	4.35	8.70	29.23
Actinopyga spinea	Burrowing blackfish	-	-	3.09	-	-	-
Bohadschia argus	Tigerfish	6.13	4.52	2.67	2.18	17.40	18.27
Bohadschia similis	Chalkfish	2.92	3.15	-	4.35	11.31	36.54
Bohadschia vitiensis	Brown sandfish	4.25	3.53	-	1.74	11.31	15.35
Holothuria atra	Lollyfish	1.10	0.98	-	0.87	8.70	6.82
Holothuria coluber	Snakefish	-	-	-	1.74	13.05	8.16
Holothuria edulis	Pinkfish	-	-	-	1.74	4.35	7.31
Holothuria flavomaculata	Red snakefish			-	-	-	7.31
Holothuria fuscogilva	White teatfish	38.15	15.00	9.05	27.84	69.60	48.72
Holothuria fuscopunctata	Elephant trunkfish	3.58	4.28	3.30	3.48	8.70	8.53
Holothuria lessoni	Golden sandfish			3.57	20.88	52.20	24.36
Holothuria leucospilota	White snakefish			-	-	-	6.09
Holothuria scabra	Sandfish	31.82	15.49	4.22	31.32	73.95	63.34
Holothuria sp.	Hong pay/pigfish			-	-	-	4.87
Holothuria whitmaei	Black teatfish	9.10	11.56	8.48	10.44	43.50	48.72
Pearsonothuria graffei	Flower fish	-	-	-	4.35	11.31	4.26
Stichopus chloronotus	Greenfish	5.26	5.29	2.42	1.74	43.50	36.54
Stichopus herrmanni	Curryfish	13.06	10.02	3.35	2.61	17.40	36.54
Stichopus horrens	Peanutfish/dragonfish			-	-	-	39.10
Stichopus vastus	Brown curryfish	11.91	-	-	-	-	24.36
Thelenota ananas	Prickly redfish	13.91	12.21	5.08	21.75	34.80	36.54
Thelenota anax	Amberfish	3.55	1.42	3.85	3.48	11.31	10.35
Thelenota rubralineata	Lemon/rainbow/candyfish	-	-	-	-	-	12.18
	Miscellaneous	-	-	2.39	-	-	0

In regard to this latter point, the reference prices serve as an information source and a basis for negotiation by fishers, and are not necessarily the prices actually paid by BDM buyers.

[30] Different scientific names may be used by different countries for the same species. For example, *B. similis* is listed as *B. marmorata* and *S. horrens* as *S. monotuberculatus* in table SOL2 (Appendix 1).

4.3 Export prices

Several PICTs publish information on the volume and value of exports, and this can be used to deduce average BDM prices at these points in the value chain. Two PICTs also published species-specific data on export prices, as shown in Table 9. More details are shown in Appendix 1.

Table 9: PICTs from which national BDM export price data are available

PICT	Data available	App 1 source
French Polynesia	Export volume/value and calculated average export price, 2017–2020.	FP1
New Caledonia	Export volume/value and calculated average export price, 2010–2022, plus partial data for 2023.	NC7
Papua New Guinea	Export volume/value and calculated average export price, 1995–2006 plus partial data for 2018–2020.	PNG1
Solomon Islands	Export volume/value, 2015–2022 (average export price can be extrapolated).	SOL1
	Species-specific export volume and revenues received (prices can be extrapolated).	SOL2, SOL3
	List of species-specific reference export prices that are used as a basis for determining wet and dry first-sale prices.	SOL3
Vanuatu	Species-specific export volume and price received per kg, 2020.	VAN1
	List of species-specific reference export prices that are used as a basis for determining wet and dry first-sale prices.	VAN3

Six of the eight PICTs under study have also reported some BDM exports to the UN Comtrade database in some years. Table 10 summarises the available information on average export prices from these PICTs, plus Papua New Guinea (which did not report to Comtrade, but which provided national data), using national export records (Nat) and Comtrade data (CT, shaded).

Some observations can be made from the table as follows.

- Historical national data from PNG suggest that average BDM export prices there have increased only marginally since 2005. This may be related to the generally observed shift towards lower-value species in the past decade.
- Export prices obtained by the French territories are significantly higher than those in PNG and especially Solomon Islands, which are the lowest of all. As noted elsewhere, these latter two PICTs face the continual challenge of false declarations of BDM values by exporters.
- Only French Polynesia has a multi-year overlap period that includes both national and Comtrade data. There is very good correspondence between the two data sets.
- Where other PICTs have national and Comtrade data for the same years, the correspondence is either less strong (New Caledonia) or extremely weak (Solomon Islands). In both cases Comtrade data indicate higher prices than national data, which originate from national fisheries, customs and statistics agencies.
- Comtrade data for Fiji show a trend of increasing prices from 2012–2014 followed by a decline to 2017, and a complete slump in 2018–2020, then a minor recovery in 2021–2022.
- Conversely, national export price data provided by Solomon Islands shows a steady if modest increase between 2015 and 2022, although prices are mostly low relative to those from other PICTs.

Table 10: BDM average export prices (USD/kg) from seven PICTs, 1995–2023

Year	Fiji	French Polynesia		Kiribati[31]	New Caledonia		PNG	Solomon Islands[32]		Tonga
	CT	CT	Nat	CT	CT	Nat	Nat	CT	Nat	CT
1995			-			-	8.01		-	
1996			-			-	10.00		-	
1997			-			-	10.26		-	
1998			-			-	12.00		-	
1999			-			-	10.53		-	
2000			-			-	10.53		-	
2001			-			-	10.85		-	
2002			-			-	14.46		-	
2003			-			-	13.07		-	
2004			-			-	14.63		-	
2005			-			-	16.09		-	
2006			-			-	18.78		-	
2010			-			55.89	-		-	
2011			-			80.89	-		-	
2012	12.11	21.72	-			79.88	-		-	
2013	28.09	25.34	-			76.70	-		-	
2014	69.57	70.43	-		82.43	70.56	-		-	5.93
2015	46.27	89.15	-	4.13	85.78	68.55	-		11.62	
2016	30.80	81.99	-			81.80	-			
2017	25.40	77.16	77.43	2.17		70.46	-		8.04	
2018	3.83	92.02	92.10			82.68	-	51.98	7.61	
2019	3.12	76.56	76.69			86.50	-		11.45	
2020	3.49	16.03	15.97			91.25	20.39			
2021	10.46		-			103.50	-		7.87/10.46	
2022	16.62		-			94.70	-		16.53/12.25	
2023			-			94.13[33]	-			

[31] Comtrade data for Kiribati shows exports of 351 t valued at USD 85,000 in 2015, and 25 t valued at USD 11,000 in 2017. This is not credible in terms of either volumes or prices. It is assumed that the volume and price data are reversed, and this has been corrected here.

[32] Two values for Solomon Islands are shown in 2021 and 2002, due to conflicting data sets (see table SOL1)

[33] New Caledonia 2023 data is for January–April only

The Comtrade export data again indicate that exports continued to be made during periods of fishery closure in Fiji, Kiribati, Solomon Islands and Tonga.

Solomon Islands and Vanuatu both report export data by species and also maintain lists of reference export prices, which allows the two to be compared. The species-specific actual and indicative export prices for both countries are shown in Table 11.

Table 11: Species-specific actual and reference BDM export prices, Solomon Islands (average 2021–2022) and Vanuatu (2020), USD/kg

Scientific name	English common name	Solomon Islands			Vanuatu		
		Price received (A)	Reference price (B)	Ratio (A/B)	Price received (A)	Reference price (B)	Ratio (A/B)
Actinopyga lecanora	Stonefish	60.23	84.25	71%	31.09	78.30	40%
Actinopyga mauritiana	Surf redfish	45.34	84.25	54%	22.63	60.90	37%
Actinopyga miliaris	Blackfish	49.66	74.34	67%	-	60.90	
Actinopyga palauensis	Deepwater blackfish	-	-		-	52.20	
Bohadschia argus	Tigerfish	28.00	34.69	81%	25.08	43.50	58%
Bohadschia similis	Chalkfish	55.76	74.34	75%	-	43.50	
Bohadschia vitiensis	Brown sandfish	22.80	43.37	53%	15.99	34.80	46%
Holothuria atra	Lollyfish	10.02	24.78	40%	5.64	43.50	13%
Holothuria coluber	Snakefish	10.93	29.74	37%	-	26.10	
Holothuria edulis	Pinkfish	3.87	34.69	11%	-	43.50	
Holothuria flavomaculata	Red snakefish	11.15	24.78	45%	-	43.50	
Holothuria fuscogilva	White teatfish	74.86	99.12	76%	91.24	165.30	55%
Holothuria fuscopunctata	Elephant trunkfish	1.86	29.74	6%	-	13.05	
Holothuria lessoni	Golden sandfish	38.93	74.34	52%	-	261.00	
Holothuria scabra	Sandfish	92.93	84.25	110%	-	261.00	
Holothuria whitmaei	Black teatfish	74.16	69.38	107%	119.46	156.60	76%
Pearsonothuria graffei	Flower fish	6.00	6.20	97%	-	52.20	
Stichopus chloronotus	Greenfish	18.65	74.34	25%	13.17	60.90	22%
Stichopus herrmanni	Curryfish	54.96	84.25	65%	16.92	104.40	16%
Stichopus horrens	Peanutfish	57.86	84.25	69%	-	43.50	
Stichopus vastus	Brown curryfish	37.17	43.37	86%	-	21.75	
Thelenota ananas	Prickly redfish	52.34	84.25	62%	30.10	52.20	58%
Thelenota anax	Amberfish	13.65	34.69	39%	-	19.14	40%

The table indicates that the prices received by exporters in both countries were for the most part significantly lower than the established reference prices. In Solomon Islands, exporters achieved reasonable prices compared to the reference prices for high- and medium-value species – sometimes slightly more than 100% but more usually between 50% and 80%. For low-value species, however, actual prices received are more usually less than 40% of the reference price. In Vanuatu, actual prices were always lower than the reference price, and less than 50% for six out of the ten species exported. It is notable that the Vanuatu reference prices are generally higher than those of Solomon Islands.

Possible reasons for the differences between actual and reference prices may include:

- unrealistic reference prices set by national fishery agencies;
- poor quality of BDM processing, resulting in lower export prices; and
- inaccurate reporting of the prices received by exporters.

The latter issue has been recognised as a general matter of concern for several PICTs.

4.4 Import prices

Average BDM prices can also be derived from the import data contained in the UN Comtrade database. These data are recorded by the market states that import BDM, and are therefore independent of the data collection systems operated by national fisheries, customs or statistics agencies in PICTs.

Table 12: Average BDM import prices (USD/kg) from eight PICTs 2012–2021[34]

Year	Fiji	Fr. Pol	Kiribati	N. Cal	PNG	Sol. Is.	Tonga	Vanuatu	Average
2012	16.26	4.17	7.92	-	327.00	49.07	9.39	112.16	**14.75**
2013	14.61	27.56	11.97	98.52	99.52	11.53	7.07	76.29	**12.78**
2014	12.67	27.32	9.67	90.45	-	121.33	7.62	72.57	**12.59**
2015	16.80	-	-	30.12	9.87	-	13.69	26.03	**12.49**
2016	22.60	-	-	53.20	19.41	-	13.85	15.87	**21.99**
2017	19.65	29.26	-	37.38	23.38	33.75	19.27	-	**22.19**
2018	34.30	-	-	89.74	64.85	84.19	19.84	-	**64.27**
2019	15.88	16.12	-	105.15	21.05	9.64	15.42	-	**16.15**
2020	12.56	50.08	-	108.37	18.61	204.97	12.62	26.07	**20.03**
2021	10.43	21.70	-	130.97	19.72	13.85	18.11	8.03	**18.29**
Avg	**17.09**	**24.27**	**8.73**	**60.74**	**26.58**	**13.80**	**12.54**	**19.95**	**18.90**

These price calculations are mostly based on significant volumes of BDM imports (range from 255 t [2018] to 901 t [2017]). Comparing information in Table 12 with the export price data presented in section 4.3 reveals the following.

- Comtrade import data for Fiji generally shows lower prices than indicated by Fiji's Comtrade export data. The import data is based on larger trade volumes than the export data, indicating that export data submitted to Comtrade by Fiji is incomplete, and possibly selective.
- Conversely, Comtrade data on imports from French Polynesia are based on just a small fraction of the exports declared in its national statistics. This may explain why the Comtrade import data shows consistently lower prices than indicated by the export data in Table 10.
- Comtrade import data for Kiribati covers the period 2012–2014. Export data (Table 10) is for 2015 and 2017. Both are based on similar export volumes. The import data indicate prices 2–3 times higher than the export data.
- Prices of imports from New Caledonia are mostly (but not always) higher than export prices.
- The price of USD 327/kg indicated for PNG in 2012 is based on a trade volume of only 5kg, and is almost certainly anomalous. Otherwise PNG prices are consistent with the 2020 data and the historical information shown in Table 10.

[34] Data downloaded from Comtrade on 28 November 2022.

- Solomon Islands import price data are mostly greater (sometimes much greater) than the BDM export prices reported to Comtrade and through national systems.
- Only one export price from Tonga, for 2014, is shown in Table 10, and this is less than any of the prices shown by Comtrade import data, which also indicate that market states continued to import Tongan BDM throughout the 2015–2019 fishery closure period.
- No prices based on Vanuatu export data are shown in Table 10. However, the average BDM import prices being realised, as shown above, appear to be generally lower than the actual and reference species-specific export prices for Vanuatu shown in Table 11.

Average annual BDM prices across the eight PICTs shown in Table 12 indicate a gradual but unsteady progression from USD 14.75/kg in 2012 to USD 18.29/kg in 2021, with peaks during the period 2016–2020. This coincides with the period when many PICTs, including Fiji, PNG, Solomon Islands and Vanuatu, imposed or renewed fishery closures. Prices subsequently fell back, and it would be interesting to see whether this corresponded with market states developing alternative sources of supply. However, this is beyond the scope of the present study.

The average price data for each PICT shown in Table 12 indicate that the French territories and PNG achieved the highest long-term average prices. Kiribati, Tonga and Solomon Islands had the lowest, although the Kiribati data is no longer current.

4.5 Wholesale and retail prices

It was not possible to make direct observations of BDM wholesale and retail prices in Asian market states during the present study due to travel restrictions.

Indicative BDM wholesale prices are nevertheless available from online websites such as Alibaba.com, where bulk supplies of BDM can be purchased in the range of USD 100–1,000/t (USD 0.10–USD 1.00/kg) depending on species and quantity. In most cases minimum orders of between 10 and 50 t are required to obtain these prices. Some of these prices are lower than those reported by PICT exporters. Other suppliers have smaller minimum order quantities, as low as 5 kg, but in these cases the prices are orders of magnitude higher, at USD 30–55/kg, more closely approximating retail prices.

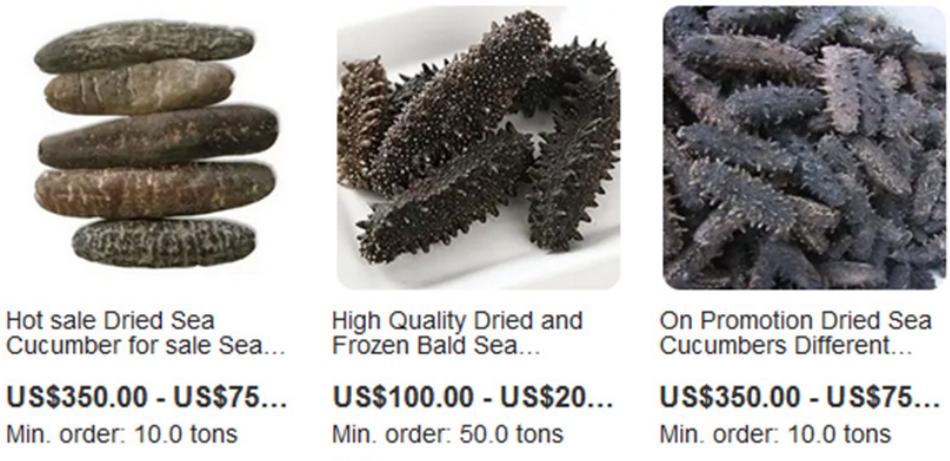

Figure 8: Wholesale BDM for sale (USD prices) on Alibaba.com

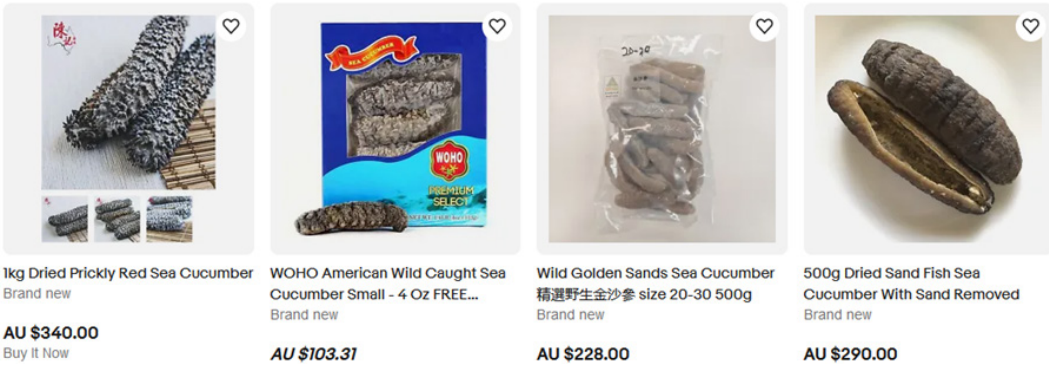

Figure 9: Retail BDM for sale (AUD) on eBay

Retail quantities of BDM can also be bought online at large-scale shopping websites such as Amazon and eBay, as well as from specialised seafood retailers. Prices for several products and species are shown in Figure 8 and Figure 9.

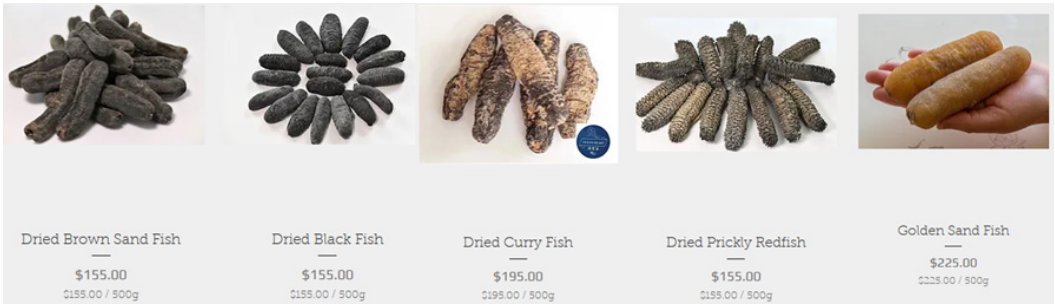

Figure 10: Retail BDM for sale (AUD) at https://www.foodexport.com.au/shop

Retail prices vary considerably but appear to be in the range of AUD 340–600 (USD 225–400)/kg depending on species. Prickly redfish and blackfish are at the lower end of the range, and curryfish in the middle, with golden sandfish and white teatfish at the upper end.

A short visit was made to the Sydney Chinatown in early 2023, when international travel restrictions had been partially eased, to view BDM products on retail sale and gather indicative prices. Several species were recognisable in the products on display, including sandfish, black teatfish and white teatfish (Figure 10) all of which were priced above AUD 1000/kg.

Figure 11: Black teatfish, white teatfish and sandfish on sale in Sydney, all at over AUD 1000/kg (author photo).

Unfortunately, none of the traders encountered were willing to provide any detailed information on their products and prices, other than to say that, in one case, the BDM on display came from New Zealand. As most of these were tropical species, it seems likely that they had originated from PICTs and been sent to New Zealand for further processing and packaging before entering the Australian market.

Several authors have undertaken research into BDM retail prices in Asian markets. Purcell et al. (2018)[35] reported on 2016 BDM prices in Hong Kong and Guangzhou and compared these to price data collected using similar methodology five years earlier, in 2011[36].

Several key takeaways from that report are listed below.

- The tropical species with the highest maximum recorded price was sandfish (*H. scabra*), where extra-large product retailed at over USD 1800/kg at one Hong Kong store.
- There was a 2.7-fold increase in price per kg and a 9.8-fold increase in price per individual for *H. scabra* greater than 10 cm product length compared to sub-10 cm individuals. Prices were directly correlated with length for several other high-value species.
- Generally sandfish prices sampled were similar to those of golden sandfish (*H. lessoni*), which retailed at up to USD 849/kg.
- White teatfish (*H. fuscogilva*) retailed at a maximum price of USD 401/kg and some other species at over USD 200/kg (see Table 13).
- The largest proportional price increases from 2011–2016 were among the low-value species.
- No tropical BDM species came close to the price of *Stichopus japonicus*, a temperate-water species that retailed at prices up to USD 3583/kg.
- In 2016 average retail prices of BDM species were 1.3–3.8-fold higher in Hong Kong stores than in Guangzhou stores.

Purcell et al. (2018) noted that average BDM prices increased at an annual rate of about 2.4% over the 5-year period between the two studies. Applying the same rate of increase would mean that 2022 prices should have increased by about 15.3%, as shown in Table 13.

The estimated prices for 2022 are based on unverified assumptions regarding the rates of inflation in Hong Kong and Guangzhou and their applicability to the BDM trade, alongside the impacts of COVID-19 and associated lockdowns on the dietary and retail habits of Chinese communities worldwide. Nevertheless the 2022 estimates are consistent with BDM prices seen on internet marketing platforms, and with the limited observations made in Sydney. It seems likely that, in the absence of more reliable data, these estimates based on data collected by Purcell et al. in 2016[37] could serve as valid reference points for any price-setting approaches implemented by PICTs.

[35] Purcell, S., D. H. Williamson and P. Ngaluafe (2018). Chinese market prices of beche-de-mer: Implications for fisheries and aquaculture. Marine Policy 91 (2018) 58-65.

[36] Purcell, S. (2014b). Value, market preferences and trade of beche-de-mer from Pacific Island sea cucumbers. PLoS ONE 9(4): e95075. doi:10.1371/journal.pone.0095075

[37] Purcell, S.W. (2016). Update on beche-de-mer market prices in China. SPC Fisheries Newsletter #150 May-August 2016. Secretariat of the Pacific Community, Noumea, New Caledonia.

Table 13: Reported BDM retail prices, USD/kg, in 2014[38] and 2016[39], and estimated 2022 prices

Scientific name	English common name	2011		2016		2022	
		Avg	Max	Avg	Max	Avg	Max
Hong Kong							
Actinopyga lecanora	Stonefish	-	-	166	166	191	191
Actinopyga palauensis	Panning's blackfish	-	-	145	145	167	167
Bohadschia vitiensis	Brown sandfish	-	-	209	209	241	241
Holothuria fuscogilva	White teatfish	192	274	219	401	252	462
Holothuria lessoni	Golden sandfish	385	787	389	849	448	979
Holothuria scabra	Sandfish	303	1,668	369	1,898	425	2188
Holothuria whitmaei	Black teatfish	180	230	208	294	240	339
Stichopus herrmanni	Curryfish	197	214	350	358	404	413
Stichopus monotuberculatus	Dragonfish	-	-	188	188	217	217
Stichopus naso	Dragonfish	-	-	145	145	167	167
Stichopus vastus	Brown curryfish	-	-	230	230	265	265
Guangzhou							
Actinopyga echinites	Deepwater redfish	63	63	69	69	80	80
Actinopyga lecanora	Stonefish	94	108	76	107	88	123
Actinopyga mauritiana	Surf redfish	75	79	72	72	83	83
Actinopyga palauensis	Panning's blackfish	106	116	77	131	89	151
Actinopyga spinea	Burying blackfish	79	95	110	110	127	127
Bohadschia argus	Leopardfish	58	63	63	70	73	81
Bohadschia vitiensis	Brown sandfish	48	48	55	81	63	93
Holothuria atra	Lollyfish	-	-	31	31	36	36
Holothuria coluber	Snakefish	38	38	37	37	43	43
Holothuria fuscogilva	White teatfish	120	165	154	219	178	252
Holothuria fuscopunctata	Elephant trunkfish	15	19	22	78	25	90
Holothuria scabra	Sandfish	137	200	153	251	176	289
Holothuria whitmaei	Black teatfish	68	116	161	194	186	224
Stichopus chloronotus	Greenfish	79	95	100	125	115	144
Stichopus herrmanni	Curryfish	121	159	145	219	167	252
Stichopus horrens	Dragonfish	69	83	119	119	137	137
Stichopus monotuberculatus	Dragonfish	118	133	127	204	146	235
Stichopus naso	Dragonfish	-	-	91	94	105	108
Stichopus ocellatus	Eye-spot curryfish	111	111	78	78	90	90
Stichopus pseudohorrens	-	-	-	119	119	137	137
Thelenota ananas	Prickly redfish	130	231	107	219	123	252
Thelenota anax	Amberfish	22	32	31	47	36	54

[38] Purcell (2014b). Value, market preferences and trade of beche-de-mer from Pacific Island sea cucumbers. PLoS ONE 9(4): e95075. doi:10.1371/journal.pone.0095075

[39] Purcell et al. (2018). Chinese market prices of beche-de-mer: Implications for fisheries and aquaculture. Marine Policy 91 (2018) 58-65.

5. BDM fishery management

5.1 Economics of PICT BDM fisheries

The PICT sea cucumber fishery is diverse, with fishers in different countries operating in different ways, targeting different species, and variously selling raw, processed or semi-processed product, making for a complex value chain. James (2018)[40] discusses some of the economic considerations, summarised here.

- In most PICTS the BDM business is an oligopsony, meaning that numerous producers are competing to sell to a small number of buyers. This gives the buyers a great deal of control over the market, and allows them to offer lower prices.
- This arrangement is reinforced by the BDM fishery management measures used by many PICTs, which regulate the number of buyers, processors and/or exporters through licence limitation. Limiting the number of buyers decreases competition and further strengthens the market power of the buyers.
- Logically, changing the management regime to limit export quantities rather than the number of exporters should result in more competition among buyers and therefore higher prices for fishers. However in cases where this has been tried, the consequences seem to have been either (a) reducing the profitability of individual buyers so they cannot make a living, (b) monitoring, control and surveillance challenges, increased illegal fishing and black marketing, or (c) resource overexploitation.
- In many locations there is a two-tier production system, involving both dedicated and opportunistic fishers. Dedicated fishers rely on sea cucumbers as a main source of income, and may have invested in vessels and processing equipment, so they need a certain minimum income in order to remain viable. Opportunistic fishers are those with little or no marginal cost from harvesting sea cucumbers (meaning that their main source of income is not from BDM). Opportunistic fishers are typically more willing to accept lower prices than dedicated fishers, resulting in a general depression in prices overall.
- Regulation, such as bans on underwater breathing apparatus, or size limits, need to be rigorously enforced, otherwise there is a danger that they will lead to the creation of black markets (cut-price sale of illegally harvested or undersized BDM, especially by opportunistic fishers).
- Unfortunately the remote, dispersed nature of communities in most PICTs makes monitoring, control and surveillance difficult in all coastal fisheries, not just those for sea cucumbers.
- Rather than adding value, fishers may actually be *reducing* the value of their product by carrying out their own processing. This is evidenced by the higher relative (and sometimes absolute) price BDM buyers pay for raw sea cucumbers than for processed ones in some locations. Poorly processed BDM may need to be reprocessed to improve quality prior to export, so buyers are better off starting with unprocessed product to ensure satisfactory quality. Fishers may be better off simply selling their product raw or semi-processed (e.g. gutted and salted) – but this is not always possible due to remoteness and other factors.
- If minimum prices were set in PICT sea cucumber fisheries and these prices were then passed along the value chain to the end consumer in China, there may be a reduction in demand for PICT product, and the production would shift to other tropical regions, as has already happened with US and Mexican sea cucumbers.

[40] James, P. (2018). Pacific Sea cucumber fishery: Options for intervention. Unpublished draft report. Pacific Community, Noumea, New Caledonia.

The views laid out above appear generally sound, although some may be open to debate. In regard to Papua New Guinea, Kinch et al. (2008a)[41] recommend limiting the number of licences issued for each province, stating that:

> Too many companies make it difficult for the NFA to monitor purchasing and exporting data. Whilst it is generally thought good economic theory that competition raises standards along with prices, this does not appear to have happened as companies compete against each other to secure adequate product, and this leads to increased infringements of some regulations, particularly buying undersize bêche-de-mer. Competition from illegal operators also undermines any incentive licensed operators have to operate legally. (p. 69)

As regards minimum export prices causing BDM production to shift to other regions, and given the overfished status of BDM in most PICTs, it seems that a respite from the current intense levels of demand from Asian consumers could be a blessing rather than a problem.

James (2018) also notes that a regional BDM trading arrangement could enhance PICTs power in BDM markets and could help improve prices paid to the producing communities. Greater regional cooperation could also provide economies of scale in monitoring, control and surveillance of the fishery. Other analysts have made similar recommendations.[42] Twenty years ago, Kriz (1994)[43] noted that existing BDM marketing and distribution channels involve numerous middlemen and agents, all of whom take a cut along the value chain, resulting in final BDM prices that are substantially in excess of those received by PICT exporters and producers. In order to improve returns to PICTs, circumventing existing distribution channels is suggested as a possible strategy, especially for product that is re-exported from Hong Kong to secondary markets. For example, given the large secondary market that now exists in Sydney, it might be feasible for PICT exporters to obtain higher prices by consigning product directly to Australia rather than working through import/export agents in Hong Kong. However, the author notes that such an approach requires significant experience of the BDM and dried seafood market.

The Melanesian Spearhead Group (MSG), whose members are the major BDM-producing PICTs, has proposed such harmonised approaches through the MSG Roadmap for Coastal Fisheries and the MOU on Technical Cooperation in Coastal Fishery and Aquaculture Development (both 2015).[44] However there does not yet seem to be the high-level political will needed for implementation.

5.2 Current management arrangements

The eight PICTs in the study collectively have a wide range of sea cucumber fishery management measures in place, which variously include: limits on the number of licences; size limits for wet and dry product; prohibited species; prohibited fishing methods; closed areas; closed seasons; catch, effort and export quotas; and prohibitions on exporting specific products (such as chopped BDM pieces, which can be a means of evading size limits). Unfortunately, despite the plethora of restrictions, sea cucumber resources have continued to decline, largely because of the difficulty of enforcing the rules, especially in situations where influential business people or

[41] Kinch, J., S. Purcell, S. Uthicke and K. Friedman (2008a). Papua New Guinea: a hotspot of sea cucumber fisheries in the Western Central Pacific. In Toral-Granda, V., A. Lovatelli and M. Vasconcellos (eds). Sea cucumbers. A global review of fisheries and trade. FAO Fisheries and Aquaculture Technical Paper. No. 516. Rome, FAO. pp. 57–77.

[42] Preston, G. L. (2012). A Fisheries Engagement Strategy for the Pacific Islands Region. World Bank Regional Office for Papua New Guinea, East Timor and the Pacific Islands, Sydney, Australia.

[43] Kriz, A. (1994). Marketing of South Pacific seafood: A case study of sea cucumber. Pacific Islands Forum Fisheries Agency, Honiara, Solomon Island.

[44] The MSG is a sub-regional organisation of Papua New Guinea, Solomon Islands, Vanuatu.

senior public figures are involved in the BDM trade. This has led to many PICTS declaring complete moratoria, sometimes for many years. However, even moratoria can be difficult to enforce, and trade data indicate that BDM continued to be exported from many PICTs even when the fishery was supposed to be closed. Given the potential value of a well-managed sea cucumber fishery in many PICTs, and the benefits that flow from the fishery directly to rural communities (many of which have few alternative sources of income) it may be said that the overexploitation of sea cucumbers in many PICTs represents a major management failure. There would be significant economic and social benefits from developing better sea cucumber management arrangements and investing more into monitoring and enforcement in many PICTs.

In most of the eight PICTs covered by the present study, sea cucumber fishery management measures are laid out in fishery management regulations or plans (or both), although in some cases these instruments have not yet been formally adopted. The status of sea cucumber fishery management in each PICT, with particular reference to price considerations, is summarised in Table 14. The table does not attempt to enumerate the plethora of other measures that may apply in each country. A detailed comparison of sea cucumber fishery management measures in all the subject PICTs is beyond the scope of the present study, but more comprehensive reviews have previously been undertaken by Pakoa and Bertram (2013)[45], Govan (2017a)[46], Lee et al. (2020)[47] and others.

Table 14: Status of sea cucumber management arrangement in the eight PICTs covered by the present study

Country	SC fishery regulation/plan	Reference buying prices	Reference export prices
Fiji	Not yet gazetted	Not yet determined	Unknown
French Polynesia	Yes	No	No
Kiribati	Pending	Unknown	Unknown
New Caledonia	Yes	No	No
Papua New Guinea	Yes	No	No
Solomon Islands	Yes	Yes	Yes
Tonga	Yes	No	No
Vanuatu	Yes	Yes	Yes

Most of the eight PICTs also require licensed buyers and exporters to submit frequent detailed records of the quantities and types of sea cucumbers and BDM that they purchase, hold and sell. Two PICTs (Solomon Islands and Vanuatu) publish reference lists of sea cucumber first-sale prices, and of BDM export prices. Neither of these lists are legally binding, but are said to be guidelines and information sources to assist in negotiations between fishers, buyers and exporters. However, neither country has updated its list since 2015, and the actual prices that exporters declare having received are quite different (and usually lower) than the reference prices. There is no real information on whether the reference prices are actually used during negotiations between participants in the fishery. If reference prices are to be established, they need to be updated regularly, the changes widely disseminated to fishers and others involved in the industry, and monitored for impact.

[45] Pakoa, K. and I. Bertram (2013). Management state of Pacific sea cucumber fisheries. SPC Beche-de-mer Information Bulletin #33, May 2013. Secretariat of the Pacific Community, Noumea, New Caledonia.

[46] Govan, H. (2017a). A review of sea cucumber fisheries and management in Melanesia. SPC Fisheries Newsletter # 154, September-December 2017. Secretariat of the Pacific Community, Noumea, New Caledonia.

[47] Lee, S., H. Govan, I. Bertram and J. Kinch (2020). A comparison of sea cucumber fishery management plans, and implications for governance in Pacific Island countries. SPC Fisheries Newsletter # 161, January-April 2020. Secretariat of the Pacific Community, Noumea, New Caledonia.

Although they do not publish reference price lists, all six independent PICTs in Table 14 require applicants for BDM buying or exporting licences to specify what prices they intend to pay for the product they buy. Only the French territories (French Polynesia and New Caledonia) do not implement this requirement. In the case of Solomon Islands, the published reference price list is intended to serve as a floor, meaning that licence applicants should specify buying prices higher than those in the reference list. However, there is no evidence to suggest that buyers are then monitored or compelled to pay the prices shown in their licence applications, and indeed this would be very difficult to enforce given the wide variations that occur in product form and quality, transportation costs from different locations, and other factors that may affect prices.

A relatively new factor that has affected sea cucumber fishery management and the BDM trade in recent years is the listing of sea cucumbers in the appendices to CITES:

- Appendix 1 identifies *Endangered species*;
- Appendix 2 refers to *Vulnerable species threatened by trade*; and
- Appendix 3 applies to *Nationally protected species*.

Several sea cucumber species have now been listed in Appendix 2 and Appendix 3.

CITES listing of sea cucumbers dates back to 2003, with the addition to Appendix 3 by Ecuador of *Isostichopus fuscus*, an eastern Pacific species not found west of the Galapagos Islands. This was followed in 2019 by the listing in Appendix 2 of three commercially important species found in PICTs: *H. fuscogilva*, *H. nobilis* and *H. whitmaei*; and then again, in November 2022, when *T. ananas*, *T. anax* and *T. rubralineata* were also added to Appendix 2.[48]

The listing proposals in 2019 and 2022 were submitted by France, and co-sponsored by the European Union, the USA, Seychelles and others. Although commercially important in many PICTs, the 2022 listings were supported by Fiji, Tonga and Vanuatu. Papua New Guinea and Solomon Islands opposed the listings, believing that they would have negative consequences on the livelihoods of coastal communities. The proposal was put to the vote and passed by a majority of 97 in favour, with 16 against and 16 abstentions. Entry into force will occur in November 2023, in order to provide time for exporting and importing states to accommodate the listing through the implementation of effective management, identification, monitoring and permitting procedures. CITES Appendix 2 requires a Non-Detriment Finding (NDF) to be determined by the Scientific Authority in the producing country prior to export of the species.[49] In the absence of these documents, the shipments must be seized as they are expected to be illegal trade.[50]

Of the eight PICTs under study in this report, only Kiribati is not a signatory to CITES. As of November 2023, therefore, all exports of the six Appendix 2 sea cucumber species listed will need to be certified as coming from sustainable fisheries (which appears difficult, given the stressed state of most sea cucumber resources in the region) or from aquaculture (which has not yet reached commercial production status in the region). It seems likely therefore that trade in these six species – three of which are among the most highly valued – will be impeded in the foreseeable future.

[48] Di Simone, M., A. Horellou and C. Conand (2023). The listing of three new holothurian species in CITES Appendix II. SPC Beche-de-Mer Information Bulletin #43, April 2023. Secretariat of the Pacific Community, Noumea, New Caledonia.

[49] Purcell, S.W., A. Lovatelli, M. González-Wangüemert, F. A. Solís-Marín, Y. Samyn, and C. Conand, (2023). Commercially important sea cucumbers of the world – Second edition. FAO Species Catalogue for Fishery Purposes No. 6, Rev. 1. Food and Agriculture Organisation, Rome, Italy.

[50] CITES Secretariat (2020). CoP18 listing of valuable Teatfish and Cedrela species in CITES Appendix II enters into force. https://cites.org/eng/teatfish_cedrela_listing_AppendixII_CITES_28082020

5.3 Distribution of benefits

Govan (2017b)[51] notes that comparison of prices paid to fishers and to exporters is complicated by the variety of grades, and differences between wet and dry products but provides the following illustration of the proportion of benefits captured by the main participants in the value chain. The charts indicate that the percentage captured by fishers is rarely more than 10% of the final sale value. The same author notes that there appears to be room for increasing the proportion of value left in the country through setting of minimum prices.

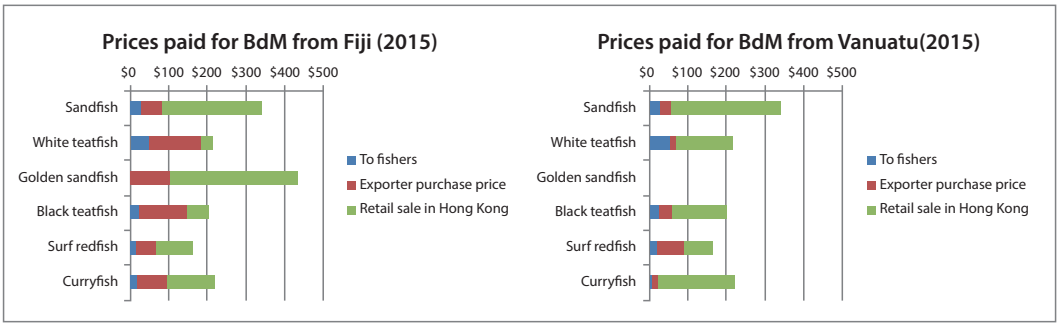

Figure 11: Price shares received by different participants in the BDM value chain in Fiji and Vanuatu (from Govan, 2017b)[52]

Purcell et al. (2017)[53] make the following points about the distribution of financial benefits from the BDM trade.

- For the three most valuable species, fishers receive less than 10% of the end market value when selling to middlemen or exporters. In contrast, the average proportional return to fishers for mid-value species ranged from 15%–34% of the end market value, and averaged 50% of the end market value for the three lowest-value species.
- In Fiji, exporters reported gross profit margins of around USD 40–65/kg bought from fishers, except for the three lowest-value species, which returned USD 8–20/kg when traded. The gross markup, in price per kg, by Fijian exporters averaged 2.9 times more than the actual sale prices of the species sold by fishers to them (i.e. 290% markup).
- Certainly in Fiji, exporters were, on average, earning several times more gross income per kg from exporting sea cucumbers than fishers earn from selling dried sea cucumbers to them. There was less disparity in Kiribati, where fishers earned slightly more gross income per kg of dried sea cucumbers than exporters.
- Variation in buying prices among PICTs indicate potential for higher earning to fishers.[54]
- For certain species, trade is restricted under national or international regulations (e.g. CITES) so traders can offer low prices in black market transactions.
- If fishers could get higher prices, it is possible that they would fish less, leading to resource conservation benefits. One exporter said that one reason he offered relatively low prices to fishers for their sea cucumbers was so that they would continue to harvest at a high rate and sell greater volumes to him, rather than fishing at a slower rate, had they been content with weekly income received from higher prices.[55]

[51] Govan H. (2017b). Sea cucumber fisheries and management in Melanesia: Review and policy briefs. Pacific Regional Oceanscape Programme.
[52] Govan H. (2017a). A review of sea cucumber fisheries and management in Melanesia. SPC Fisheries Newsletter # 154, September-December 2017. Secretariat of the Pacific Community, Noumea, New Caledonia.
[53] Purcell, S. W., B. I. Crona, W. Lalavanua and H. Eriksson (2017). Distribution of economic returns in small-scale fisheries for international markets: A value-chain analysis. Marine Policy 86 (2017) 9-16.
[54] This assumes that the end prices, transportation costs and other outgoings are consistent between countries, which may not be true.
[55] It also seems possible that higher prices would cause some fishers to fish more, or attract new participants into the fishery.

- Fishers often stated that it was not worth their effort to harvest certain species if the price was too low (e.g.<USD 5–10/kg) so traders were forced to offer a greater share of the end retail value for low-value species.
- The markup by exporters is higher for high-value species but the proportion of the end market value they receive is actually greater for low-value species. This apparent paradox is due to the massive difference in prices between low- and high-value species in stores in China.
- This also means that actors further along the supply chain receive a relatively lower proportion of the overall value of the product when trading those low-value species. This is one key reason why exporters preferred buying and exporting high-value species.
- Low-value sea cucumbers such as *H. atra* are sold in large quantities from PICTs but are not commonly seen in retail markets in Guangzhou or Hong Kong because they are used as ingredients in widely consumed foodstuffs.
- Prices to fishers and middlemen varied by location for the same species. Some middlemen had additional patron–client arrangements with exporters, such as partial salaries or provision of equipment, which were not captured in structured surveys of BDM prices.
- Prices in China can vary seasonally, especially owing to Chinese New Year, but fishers did not note any great seasonal variation in prices in PICTs.
- Making information on end prices available to fishers would allow them to negotiate better.

Data provided by Solomon Islands allows a direct species-specific comparison of prices actually paid to sea cucumber fishers for dried product, with the declared prices received by exporters, and these are shown in Table 15. Unfortunately similar comparisons cannot be made in the other PICTs under study due to differences in the way data is collected.

There are some clear anomalies in the data (such as the three species shaded in green, where first sale price was equal to or greater than the export price) which suggested that the table needs to be treated with caution. As stated previously, sources of error could include deliberate mis-reporting by buyers and exporters of the prices they paid (in order to comply with the reference list of buying prices) or received (in order to avoid export taxes or levies).

Overall the table indicates that, on average, fishers are receiving about 72% of the BDM export price. Based on some of the other research cited earlier, this seems excessive, but that figure is more or less consistent with Kinch et al. (2008)[56] who state that, a decade ago, sea cucumber fishers in Papua New Guinea generally received one-half to two-thirds of the export price for dried sea cucumbers. These authors did not indicate that fishers received a higher proportion of the end price for low-value species than for high-value ones, which is also consistent with the data in Table 15. Overall, however, it seems unlikely that fishers really are receiving 72% of the export price, since the export price is probably being understated, so the percentage received by fishers is undoubtedly a lot lower.

[56] Kinch, J., S. Purcell, S. Uthicke and K. Friedman (2008a). Papua New Guinea: a hotspot of sea cucumber fisheries in the Western Central Pacific. In Toral-Granda, V., A. Lovatelli and M. Vasconcellos (eds). Sea cucumbers. A global review of fisheries and trade. FAO Fisheries and Aquaculture Technical Paper. No. 516. Rome, FAO. pp. 57–77.

Table 15: Species-specific sea cucumber first-sale and export prices in Solomon Islands (average 2021–2022), USD/kg and retail prices in Hong Kong and Guangzhou)

Scientific name	English common name	Price (USD/kg) dry weight						
		Solomon Islands			Hong Kong		Guangzhou	
		First sale (A)	Export (B)	Ratio (A/B)	Retail (C)	Ratio (A/C)	Retail (D)	Ratio (A/D)
Actinopyga lecanora	Stonefish	40.44	60.23	67.1%	191	21.2%	88	46.0%
Actinopyga mauritiana	Surf redfish	30.45	45.34	67.2%	-		83	36.7%
Actinopyga miliaris	Blackfish	34.47	49.66	69.4%	-		-	
Actinopyga palauensis	Deepwater blackfish	29.23	-	-	167	17.5%	89	32.8%
Bohadschia argus	Tigerfish	18.27	28.00	65.3%	-		73	25.0%
Bohadschia similis	Chalkfish	36.54	55.76	65.5%	-		-	
Bohadschia vitiensis	Brown sandfish	15.35	22.80	67.3%	241	6.4%	63	24.4%
Holothuria atra	Lollyfish	6.82	10.02	68.1%	-		36	18.9%
Holothuria coluber	Snakefish	8.16	10.93	74.7%	-		43	19.0%
Holothuria edulis	Pinkfish	7.31	3.87	188.9%	-		-	
Holothuria flavomaculata	Red snakefish	7.31	11.15	65.6%	-		-	
Holothuria fuscogilva	White teatfish	48.72	74.86	65.1%	252	19.3%	178	27.4%
Holothuria fuscopunctata	Elephant trunkfish	8.53	1.86	458.6%	-		25	34.1%
Holothuria lessoni	Golden sandfish	24.36	38.93	62.6%	448	5.4%	-	
Holothuria scabra	Sandfish	63.34	92.93	68.2%	425	14.9%	176	36.0%
Holothuria whitmaei	Black teatfish	48.72	74.16	65.7%	240	20.3%	186	26.2%
Pearsonothuria graffei	Flower fish	4.26	6.00	71.0%	217	2.0%	-	
Stichopus chloronotus	Greenfish	36.54	18.65	195.9%	-		115	31.8%
Stichopus herrmanni	Curryfish	36.54	54.96	66.5%	404	9.0%	167	21.9%
Stichopus horrens	Peanut/Dragonfish	39.10	57.86	67.6%	-		137	28.5%
Stichopus vastus	Brown curryfish	24.36	37.17	65.5%	265	9.2%	-	
Thelenota ananas	Prickly redfish	36.54	52.34	69.8%	-		123	29.7%
Thelenota anax	Amberfish	10.35	13.65	75.8%	-	21.2%	36	28.8%
Average (unweighted)		**26.77**	**37.32**	**71.7%**	**285**	**9.4%**	**101**	**26.5%**

Table 15 also summarises average retail price information from Hong Kong and Guangzhou, shown in more detail in Table 13. This indicates that, on average, first sale price is slightly less than 10% of the retail price in Hong Kong, and slightly more than 25% of that in Guangzhou (because prices in Guangzhou are lower than in Hong Kong). This also illustrates one of the problems with relying on the percentage share of the retail BDM price as an indicator. A higher share of the price of a low-value species is not necessarily a better deal for the fisher than a smaller share of a high-value product. For example, 10% of a product worth $100 is a much better return than 50% of a product worth $10. The overall goal should be to increase the gains to fishers in absolute rather than relative terms.

6. Price-setting as a management tool

A key concern for fishery agencies and development partners in PICTs is the perception that fishers and their communities do not receive a fair share of the benefits from the BDM fishery. Several researchers have explored this topic:

- A study that covered New Caledonia, Kiribati (Gilbert Island group and Christmas Island), Fiji and Tonga (Purcell et al., 2016) [57] found that dissatisfaction with income among BDM fishers was common (44% of fishers).
- In Tonga, a small majority of fishers were generally happy with their income, with 47% saying that they were not satisfied with the levels that they earned from the sea cucumber fisheries (Purcell, 2013).[58]
- Kiribati is different to Fiji and Tonga, with 66% of fishers being unsatisfied with the income they were earning (Purcell, 2013).
- Conversely, Mangubhai et al. 2016 [59] stated that 75% of fishers in Fiji were "very satisfied" or "mostly satisfied" with the income that they earned from sea cucumber, and 24% were unhappy with their earnings.
- Léopold (2016) [60] found that fishers in Vanuatu were generally happy with prices and the industry.

This is a highly subjective topic, so is difficult to measure in an objective way – many people, fishers or not, would like to receive more money than they actually do – but the perception by fishers that the price they receive is 'fair' has a significant impact on the way the sea cucumber market functions, since satisfied fishers are less likely to negotiate prices with buyers than unsatisfied ones.

Only two of the PICTs studied here have attempted to establish benchmark or reference buying prices, although most try to monitor the prices at different points in the value chain as a condition of licence. However, most published reports on sea cucumber fishery management do not propose price controls as a management tool. For example, Kinch et al. (2008)[61] make 20 recommendations to improve management of the PNG sea cucumber fishery, but none of them concerns establishing a minimum price payable to fishers, or any other form of price-setting. Of the documents and papers reviewed for this study, only Govan (2017b)[62] seems to favour the concept of establishing minimum buying prices.

Observations during the present study suggest the following conclusions.

- In the two PICTs that have established benchmark minimum buying prices the information dates from 2015 and has not been updated in the interim. To be useful, this information needs to be updated regularly and promulgated widely.
- Both benchmarks are meant to be for information and guidance in negotiations between sellers and buyers, but there is little information on whether this really happens.

[57] Purcell, S.W., P. Ngaluafe, S. Foale, N. Cocks, B. Cullis and W. Lalavanua (2016). Multiple factors affect socioeconomics and wellbeing of artisanal sea cucumber fishers. PLoS ONE 11(12): e0165633. doi:10.1371/journal.pone.0165633

[58] Purcell, S. W. (2013). Increasing the value of sea cucumber harvests by improving postharvest processing of fishers. Working Paper 10, Eighth SPC Heads of Fisheries Meeting, 4-8 March 201. Secretariat of the Pacific Community, Noumea, New Caledonia.

[59] Mangubhai S., Y. Nand, R. Ram, M. Fox, M. Tabunakawai-Vakalalabure and T. Vodivodi (2016) Value chain analysis of the wild caught sea cucumber fishery in Fiji. Wildlife Conservation Society and Fiji Department of Fisheries. Report No. 02/16. Suva, Fiji.

[60] Léopold, M. (2016) Evaluating harvest and management strategies for sea cucumber fisheries in Vanuatu. IRD BICHLAMAR 4 Project No CS14-3007-101

[61] Kinch, J., S. Purcell, S. Uthicke and K. Friedman (2008a). Papua New Guinea: a hotspot of sea cucumber fisheries in the Western Central Pacific. In Toral-Granda, V., A. Lovatelli and M. Vasconcellos (eds). Sea cucumbers. A global review of fisheries and trade. FAO Fisheries and Aquaculture Technical Paper. No. 516. Rome, FAO. pp. 57–77.

[62] Govan, H. (2017b). Sea cucumber fisheries and management in Melanesia: Review and policy briefs. Pacific Regional Oceanscape Programme.

- If minimum buying prices were to become legally binding, it is hard to see how they could be enforced.

James (2018) states that the analysis in his discussion paper "does not appear to provide a rationale for across the board minimum pricing of sea cucumber". This is partly because retailers do not appear to be making excessive profits once adjustments are made to account for such things as taxes and cost of living differentials between different market centres, and partly because of concerns that setting a minimum price for fishers would result in higher prices to the end consumer, making PICT product less competitive.

However, he does note that "on average it appears that the price fishers are getting for their product does not cover their actual costs of production". These include costs that may not be considered by the fisher, such as the shadow price of labour (i.e. opportunity costs), depreciation, and similar intangible expenses. Excluding these expenses from operations causes the fisher to think that they are making a profit from their operations because on a daily basis they are getting more cash out of the operation than they appear to be putting in. Averaged over several countries (Fiji, Kiribati, Tonga and Vanuatu) the author concluded that fishers need to increase their sea cucumber prices by a factor of about 1.6 (by 60%) to break even, although this is likely to vary widely between countries.

James (2018) concludes that:

> the lack of transparency (about costs at various stages of the value chain) means that a top-down approach to setting minimum prices is extremely challenging as the final sale price is heavily dependent on quality and species. Therefore, it is extremely difficult to set a minimum wet price for primary producers by tracing the value chain from the retailer. However, this exercise is useful to understand how far producer prices could be raised without making the Pacific Islands' sea cucumber and BDM uncompetitive against other source areas.

He does, however, note:

> This paper also urges caution on the use of minimum prices and concludes that minimum prices may not be the most efficient or effective measure in addressing some of the key market failures in the sea cucumber value chain. There are also likely to be a number of impacts without supplementary activities and management measures such as shadow market creation and over exploitation as higher prices lead to increases in harvest rates.

The results of the present study generally support these conclusions. An additional consideration, not strongly emphasised by James (2018), is that of monitoring and enforcement. Minimum buying prices would be impossible to police in most cases, and therefore not useful as a management measure. The current practice of some PICTs to publish reference or benchmark prices is a more useful approach, but only if this information is regularly updated and promulgated, which is currently not the case.

7. Recommendations

In view of the information and discussion presented in previous sections, price-setting (meaning the establishment of legally binding minimum buying prices) for sea cucumbers or BDM is not recommended as an option, in Solomon Islands or anywhere else, because:

- the number of sea cucumber species harvested, product quality considerations, and the complexity of the BDM value chain makes it difficult to envisage how a regulated system of minimum prices payable to fishers would be determined; and
- even if such a scheme could be devised, effective enforcement would be difficult or impossible. Even straightforward rules such as BDM closed seasons, quotas or export bans provide major enforcement challenges for PICT fishery and other agencies. Monitoring BDM buyers to ensure they comply with minimum price requirements would be even more difficult.

James (2018) outlines some other negative impacts that might result from price-setting, including:

- increasing the price of PICT BDM to consumers, making it uncompetitive internationally;
- squeezing buyers and exporters, who may not be making very much of a margin in some cases; and
- increasing overexploitation of the sea cucumber resource.

These issues are worth keeping in mind but are probably less significant than the fundamental difficulties of devising and implementing a sea cucumber price-setting system.

Two PICTs already publish minimum reference prices as part of fishery legislation or fishery management plans. The main function of these reference prices is (a) to serve as a floor for licence applicants to consider their own proposed buying prices, which may be required as part of the licence approval process, and (b) to inform fishers and the general public about the buying prices they should expect for their product. However, the reference prices are not legally binding, there is no obligation for buyers or fishers to adhere to them, and the final prices are agreed between sellers and buyers according to normal free market principles. This is an appropriate arrangement that should be continued. However, it should be recognised that the reference prices in question are now nearly eight years old and are becoming increasingly irrelevant. If this information is to be promulgated by PICT fishery agencies, it needs to be regularly updated and disseminated. For the time being the data shown in Table 13 could be used as a basis for updating reference prices.

More useful, however, would be the establishment of a system under which information on Hong Kong market prices for BDM could be gathered systematically (at least monthly) and disseminated widely to all those involved in the industry, especially fishers but also exporters and middlemen. Insufficient information about current prices, and lack of transparency, are cited as the primary obstacles to improving benefits to fishers by just about every research document on prices and value chains reviewed during the course of the present assignment.

Ideal features of such an information system would include the following.

- An agent stationed in Hong Kong who would regularly sample import and retail prices for each of the major BDM species traded from PICTs, and submit this information to SPC or other appropriate regional organisation in an agreed format (monthly report or similar). The agent may be an individual appointed for this purpose, or a suitably qualified organisation (INFOFISH, University of Hong Kong,[63] Hong Kong Fisheries Department,[64] Hong Kong Statistics Office) engaged under contract.
- SPC promptly making this information available to national fishery agencies, if necessary with additional interpretation or adjustment relevant to the needs and circumstances of each country (for instance by tailoring the species information to match those present in each country).
- National fisheries agencies promulgating the information via appropriate communication channels in each country. This might involve publication in local newspapers, radio announcements, posting on social media, or mobile phone text messages, all of which are used to communicate prices of other agricultural products. SPC may wish to assist countries in these efforts by providing information directly to media outlets (traditional or social) if considered appropriate.
- Summary information being systematically included and updated in the 6-monthly SPC BDM Information Bulletin, providing a permanent and growing record of Hong Kong import volumes and values and revealing market trends over time.

Such a system would benefit fishers and other industry participants in all PICTs, not just Solomon Islands. Fishers would be better positioned to negotiate more equitable prices for their product, and even middlemen and exporters would be better informed about changing conditions in the market. Some researchers have speculated that improved prices for their product would enable fishers to harvest fewer sea cucumbers, but this has not been demonstrated. Many observers suspect it might have the opposite effect, encouraging existing fishers to harvest more, or attracting new entrants.

A BDM market information system would also benefit PICT fishery management and customs agencies by providing them with a benchmark against which to compare export declarations from their own countries. Having a realistic basis for price comparisons would make it harder for exporters to mis-declare the value of their product, improving the reliability of fisheries management information and increasing government revenues from the fishery.

Regional cooperation in BDM fishery management has been proposed for at least 15 years, but so far the mechanisms for achieving this have proven elusive. Establishment of a BDM market price information system would be a positive first step in promoting such cooperation. The system would be a suitable activity for SPC, fitting well with the current range of coastal fishery activities under way, and would probably be attractive to development partners (possibly including China) interested in supporting improved fisheries management in the region. As the second-most important export fishery (after tuna) in many PICTs and a critical source of livelihoods for rural communities, the BDM fishery's improved management would be a highly appropriate goal for both PICT fishery agencies and the region's development partners.

[63] HKU School of Biological Sciences, Swire Institute of Marine Science.
[64] Agriculture, Fisheries and Conservation Department, Government of Hong Kong Special Administrative Region.

8. References

Adams, T. (1993). Management of beche-de-mer (sea cucumber) fisheries. Beche-de-Mer Information Bulletin #5. South Pacific Commission, Noumea, New Caledonia.

Andrefouet, S., A Tagliaferro, L. Chanran-Poete, J. Campanozzi-Tarahu, F. Tertre, G. Haumani and A. Stein (2019). An assessment of commercial sea cucumber populations in French Polynesia just after the 2012 moratorium. Beche-de-mer Information Bulletin # 39. Pacific Community, Noumea, New Caledonia.

Anon. (1979) Beche-de-mer of the Tropical Pacific: A handbook for fishermen. Handbook No 18, South Pacific Commission, Noumea, New Caledonia.

CITES Secretariat (2020). CoP18 listing of valuable Teatfish and Cedrela species in CITES Appendix II enters into force. https://cites.org/eng/teatfish_cedrela_listing_AppendixII_CITES_28082020

Conand, C. (1979). Beche-de-mer in New Caledonia: weight loss and shrinkage during processing in three species of holothurians. SPC Fisheries Newsletter N0 19, pp 14-17. South Pacific Commission, Noumea, New Caledonia.

Di Simone, M., A. Horellou and C. Conand (2023). The listing of three new holothurian species in CITES Appendix II. SPC Beche-de-Mer Information Bulletin #43, April 2023. Secretariat of the Pacific Community, Noumea, New Caledonia

DRM (2022). Direction des Ressources Marines (2022). Bulletin Statistique: Edition 2021.

Fabry L. and J-F. Laplante. (2022). Bilan statistique annuel de la pêche côtière professionnelle de Nouvelle-Calédonie, Année 2020. Observatoire des pêches côtières de Nouvelle-Calédonie, Adecal Technopole, Nouméa, Nouvelle-Calédonie.

Friedman, K., P. Lokani, P. Fale, S. Mailau, P. Ramohia and C. Ramofafia (2004). Survey of sea cucumber resources of Ha'apai, Tonga. Secretariat of the Pacific Community, Noumea, New Caledonia.

Gillett, R. and M. Fong (in press). Fisheries in the Economies of Pacific Island Countries and Territories (Benefish 4). Secretariat of the Pacific Community, Noumea, New Caledonia.

Gisawa, L. (2023). Papua New Guinea Coastal Fisheries Information. Informal notes.

Govan, H. (2017a). A review of sea cucumber fisheries and management in Melanesia. SPC Fisheries Newsletter # 154, September-December 2017. Secretariat of the Pacific Community, Noumea, New Caledonia.

Govan, H. (2017b). Sea cucumber fisheries and management in Melanesia: Review and policy briefs. Pacific Regional Oceanscape Programme.

Govan, H. (2018) A preliminary assessment of the evolution of price/kg of beche-de-mer exports since 2013 in Solomon Islands. SPC report, December 2018.

Govan, H. (2019). 2018 Market price update for beche-de-mer in Melanesian countries. SPC Fisheries Newsletter #158 January-April 2019. Secretariat of the Pacific Community, Noumea, New Caledonia.

Govan, H. and I. Bertram (2020). Update of beche-de-mer exports in the Pacific Islands to 2019. Informal spreadsheet managed by the Secretariat of the Pacific Community, Noumea, New Caledonia

James, P. (2018). Pacific Sea cucumber fishery: Options for intervention. Unpublished draft report. Secretariat of the Pacific Community, Noumea, New Caledonia.

Jupiter S. D., W. Saladrau and R. Vave (2013) Assessment of sea cucumber fisheries through targeted surveys of Lau Province, Fiji. Wildlife Conservation Society/University of the South Pacific/Fiji Department of Fisheries/Khaled bin Sultan Living Oceans Foundation, Suva, Fiji.

Kinch, J. (2004). The status of commercial invertebrates and other marine resources in Santa Isabel Province, Solomon Islands. United Nations Development Programme, Suva, Fiji; and Isabel Province Development Programme, Buala, Solomon Islands.

Kinch, J., S. Purcell, S. Uthicke and K. Friedman (2008a). Papua New Guinea: a hotspot of sea cucumber fisheries in the Western Central Pacific. In Toral-Granda, V., A. Lovatelli and M. Vasconcellos (eds). Sea cucumbers. A global review of fisheries and trade. FAO Fisheries and Aquaculture Technical Paper. No. 516. Rome, FAO pp. 57-77.

Kinch J., S. Purcell, S. Uthicke and K. Friedman (2008b). Population status, fisheries and trade of sea cucumbers in the Western Central Pacific. In: Toral-Granda V., A. Lovatelli and M. Vasconcellos (eds). Sea cucumbers. A global review of fisheries and trade. Technical Paper. No. 516, Food and Agriculture Organization of the United Nations, Rome, Italy.

Kriz, A. (1994). Marketing of South Pacific seafood: A case study of sea cucumber. Pacific Islands Forum Fisheries Agency, Honiara, Solomon Island.

Lee, S., H. Govan, I. Bertram and J. Kinch (2020). A comparison of sea cucumber fishery management plans, and implications for governance in Pacific Island countries. SPC Fisheries Newsletter # 161, January-April 2020. Secretariat of the Pacific Community, Noumea, New Caledonia.

Léopold, M. (2016). Evaluating the harvest and management strategies for the sea cucumber fisheries in Vanuatu. Projects No 4860A1 (BICH2MER) and No CS14-3007-101 (BICHLAMAR). IRD, Nouméa.

Lindsay, S., R. Lindley, M. Lam and H. Lassauce (2022). Assessment of the aquaculture needs, priorities and future direction in the Pacific Islands region. Report by Integrated Aquatic Solutions for the Secretariat of the Pacific Community, Noumea, New Caledonia.

Lis, R. (2023). Information brief on sea cucumber fishery (beche-de-mer) in Papua New Guinea. National Fisheries Authority, Port Moresby, Papua New Guinea.

Lokani, P., S. V. Matoto and E. Ledua (1996). Survey of sea cucumber resources at Ha'apai, Tonga, May/June 1996. South Pacific Commission, Noumea, New Caledonia.

Mangubhai, S., Y. Nand, R. Ram, M. Fox, M. Tabunakawai-Vakalalabure and T. Vodivodi (2016) Value chain analysis of the wild caught sea cucumber fishery in Fiji. Wildlife Conservation Society and Fiji Department of Fisheries. Report No. 02/16. Suva, Fiji.

MFMR (undated). Solomon Islands National Sea Cucumber Fishery Policy, 2021-2031. Ministry of Fisheries and Marine Resources, Honiara, Solomon Islands.

MFMR (2021a). 2021/2022 Beche-de-Mer Minimum Benchmark Local Buying Price and 2021/2022 Beche-de-Mer Minimum Benchmark Export Price. Ministry of Fisheries and Marine Resources, Honiara, Solomon Islands.

MFMR (2021b). Beche-de-mer minimum harvest sizes (Wet Length) and minimum purchase and export sizes (Dry Length). (Media Release). https://solomons.gov.sb/beche-de-mer-minimum-harvest-sizes-wet-length-and-minimum-purchase-and-export-sizes-dry-length/

MFMRD (2011). Sea Cucumber Regulations 201X. First draft 151211. Government of Kiribati, Tarawa, Kiribati.

Ministry of Fisheries (2020). Sea Cucumber. PowerPoint presentation. Government of Tonga, Nuku'alofa, Tonga.

Ministry of Fisheries (2021). Annual Report 2020-2021. Government of Tonga, Nuku'alofa, Tonga.

Ministry of Fisheries (2022). Annual Report 2021-2022. Government of Tonga, Nuku'alofa, Tonga.

Ministry of Fisheries, undated. Tonga National Sea Cucumber Fishery Management and Development Plan. Government of Tonga.

MOF (2021a). Declaration of the Sea Cucumber Fishery as a Designated Fishery And Regulations & Sea Cucumber Fishery Management Plan. Ministry of Fisheries, Suva, Fiji

MOF (2021b). Annual Report for the period 1 August 2021 to 31 July 2022. Ministry of Fisheries, Suva, Fiji.

MOFF (2015). Draft Fiji Sea Cucumber Management Plan 2015. Ministry of Fisheries and Forests, Suva, Fiji.

NFA (2017). A roadmap for coastal fisheries and marine aquaculture for Papua New Guinea: 2017-2026. National Fisheries Authority, Port Moresby, Papua New Guinea.

NFA (2021). Papua New Guinea Fisheries Strategic Plan 2021-2030. National Fisheries Authority, Port Moresby, Papua New Guinea.

NFA (2022). Fisheries Sector Executive Overview. National Fisheries Authority, Port Moresby, Papua New Guinea.

Pakoa, K. and I. Bertram (2013). Management state of Pacific sea cucumber fisheries. SPC Beche-de-mer Information Bulletin #33, May 2013. Secretariat of the Pacific Community, Noumea, New Caledonia.

Pakoa, K, W. Saladrau, W. Lalavanua, D. Valotu, I Tuinasavusavu, M. Sharp and I. Bertram (2013a). The status of sea cucumber resources and fisheries management in Fiji. Secretariat of the Pacific Community, Noumea, New Caledonia.

Pakoa, K. M., P. V. Ngaluafe, T. Lotoahea, S. V. Matoto and I. Bertram (2013b). The status of Tonga's sea cucumber fishery, including an update on Vava'u and Tongatapu. Secretariat of the Pacific Community, Noumea, New Caledonia.

Pakoa, K., R. Malu, J. Teri, J. Leqata, P. Tua, D. Fisk and I. Bertram (2014a). Solomon Islands sea cucumber resource status and recommendations for management. Secretariat of the Pacific Community, Noumea, New Caledonia.

Pakoa, K., J. Raubani, F. Siaosi, G. Amos and J. Ham (2014b). The status of sea cucumber fisheries and resources in Vanuatu, November 2013. Secretariat of the Pacific Community, Noumea, New Caledonia.

PNG National Fisheries Authority (2003). National Beche-de-mer Fishery Management Plan.

Pohiva, S. (2021). Sea cucumber brief summary report as of April–September 2021. Ministry of Fisheries, Nuku'alofa, Tonga.

Preston, G. L. (1990a). Beche-de-mer recovery rates. SPC Beche-de-mer Information Bulletin No. 1, p. 7. South Pacific Commission, Noumea, New Caledonia.

Preston, G. L. (1990b). Mass beche-de-mer production in Fiji. Beche-de-mer Information Bulletin #1, January 1990. Secretariat of the Pacific Community, Noumea, New Caledonia

Preston, G.L. (1993). Beche-De-Mer. In: Nearshore Marine Resources of the South Pacific: Information for Fisheries Development and Management. Wright, A. and L. Hill (Eds.). Forum Fisheries Agency, Honiara, Solomon Islands, pp. 371-401.

Preston, G. L. (2012). A Fisheries Engagement Strategy for the Pacific Islands Region. World Bank Regional Office for Papua New Guinea, East Timor and the Pacific Islands, Sydney, Australia.

Preston, G., P. Lokani, V. Vakamoce, and F. Viala. (1988) Beche-de-mer Exploitation in Fiji. Report to Chief Fisheries Officer, 9 December 1988. South Pacific Commission, Noumea, New Caledonia.

Purcell, S. W. (2013). Increasing the value of sea cucumber harvests by improving postharvest processing of fishers. Working Paper 10, Eighth SPC Heads of Fisheries Meeting, 4-8 March 201. Secretariat of the Pacific Community, Noumea, New Caledonia.

Purcell, S.W. (2014a). Processing sea cucumbers into beche-de-mer: A manual for Pacific Island fishers. Southern Cross University, Lismore, Australia, and Secretariat of the Pacific Community, Noumea, New Caledonia.

Purcell, S. W. (2014b). Value, market preferences and trade of beche-de-mer from Pacific Island sea cucumbers. PLoS ONE 9(4): e95075. doi:10.1371/journal. pone.0095075

Purcell, S.W. (2016). Update on beche-de-mer market prices in China. SPC Fisheries Newsletter #150 May-August 2016. Secretariat of the Pacific Community, Noumea, New Caledonia.

Purcell, S.W., B. I. Crona, W. Lalavanua and H. Eriksson (2017). Distribution of economic returns in small-scale fisheries for international markets: A value-chain analysis. Marine Policy 86 (2017) 9-16.

Purcell, S.W., P. Ngaluafe, S. Foale, N. Cocks, B. Cullis and W. Lalavanua (2016). Multiple factors affect socioeconomics and wellbeing of artisanal sea cucumber fishers. PLoS ONE 11(12): e0165633. doi:10.1371/journal.pone.0165633

Purcell, S., D. H. Williamson and P. Ngaluafe (2018). Chinese market prices of beche-de-mer: Implications for fisheries and aquaculture. Marine Policy 91 (2018) 58-65.

Purcell, S.W., A. Lovatelli, M. González-Wangüemert, F. A. Solís-Marín, Y. Samyn, and C. Conand, (2023). Commercially important sea cucumbers of the world – Second edition. FAO Species Catalogue for Fishery Purposes No. 6, Rev. 1. Food and Agriculture Organization, Rome, Italy.

Ram, R., R. V. Chand and P. C. Southgate (2016). An overview of sea cucumber fishery management in the Fiji Islands. Journal of Fisheries and Aquatic Sciences 11: 191-205.

Ramofafia C. (2004). The sea cucumber fisheries in Solomon Islands: Benefits and importance to coastal communities. Australian Centre for International Agricultural Research. Sydney, NSW, Australia

Rivaton, J., P. Chavance, L. Fabry, J-F. Laplante and A. Lataste (2022). Rapport d'activité 2021. Observatoire des pêches côtières Nouvelle-Calédonie.

Shedrawi, G., P. Bosserelle, S. Malimali, V. Fatongiatau, S. Mailau, F. Magron, T. Havea, S. Finau, S. Finau, P. Aleamotua and A. Halford (2020). The status of sea cucumber stocks in the Kingdom of Tonga. Secretariat of the Pacific Community, Noumea, New Caledonia

Solomon Islands Government (2009). Fisheries (Amendment) Regulations 2009. Legal Notice No 33, Solomon Islands Gazette No 16, Honiara, Solomon Islands.

Solomon Islands Government (2014). Fisheries (Beche-De-Mer) (Amendment) Regulations 2014. Legal Notice No. 112, Solomon Islands Gazette No 125 and Supplement No 79.

Solomon Islands Government (2019). Prohibited Activities (Fishing Or Possession Or Export Of Beche-De-Mer) Order 2019. Notice 745, Solomon Islands Gazette No 76.

Solomon Islands Government (2021). Prohibited Activities (Fishing and Possession of Beche-De-Mer) Order 2021. Supplement No 168 to the Solomon Islands Gazette.

Teemari, T., C. Muron and A. D'Andrea (2020). Kiribati takes a major governance step towards sustainable coastal fisheries. SPC Fisheries Newsletter #161, January – April 2020. Secretariat of the Pacific Community.

VFD (2015). Vanuatu National Sea Cucumber Fishery Management Plan 2015. Vanuatu Fisheries Department, Port Vila, Vanuatu.

VFD (2019). Vanuatu National Sea Cucumber Fishery Management Plan 2019-2024. Vanuatu Fisheries Department, Port Vila, Vanuatu/Secretariat of the Pacific Community, Noumea, New Caledonia.

VFD (2021). Catch Production and Market Data Report 2020. Vanuatu Fisheries Department, Port Vila, Vanuatu.

VFD (2022). Catch Production and Market Data Report 2021. Vanuatu Fisheries Department, Port Vila, Vanuatu.

VFD (2023). Catch Production and Market Data Report 2022. Vanuatu Fisheries Department, Port Vila, Vanuatu.

Ward, R.G. (1972). The Pacific beche-de-mer trade, with special reference to Fiji. In Man in the Pacific Islands: Essays on geographical changes in Pacific, (R.G. Ward, ed.), pp. 91-123. Oxford University Press, 337 pp.

Appendix 1: Country and territory information

FIJI

Sea cucumber fishing in Fiji can be dated back to 1813, and early records show approximately 600 t were exported from 1827 to 1835. In 1834, however, the sea cucumber populations were considered depleted on reefs of the western, central and northern Vanua Levu and southeast Viti Levu (Ward, 1972)[65].

The industry subsequently remained quiet for over a century before a moderate increase in production took place in the late 1970s and early 1980s. In the mid-1980s exports grew rapidly due to resurgence in demand from the Asian (particularly Chinese) market and high BDM prices (Preston, 1990)[66]. By 1988 production had increased to 717 t (and possibly more, because a considerable amount of product appeared to go through Customs classified as 'miscellaneous molluscs') before it declined to 149 t by 1993 (Pakoa et al., 2013)[67]. At the height of the trade a total of 13 species were important: the high-value hairy blackfish, white teatfish, black teatfish, sandfish and golden sandfish; and the low value tigerfish, brown sandfish, pinkfish, elephant trunkfish, flowerfish, greenfish, amberfish and prickly redfish (Preston et al., 1988)[68]. Small quantities of sea cucumber were imported to Fiji from neighbouring Pacific Island countries (e.g., Tuvalu, Kiribati, Wallis and Futuna) and re-exported from Fiji[69].

A second boom in production followed in 1996–1997, when production peaked at 862 t, as shown in Figure FJ1.

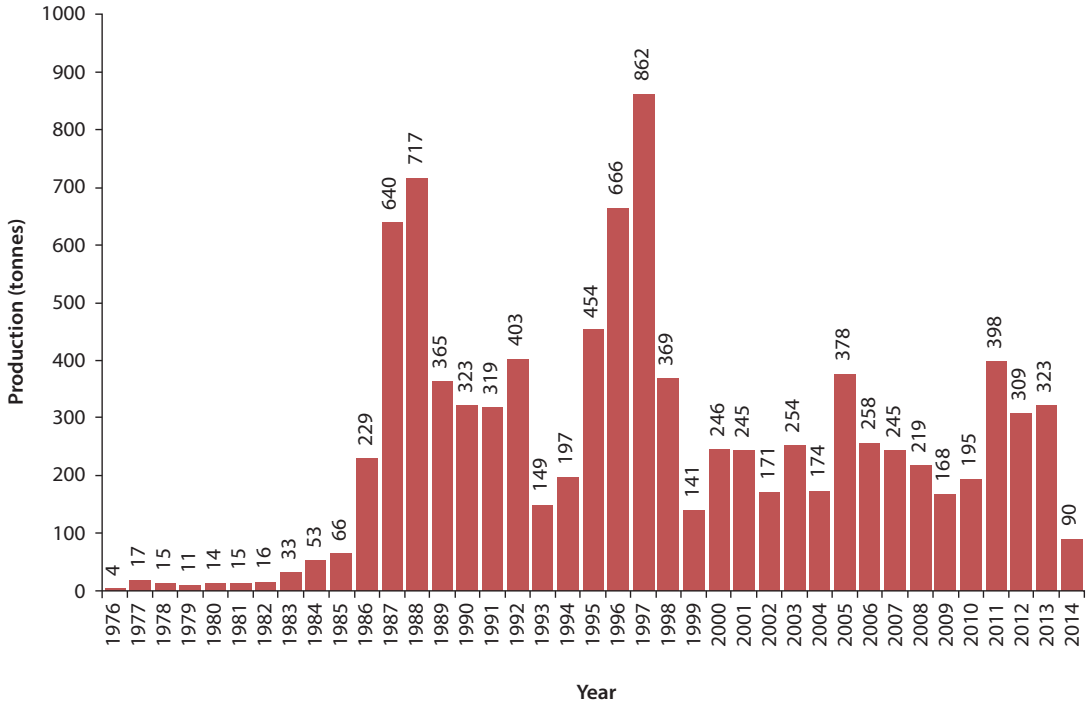

Figure FJ1: Fiji beche-de-mer exports (tonnes), 1976–2014[70]

[65] Ward, R.G. (1972). The Pacific beche-de-mer trade, with special reference to Fiji. In Man in the Pacific Islands: Essays on geographical changes in Pacific, (R.G. Ward, ed.), pp. 91-123. Oxford University Press, 337 pp.

[66] Preston, G. (1990b). Mass beche-de-mer production in Fiji. Beche-de-mer Information Bulletin #1, January 1990. Secretariat of the Pacific Community, Noumea, New Caledonia

[67] Pakoa, K., W. Saladrau, W. Lalavanua, D. Valotu, I. Tuinasavusavu, M. Sharp and I. Bertram (2013a). The status of sea cucumber resources and fisheries management in Fiji. Secretariat of the Pacific Community, Noumea, New Caledonia.

[68] Preston, G., P. Lokani, V. Vakamoce, and F. Viala. (1988) Beche-de-mer Exploitation in Fiji. Report to Chief Fisheries Officer, 9 December 1988. South Pacific Commission, Noumea, New Caledonia.

[69] Kinch, J., S. Purcell, S. Uthicke and K. Friedman. (2008b). Population status, fisheries and trade of sea cucumbers in the Western Central Pacific. In Toral-Granda, V., A. Lovatelli and M. Vasconcello. (eds). Sea cucumbers. A global review of fisheries and trade. Fisheries and Aquaculture Technical Paper No. 516. FAO, Rome, Italy.

[70] MOFF (2015). Draft Fiji Sea Cucumber Management Plan 2015. Ministry of Fisheries and Forests, Suva, Fiji.

Production fell between the 1987/88 and 1996 /97 booms, possibly due to the impact of the Fiji Beche-de-mer Exporters Association's initiative to control the number of exporters during its short existence. After 1998, production again fell to an annual average volume of 243 t and hovered around this mean for more than a decade. During that period exports of nine out of the twenty or so commercial species declined, and production of four species – pinkfish, stonefish, dragonfish and flowerfish – became so low as to question the viability of these species. A major reef survey carried out in 1988 confirmed the depauperate state of many sea cucumber species, and recommended better management of the resource through seasonal fishery closures, the establishment of catch quotas for individual fishers, and other measures (Adams, 1993)[71]. Sandfish, a species which is traditionally eaten in Fiji, was subsequently prohibited as an export in 1989, but continued to appear in export data in 2003 and 2004, indicating the species was still being harvested.[72]

Ram et al. (2016)[73] provide data on sea cucumber species being harvested in Fiji, as shown in Table FJ1.

Table FJ1: Sea cucumber species harvested in Fiji.

Scientific name	Common name	Fijian name	Value group
Actinopyga echinites	Deepwater redfish	Tarasea	High
Actinopyga lecanora	Stonefish	Dritabua, Drivatu	Medium
Actinopyga mauritiana	Surf redfish	Tarasea	High
Actinopyga miliaris	Blackfish	Dri, Driloa	Medium
Actinopyga palauensis	Deepwater blackfish	Dri ni cakau	Medium
Bohadschia argus	Tigerfish	Tiger, Vula ni cakau, Vula wadrawadra	Medium
Bohadschia marmorata	Chalkfish	Mundra	Medium
Bohadschia ocellatus	Deepwater tigerfish	Tiger, Vula ni cakau, Vula	Medium
Bohadschia vitiensis	Brown sandfish	Vula	Medium
Holothuria atra	Lollyfish	Loliloli	Low
Holothuria coluber	Snakefish	Yarabale, Ika lo	Medium
Holothuria coronopertusa	Loli's mother	Tina ni loli	Low
Holothuria edulis	Pinkfish	Loli piqi	Medium
Holothuria leucospilota	White snakefish	Unknown	Unknown
Holothuria fuscogilva	White teatfish	Sucuwalu	Very high
Holothuria fuscopunctata	Elephant trunkfish	Tinani dairo, dairo ni toba	Low
Holothuria impatiens	Slender sea cucumber	Unknown	Unknown
Holothuria lessoni	Golden sandfish	Dairo kula	Very high
Holothuria scabra	Sandfish	Dairo	Very high
Holothuria whitmaei	Black teatfish	Loaloa	High
Pearsonothuria graffei	Flower fish	Senikau	Medium
Stichopus chloronotus	Greenfish	Barasi	High
Stichopus herrmanni	Curryfish	Kari, Lakolako ni qio	Medium
Stichopus horrens	Dragonfish	Katapila	Medium
Stichopus vastus	Brown curryfish	Laulevu	Low
Thelenota ananas	Prickly redfish	Sucudrau	High
Thelenota anax	Amberfish	Basi	Medium

[71] Adams, T. (1993). Management of beche-de-mer (sea cucumber) fisheries. Beche-de-Mer Information Bulletin No 5, August 1993. South Pacific Commission, Noumea, New Caledonia.

[72] Pakoa et al. (2013a). The status of sea cucumber resources and fisheries management in Fiji. Secretariat of the Pacific Community, Noumea, New Caledonia.

[73] Ram, R., R. V. Chand and P. C. Southgate (2016). An overview of sea cucumber fishery management in the Fiji Islands. Journal of Fisheries and Aquatic Sciences 11: 191-205.

In 2012 the Fiji Fisheries Department began development of a national sea cucumber management plan. As part of this process SPC carried out sea cucumber surveys in nine separate locations in Fiji between August 2012 and June 2013.[74] A further 10 assessments were undertaken in the Lau islands by the Wildlife Conservation Society (Jupiter et al., 2013[75]). Collectively these surveys found that many sea cucumber species had been fished down to low levels, and that golden sandfish (*H. lessoni*) may have become extinct. Both groups of scientists recommended a moratorium of 5–10 years to allow resource recovery, and then only short fishery open seasons in the future. Other recommended measures included: prohibition of the use of underwater breathing apparatus; formulation of size limits; better licensing arrangements; a limit on the number of exporters; and efforts to improve the prices paid to fishers, which were said to be below those of other PICTs.

A draft Fiji National Sea Cucumber Management Plan was subsequently formulated that adopted many of these recommendations (Ministry of Fisheries and Forests, 2015[76]). A sea cucumber exporter licence scheme was developed which, among other things, required applicants to submit a list of prices to be offered to local fishers, and information on prices received for each export shipment. Approval of licence applications was to be based on an evaluation system that awarded points for compliance with each requirement, with additional points awarded to those applicants whose prices offered to local fishers were considered 'favourable'. The Plan also provided for the establishment of species-specific total allowable exports (TAEx) associated with each export licence, as well as prohibitions on fishing gears.

The Fiji sea cucumber fishery was subsequently closed in mid-2017, and remained closed for 5 years until July 2022, when it was reopened for a short period only. Harvesting was permitted from July 1 to August 31, and exporting from July 1 until October 31 (which was subsequently extended to 31 January 2023). Once the fishery opened, 734 BDM harvesting licenses and nine exporting licences were issued, mostly in the Eastern Division.[77] The amount of BDM exported is not known, but the fishery was said to have resulted in payments of over FJD 8 million to rural sea cucumber harvesters, not counting any export earnings (Fiji Sun, July 2022)[78]. Reopening of the sea cucumber fishery is said to have had a major impact on coastal fisheries. Many commercial fishers switched from fishing to BDM diving, and pressure on coastal finfish declined considerably as a result.[79]

The National Sea Cucumber Fishery Regulations and Management Plan[80] were finalised in 2021 (Ministry of Fisheries, 2021[81]), but have not yet been gazetted.[82] The Plan states that "the sea cucumber resource is considered to be currently overfished" and establishes several measure to improve management of the fishery, including:

- provision for indefinite fishery closures, with limited open seasons;
- implementation of local sea cucumber fishery management arrangements, including no-fishing areas and local open or closed seasons;
- establishment of total allowable catch, total allowable effort, and total allowable export limits and quotas;
- limits on the amount of sea cucumber that may be held in the possession of any person or group of persons at any location;

[74] Pakoa et al. (2013a). The status of sea cucumber resources and fisheries management in Fiji. Secretariat of the Pacific Community, Noumea, New Caledonia.
[75] Jupiter S.D., W. Saladrau and R. Vave (2013) Assessment of sea cucumber fisheries through targeted surveys of Lau Province, Fiji. Wildlife Conservation Society/ University of the South Pacific/Fiji Department of Fisheries/Khaled bin Sultan Living Oceans Foundation, Suva, Fiji.
[76] MOFF (2015). Draft Fiji Sea Cucumber Management Plan 2015. Ministry of Fisheries and Forests, Suva, Fiji.
[77] R. Gillett, pers. comm.
[78] Fiji Sun, 11 September 2022. Beche-de-mer generates $8 million in two months. Suva, Fiji.
[79] R. Gillett, pers. comm.
[80] MOF (2021a). Declaration of the Sea Cucumber Fishery as a Designated Fishery And Regulations & Sea Cucumber Fishery Management Plan. Ministry of Fisheries, Suva, Fiji
[81] MOF (2021b). Annual Report for the period 1 August 2021 to 31 July 2022. Ministry of Fisheries, Suva, Fiji.
[82] R. Veeran, SPC, pers. comm.

- comprehensive reporting requirements and monitoring arrangements at all stages of the industry; and
- creation of a Sea Cucumber Fisheries Advisory Committee to review the implementation and performance of the Plan and, if necessary, recommend amendments.

Among other features, the Regulation provides for the Permanent Secretary to set minimum prices for sea cucumber, to be published in the national gazette, and makes it an offence for any person to "purchase any sea cucumber from a sea cucumber collector for less than the minimum price where minimum prices have been established by notice in the gazette". It is understood that, since the Regulation has not yet been gazetted, no minimum prices have been determined so far.

FRENCH POLYNESIA

Sea cucumber harvesting in French Polynesia began in 2008 and grew quickly to record levels in 2011 and 2012. As a response to these increases the fishery was closed in November 2012 so that regulations could be introduced to improve the sustainability of the fishery and traceability of its products. Regulations included: limiting harvesting to hand-collection; prohibition of commercial harvesting; establishment of quotas (by number of pieces) and size limits for the main species; prohibition of harvesting at night; creation of no-take areas; and licensing of BDM traders (Andrefouet et al., 2019)[83]. In areas where harvesting was authorised, local management committees were established to ensure compliance with the regulations by fishers and traders. The fishery was reopened in selected locations in 2014, at which time fishery monitoring and product tracking was improved through the establishment, with SPC support, of an online database accessible to all parties concerned.

Table FP1 shows data presented by the Direction des ressources marines (DRM)[84] on numbers and dry weight of French Polynesian BDM production between 2014 and 2021.

Table FP1: French Polynesia BDM production 2014–2021 (Direction des ressources marines)

Year	*Thelenota ananas*		*Actinopyga mauritiana*		*Holothuria fuscogilva*		*Holothuria whitmaei*		*Bohadschia argus*		Total	
	No.	kg	No.	kg	No.	kg	No.	kg	No.	kg	No.	kg
2014	289	74	3,110	364	5,263	2,402	310	143	7,890	1,560	16,862	4,543
2015	84	31	4,804	484	8,114	4,310	745	458	4,511	807	18,258	6,090
2016	478	130	3,363	329	12,187	5,733	1,547	795	11,368	2,053	28,943	9,040
2017	161	53	2,355	244	6,643	3,455	451	218	9,714	1,880	19,324	5,849
2018	54	21	861	88	3,384	1,656	152	78	2,751	444	7,207	2,287
2019	76	27	2.538	271	3,742	1,821	496	237	4,519	810	11,371	3,166
2020	0	0	126	13	0	0	0	0	202	46	328	59
2021	0	0	2,449	286	0	0	0	0	978	143	3,427	429

BDM production in French Polynesia declined substantially after 2019, at which time *H. fuscogilva* and *H. whitmaei* were included in Annex 2 of the CITES Convention. Since that time exports have been suspended until such time as French Polynesia can demonstrate that commerce in these two species can resume without damaging the stocks, which has still not been done. Further disruptions to the BDM trade occurred as a result of the COVID-19 pandemic, which interfered with normal inter-island shipping routines and, in particular, the supply of salt, which is essential for BDM processing.[85]

The value of BDM exports from French Polynesia was estimated to be over XPF 100 million in 2011 and again in 2012 (Bob Gillett, pers. comm). Table FP2 shows volumes and values of BDM exports since 2017, extracted from a spreadsheet provided by DRM staff member Ms. Magali Verducci (magali.verducci@drm.gov.pf).

[83] Andrefouet, S., A Tagliaferro, L. Chanran-Poete, J. Campanozzi-Tarahu, F. Tertre, G. Haumani and A. Stein (2019). An assessment of commercial sea cucumber populations in French Polynesia just after the 2012 moratorium. Beche-de-mer Information Bulletin # 39, March 2018. Secretariat of the Pacific Community, Noumea, New Caledonia.

[84] DRM (2022). Direction des Ressources Marines (2022). Bulletin Statistique: Edition 2021.

[85] DRM (2022). Direction des Ressources Marines (2022). Bulletin Statistique: Edition 2021.

Table FP2: French Polynesia BDM exports 2014–2021 (Direction des ressources marines)

Year	Export weight (kg)	Export value (XPF)	Value (XPF per kg)
2017	5,002	40,768,193	8,150
2018	1,845	17,163,843	9,303
2019	3087	25,183,232	8,158
2020	113	188,003	1,664
2021	0	0	-
2022	0	5,000	-

This data allows the average BDM export value to be calculated, as shown in the third column. Note that export quantities do not tally exactly with the production weights, since some BDM produced in one year may not have been exported until the next.

The sea cucumber fishery in 2021 was restricted to only two islands, which produced a total of just 429 kg of BDM. However, it was not commercially feasible to ship such a small quantity, so none was exported (DRM, 2022)[86].

Some small-scale experimental farming of sea cucumbers has been trialled in French Polynesia but has not progressed to a commercial activity.

[86] DRM (2022). Direction des Ressources Marines (2022). Bulletin Statistique: Edition 2021.

KIRIBATI

The Kiribati Ministry of Fisheries and Marine Resource Development (MFMRD) advised that the sea cucumber fishery in Kiribati be completely closed in 2013. This was due to "precautionary measures" and the fishery has yet to re-open.[87] Officially, therefore, there has been no sea cucumber harvesting or BDM exports from Kiribati for the last 10 years.

Prior to the closing of the fishery, MFMRD developed a draft Sea Cucumber regulation,[88] but this has still not been approved. The draft lays out the processes for issuance of sea cucumber trading (meaning buying, selling, storing and exporting sea cucumbers, but not fishing or processing); provides for restrictions on sea cucumber fishing methods, areas and seasons, as well as on the species that may be harvested; and provides records of sea cucumber buying prices, stock holdings, and prices received for export product. The Regulation does not specify minimum buying prices.

Although the Regulation has not yet been gazetted it is understood that this is planned before the fishery is reopened. It is also expected that the Regulation will undergo a detailed review and possible updating prior to gazettal.[89] Ensuring the sustainable governance and use of the sea cucumber fishery is part of a broader strategy being implemented by MFMRD to conserve and manage coastal fishery resources more broadly, which took major steps forward with the implementation in 2013 of the National Fisheries Policy 2013–2025, followed by the Fisheries (Conservation and Management of Coastal Marine Resources) Regulations in 2019.[90]

Experimental aquaculture of *H. scabra* has been undertaken by MFMRD for at least 15 years, with the aims both to restock natural populations and to support commercial sea cucumber farming. According to Lindsay et al. (2022) sea cucumber is one of the aquaculture species cultivated for food security and community-based production. These authors state:

> Sea cucumber for restocking and also community farmers. Done in the hatchery but some problems so no real progress on the ground so far, though the hatchery process is now known – small scale pilot projects.[91]

One private company is rearing juvenile *H. scabra* for the aquarium trade. One trial shipment to Florida, USA, has so far taken place via the importing company's facility in Majuro, Marshall Islands. Further shipments are anticipated in the future but are currently on hold pending regulatory approval from Marshall Islands.[92]

[87] Tooreka Temari, Director, MFMRD Coastal Fisheries Division, pers. comm.
[88] MFMRD (2011). Sea Cucumber Regulations 201X. First draft 151211. Government of Kiribati, Tarawa, Kiribati.
[89] Ariella d'Andrea, SPC Fisheries Legal Advisor, pers. comm.
[90] Teemari, T., C. Muron and A. D'Andrea (2020). Kiribati takes a major governance step towards sustainable coastal fisheries. SPC Fisheries Newsletter #161, January – April 2020. Secretariat of the Pacific Community.
[91] Lindsay, S., R. Lindley, M. Lam and H. Lassauce (2022). Assessment of the aquaculture needs, priorities and future direction in the Pacific Islands region. Report by Integrated Aquatic Solutions for the Secretariat of the Pacific Community, Noumea, New Caledonia.
[92] Mike Savins, Director, Atoll Beauties Inc. pers. comm. [93] MFMRD (2011). Sea Cucumber Regulations 201X. First draft 151211. Government of Kiribati, Tarawa, Kiribati.

NEW CALEDONIA

Several organisations are involved in documenting information on sea cucumber fisheries in New Caledonia, including the three Provincial Fisheries agencies (South, North and Islands), the Coral Sea Natural Park and Fisheries Service[93] (formerly the Merchant Marine and Fisheries Service[94]), and the New Caledonia Coastal Fisheries Observatory[95]. Historically, sea cucumber has been New Caledonia's second-most important fishery export after shrimps.

Sea cucumber fishing is monitored through the submission of harvest records by licensed BDM fishers. The data collected is whole weight equivalent (i.e. wet weight, not dry weight) and is not fully complete as not all transactions are declared: Fabry and Laplante (2022)[96] estimate the coverage rate at 80%–85%. There may also be some incorrect species identification or mis-declaration. One province has not submitted any raw data for the past 4 years, but this is a province that does not historically have significant levels of BDM production.[97]

Unpublished data from the Institut de la statistique et des études économiques de la Nouvelle-Calédonie (ISEE) made available by SPC in June 2023 shows New Caledonia BDM export volumes and values between 2010 and 2023 (2023 January–April only).[98]

Based on the above, the different estimates of wet- and dry-weight BDM production data from 2010–2023 are summarised in Table NC1 below.

Table NC1: Estimated wet sea cucumber and dry BDM production weights in New Caledonia, 2010–2023 (various sources)

	Weight (t)			
Year	Wet (Fabry and Laplante, 2022)	Dry (SPC TOR)[99]	Dry Govan and Bertram, 2020)	Dry (ISEE)
2010	-	26	-	3
2011	-	34	-	33
2012	-	31	-	31
2013	-	42	-	42
2014	-	52	-	50
2015	-	45	-	38
2016	225	-	49	49
2017	327	-	65	66
2018	198	-	-	47
2019	279	-	-	37
2020	189	-	-	21
2021	-	-	-	13
2022	-	-	-	3
2023	-	-	-	<1[100]

[93] Service du Parc Naturel de la Mer de Corail et de la Pêche (SPNMCP)
[94] Service de la Marine Marchande et des Pêches Maritime (SMMPM)
[95] Observatoire des Pêches Côtières de Nouvelle- Calédonie.
[96] Fabry L. and J-F. Laplante. (2022). Bilan statistique annuel de la pêche côtière professionnelle de Nouvelle-Calédonie, Année 2020. Observatoire des Pêches Côtières de Nouvelle-Calédonie, Adecal Technopole, Nouméa, Nouvelle-Calédonie.
[97] E-mail from Lea Carron to A. Desurmont, 2 June 2023
[98] ISEE data spreadsheet provided by J-A. Kerandel. 12 June 2023, updated by a further (slightly different) spreadsheet provided by A. Desurmont on 16 June 2023.
[99] Information provided by SPC as part of the terms of reference for the present assignment.
[100] January–April data only.

ISEE data shown in the right-hand column have been used to update the New Caledonia production data shown in section 3.2 for the period 2019–2022.

Fabry and Laplante (2022) provide data on the main sea cucumber species harvested (whole weight in tonnes), as shown in Table NC2.

Table NC2: Estimated wet weight of sea cucumber harvests by major species in New Caledonia, 2016–2020, tonnes (Fabry and Laplante, 2022)

Species	2016	2017	2018	2019	2020
South Province					
Miscellaneous	40	26	29	5	1
Holothuria scabra	0	0	0	22	43
Holothuria fuscogilva	1	4	9	3	7
Holothuria whitmaei	3	3	7	12	11
Holothuria fuscopunctata	0	0	0	10	13
Sub-total	44	33	46	52	75
Total (including other species)	48	39	54	80	113
North Province					
Bohadschia argus	55	111	38	66	28
Actinopyga miliaris	2	12	10	36	1
Holothuria whitmaei	23	37	21	16	11
Stichopus chloronotus	10	29	2	22	3
Sub-total	90	189	71	140	43
Total (including other species)	177	288	144	199	76
Grand total	**225**	**327**	**198**	**279**	**189**

The authors note that fishers in the South Province only began declaring their catches by species in 2019, which explains the preponderance of the 'miscellaneous' category prior to that time.

The same authors provide recent historical data on the estimated harvest values of holothurian fisheries (million XPF) in New Caledonia's two major producing provinces between 2016 and 2020 as shown in Table NC3.

Table NC3: Estimated value of sea cucumber harvests in New Caledonia, 2016–2020, XPF millions (Fabry and Laplante, 2022)

Year	2016	2017	2018	2019	2020
South Province	12	15	30	40	50
North Province	50	74	49	42	27
Total	**62**	**89**	**79**	**82**	**77**

Fabry and Laplante (2022) also provide data on the estimated average value and prices (XPF) for New Caledonia holothurian fisheries in the two major producing provinces in 2020 as per Table NC4.

Table NC4: Estimated value and average price of sea cucumber harvests in New Caledonia, 2020 (Fabry and Laplante, 2022)

BDM fishery in 2020	Total value (million XPF)	Average price (XPF/kg) ± standard deviation
South Province	49.6	529 ± 474
North Province	26.9	753 ± 1,093
Total/weighted average	**76.5**	**608**

Historical information from ISEE on sea cucumber harvest values in the South Province of New Caledonia was also provided by SPC,[101] and this was used to deduce the average (first sale) prices shown in Table NC5.

Table NC5: Estimated value and average price of sea cucumber harvests in New Caledonia's South Province, 2000–2004 (ISEE, 2023)

Year	Weight (g)	Value (XPF)	Average first sale price (XPF/kg)
2000	106,191	55,015,255	518
2001	75,922	23,748,370	313
2002	46,422	8,189,264	176
2003	87,728	22,693,570	259
2004	66,250	45,519,370	687

These data indicate that first-sale prices for sea cucumbers were not significantly higher in 2020 (Table NC4) than they were at the beginning of the decade (Table NC5). The reasons for this are not clear, but may be associated with a trend towards harvesting of lower-value species.

Additional information on first sale price by species for the 2020 calendar year is provided by Fabry and Laplante (2022) and shown in Table NC6.

Table NC6: First-sale prices for various sea cucumber harvests in New Caledonia, 2020 (Fabry and Laplante, 2022)

Scientific name	Common name in New Caledonia	Total value (XPF)	Average 1st sale price (XPF/kg)
Actinopyga echinites	Brune	269,000	239
Actinopyga lecanora	Caillou	3,000	174
Actinopyga mauritiana	Mauritiana	1,247,000	360
Actinopyga miliaris	Noire boule	2,495,000	306
Actinopyga palauensis	Noir long	1,055,000	444
Actinopyga spinea	Noire	2,177,000	322
Bohadschia argus	Léopard	6,324,000	278
Holothuria fuscogilva	Tété blanc	13,369,000	943
Holothuria fuscopunctata	Trompe d'éléphant	3,082,000	344
Holothuria lessoni	Mouton	522,000	372
Holothuria scabra	Grise	19,908,000	440
Holothuria whitmaei	Tété noir	18,735,000	883
Miscellaneous	Divers	626,000	249
Stichopus chloronotus	Verte	1,522,000	252
Stichopus herrmanni	Curry	1,848,999	349
Thelenota ananas	Ananas	2,591,000	529
Thelenota anax	Géante	729,000	401

[101] J-A. Kerandel, pers. comm, 12 June 2023.

ISEE data provided by SPC shows average export values for dry BDM recorded between 2010 and 2020 in New Caledonia, as shown in Table NC7, and this was used to deduce the average export prices shown in Table NC7.

Table NC7: Estimated value and average price of sea cucumber exports from New Caledonia, 2010–2023 (ISEE, 2023)

Year	Weight (kg)	Value (XPF)	Export price (XPF/kg)
2010	2,853	16,784,500	5,883
2011	32,512	276,843,200	8,515
2012	30,875	259,598,700	8,408
2013	42,391	342,253,500	8,074
2014	49,851	370,259,700	7,427
2015	38,248	275,999,600	7,216
2016	49,426	425,610,500	8,611
2017	66,253	491,404,900	7,417
2018	46,548	405,084,800	8,703
2019	36,819	335,221,900	9,105
2020	20,875	200,495,800	9,605
2021	12,753	138,940,800	10,895
2022	16,211	161,596,100	9,968
2023[102]	4,056	40,187,400	9,908

Unlike first sale price (Tables NC4 and NC5) the average export price has steadily increased since 2010, although with much inter-annual variation. Unfortunately the data do not cover the same time periods: it would be interesting to compare trends in first-sale price and export price over equivalent time periods and try to understand the reasons for any difference.

A recent regional review of aquaculture in Pacific Island countries noted that trials of raising sandfish (*H. scabra*) in prawn ponds have been carried out in New Caledonia, but this has not yet been commercialised (Lindsay et al., 2022)[103].

[102] Data for January–April only.

[103] Lindsay, S., R. Lindley, M. Lam and H. Lassauce (2022). Assessment of the aquaculture needs, priorities and future direction in the Pacific Islands region. Report by Integrated Aquatic Solutions for the Secretariat of the Pacific Community, Noumea, New Caledonia.

PAPUA NEW GUINEA

The Papua New Guinea (PNG) National Fisheries Authority (NFA) places sea cucumbers first on a list of the most important coastal fishery resources exploited in the country.[104] The BDM fishery contributes significantly in terms of export revenue for the country and income generation for more than half a million Papua New Guineans. The fishery is the second biggest export earner after tuna and contributes USD 50 million of export revenue, of which about USD 27 million goes directly to coastal and island communities annually. The income generated from the BDM fishery going directly to men, woman and children in the coastal and island communities makes up a significant proportion of annual income direct to families and is the single most important fishery that contributes the highest income directly to the coastal and island people of PNG. The value of this fishery to the coastal and island communities is estimated at USD 6.75 million per month across PNG.[105]

The PNG sea cucumber fishery appears to have begun in the late 1800s, but landings and export data only began to be recorded in about 1960, and were not considered to be even remotely reliable until the early 1980s (Kinch et al., 2008)[106]. These authors provide the data shown in Table PG1 on volume and value of PNG BDM exports between 1995 and 2006 (tonnes and USD)[107]. Additional data on export values for 2018 and 2019 is given in NFA 2022[108], while the weight data for 2018 is from Govan and Bertram (2020)[109]. The 2020 data were provided by Lis (2023)[110].

Table PG1: PNG BDM export data by volume value and price, 1995–2006 and 2020

Year	BDM exports (t)	BDM exports (USD)	Avg USD/tonne
1995	444.6	3,560,728	8,009
1996	596.2	5,959,645	9,996
1997	505.4	5,185,737	10,261
1998	678.8	8,147,243	12,002
1999	394.7	4,157,870	10,534
2000	553.9	5,832,439	10,530
2001	485.4	5,266,819	10,850
2002	389.3	5,629,250	14,460
2003	488.0	6,376,835	13,067
2004	490.8	7,181,587	14,632
2005	577.0	9,284,756	16,091
2006	611.8	11,488,601	18,778
2018	1108	28,220,000	n/a
2019	n/a	1,020,000	n/a
2020	919	18,734,112	20,385

[104] NFA (2017). A roadmap for coastal fisheries and marine aquaculture for Papua New Guinea: 2017-2026. National Fisheries Authority, Port Moresby, Papua New Guinea.
[105] NFA (2021). Papua New Guinea Fisheries Strategic Plan 2021-2030. National Fisheries Authority, Port Moresby, Papua New Guinea.
[106] Kinch, J., S. Purcell, S. Uthicke and K. Friedman (2008a). Papua New Guinea: a hotspot of sea cucumber fisheries in the Western Central Pacific. In Toral-Granda, V., A. Lovatelli and M. Vasconcellos (eds). Sea cucumbers. A global review of fisheries and trade. FAO Fisheries and Aquaculture Technical Paper. No. 516. Rome, FAO. pp. 57–77.
[107] The export tonnages reported here differ from those provided by SPC as part of the TOR, but they are presented because of the linked information on value and average price.
[108] NFA (2022). Fisheries Sector Executive Overview. National Fisheries Authority, Port Moresby, Papua New Guinea.
[109] Govan, H. and I. Bertram (2020). Update of beche-de-mer exports in the Pacific Islands to 2019. Informal spreadsheet managed by the Secretariat of the Pacific Community, Noumea, New Caledonia
[110] Lis., R. (2023). Information brief on sea cucumber fishery (beche-de-mer) in Papua New Guinea. National Fisheries Authority, Port Moresby, Papua New Guinea.

The data indicate that the value of exports increased by 526% over the 25-year period covered by the table, while export prices per tonne increased by about 250%, despite the larger export volumes. This difference probably reflects a trend towards greater proportions of low-value species.

The value of BDM exports nevertheless equals or exceeds the export value of all other coastal fishery products combined.[111] During 2018, when the fishery was open for the whole year, BDM represented 74.3% of PNG's non-tuna fishery exports and 6.0% of all fishery exports.[112]

NFA, and several other documents on PNG fisheries, notes that Papua New Guinea exports on average 630 t of BDM annually.[113] This was no doubt true in the past, but since 2009 there have been multiple periods of fishery closure. As a result, although exports were large in 2019 and 2020, PNG's BDM exports between 2010 and 2020 have averaged less than 280 t per year.

Table PG2 shows export volume and price information for major sea cucumber species from two of PNG's coastal provinces, kindly provided by Mr Rickson Lis of the PNG NFA. The total exports listed in Table PG2 are a subset of those in Table PG1, and hence the totals do not match.

The PNG National Beche-de-Mer Fishery Management Plan of 2001[114] states: price paid to fishers per unit (PG kina/kg, K/kg) has increased dramatically. Between 1980 and 1983, average BDM prices paid by buyers in PNG ranged from K 2.34/kg to K 3.36/kg; in 1985 they averaged K 3.67/kg, and K 4.64/kg in 1986. In 1994, prices paid to fishers in PNG were said to range from K 1/kg to K 12/kg, but sandfish were fetching from K 12.19/kg in North Solomons Province to K 18/kg in Manus Province, and white teat from North Solomons were selling for K 30/kg (C grade) to K 46/kg (A grade). The price paid by importers in 1994 ranged from K 4/kg to K 23/kg. In 2000, prices paid to fishers ranged from K 3.50/kg for chalkfish to K 60/kg for A-grade sandfish; however, this increased to an average of K 10/kg for chalkfish and K 100/kg for A-grade sandfish in the 2001 season.

The first management scheme for the PNG sea cucumber fishery was formulated in early 1990 as a framework to govern the fishery. The framework provided a temporary regime to guide management of the fishery while NFA continued to carry out research and gather basic data to develop a robust management plan. It took almost ten years to complete development of the framework into a National Beche-de-Mer Management Plan, which was gazetted on 10 September 2001. The plan established licensing and reporting requirements for the fishery, made provision for total allowable catch (TAC) allocations nationally and to each province, prohibited certain fishing methods (including the use of underwater breathing apparatus and night-lights), stipulated wet and dry lengths for the key species of sea cucumber, and provided for automatic closure of the fishery in any province where the TAC had been reached. The Plan also established a permanent closed season from 1 October each year to 15 January the following year.

The 2001 BDM Plan was in force for eight years, until the fishery was eventually closed down in 2009 due to concerns over resource depletion. The total TAC set at national level was 668 t under that management plan, but exports often exceeded this amount, and considerable additional volumes of BDM were known to be exported illegally.

[111] NFA (2022). Fisheries Sector Executive Overview. National Fisheries Authority, Port Moresby, Papua New Guinea.
[112] Robert Gillett, pers. comm.
[113] NFA (2021). Papua New Guinea Fisheries Strategic Plan 2021-2030. National Fisheries Authority, Port Moresby, Papua New Guinea.
[113] PNG National Fisheries Authority (2003). National Beche-de-mer Fishery Management Plan.

Table PG2: PNG export volumes by species, and first sale (dry weight) prices in Milne Bay and West New Britain provinces, 2020 (Lis, 2023)

Scientific name	Common name	Export volume (kg) (total)	Average 1st sale price dry weight (PGK/kg)	
			Milne Bay	West New Britain
Actinopyga echinites	Deepwater redfish[115]	640	12.20	-
Actinopyga lecanora	Stonefish	38,622	48.00	36.35
Actinopyga mauritiana	Surf redfish[116]	32,139	39.20	24.28
Actinopyga miliaris	Blackfish	4,661	24.20	-
Actinopyga palauensis	Deepwater blackfish	876	18.20	-
Bohadschia argus	Tigerfish	32,100	21.20	15.65
Bohadschia similis	Chalkfish[117]	73,848	10.10	10.90
Bohadschia vitiensis	Brown sandfish	48,426	14.70	12.20
Holothuria atra	Lollyfish	47,211	3.80	3.40
Holothuria coluber	Snakefish[118]	11,365	-	-
Holothuria edulis	Pinkfish[119]	5,570	-	-
Holothuria fuscogilva	White teatfish	36,055	132.00	51.90
Holothuria fuscopunctata	Elephant trunkfish	8,822	12.40	14.82
Holothuria scabra	Sandfish[120]	38,422	110.12	53.59
Holothuria whitmaei[121]	Black teatfish	10,064	31.50	40.00
Stichopus chloronotus	Greenfish	7,860	18.20	18.30
Stichopus herrmanni	Curryfish[122]	59,431	45.20	34.68
Stichopus vastus	Brown curryfish	-	41.20	-
Thelenota ananas	Prickly redfish[123]	13,862	48.13	42.25
Thelenota anax	Amberfish	22,639	12.30	4.90
Pearsonothuria graffei	Flower fish	3,162	-	-
	Miscellaneous[124]	1,165	-	-
	Unspecified	703	-	-
	Total	**497,643**		

The fishery finally reopened in 2017, 7 years and 4 months after being closed. In preparation for the re-opening, NFA developed a revised management plan which provided for greater participation in decision-making processes by subnational institutions. The plan, which incorporated a reduced, more precautionary national TAC of 362 t, was gazetted on 12 September 2016.

Unfortunately, NFA encountered numerous problems with practical implementation of the plan, ranging from maintaining resource sustainability to enforcement effectivity. The institutional changes in the plan placed a huge cost burden on NFA, and the systems and processes prescribed in the plan, especially obtaining real time data on the fishery, turned out to be impractical.

[115] Includes 'Deepwater red surf' (259 kg).
[116] Includes 'Redfish' (725 kg)
[117] Includes 'White belly fish' (177 kg)
[118] Includes 'Mix brown sandfish/snakefish' (178 kg).
[119] Includes 'Mix lolly fish (rough)/pink fish' (16 kg)
[120] Includes 'Golden sandfish' (2,474 kg)
[121] Also sometimes referred to as Holothuria nobilis in the NFA data.
[122] Includes 'Mix curry fish/yellow fish' (2,957 kg)
[123] Includes Caterpillarfish (213 kg), Dragonfish (557 kg), Green Endeavour (33 kg), Moonfish (8 kg), Pickle fish (24 kg) and Yellowfish (331 kg).
[124] PNG National Fisheries Authority (2003). National Beche-de-mer Fishery Management Plan.

In considering the issues associated with the implementation of the 2016 Plan the NFA board directed NFA to make further revisions in preparation for the 2018 opening season. NFA worked on the revised plan from November 2017 to April 2018, and it was ultimately gazetted on 6 June 2018. The main changes to the plan included a reduced fishing season (4 months) and an increased national TAC of 630 t, which was approved by the NFA Board despite scientific advice from NFA that the TAC should be set at 359 t.[125] The Plan also requires exporters to report weekly on their advertised sea cucumber buying prices, and on actual export prices received.

The fishery was closed again in 2019, but reopened 2020 as a result of a political directive aimed at supporting coastal and island communities whose livelihoods had been marred by the impact of COVID-19. Due to low levels of stock, the fishery was closed again in 2021 for a period of two years to allow the stocks to recover. The fishery remains closed at the time of writing.[126]

In preparation for the next open season, the NFA board has directed that the current plan be subjected to further review, again through a consultative process in order to have a more robust management plan, considering the dynamics of the fishery, the economics and social benefits it provides to the coastal and island communities and Papua New Guinea as a whole.[127]

[125] Lis, R. (2023). Information brief on sea cucumber fishery (beche-de-mer) in Papua New Guinea. National Fisheries Authority, Port Moresby, Papua New Guinea.
[126] Gisawa, L. (2023). Papua New Guinea Coastal Fisheries Information. Informal notes.
[127] Lis, R. (2023). Information brief on sea cucumber fishery (beche-de-mer) in Papua New Guinea. National Fisheries Authority, Port Moresby, Papua New Guinea.

SOLOMON ISLANDS

The trading of BDM from Solomon Islands is thought to have begun in 1844. Early export records before 1966 are fragmentary, but annual production prior to 1986 was estimated to be about 21 t per year (Kinch, 2004)[128]. Until the 1970s and 1980s, the trade was seasonal and did not attract many fishers, but by the 1990s it had begun to receive increased attention (Pakoa et al., 2014)[129]. Maximum export volumes of 622 t and 715 t were recorded in 1991 and 1992 respectively. The quantity of exports subsequently declined but prices increased, such that export value is thought to have peaked in 2013 at around SBD 35 million (Figure S1), although data on the value of exports from Solomon Islands and many other PICTs is notoriously unreliable (see section 3.1).

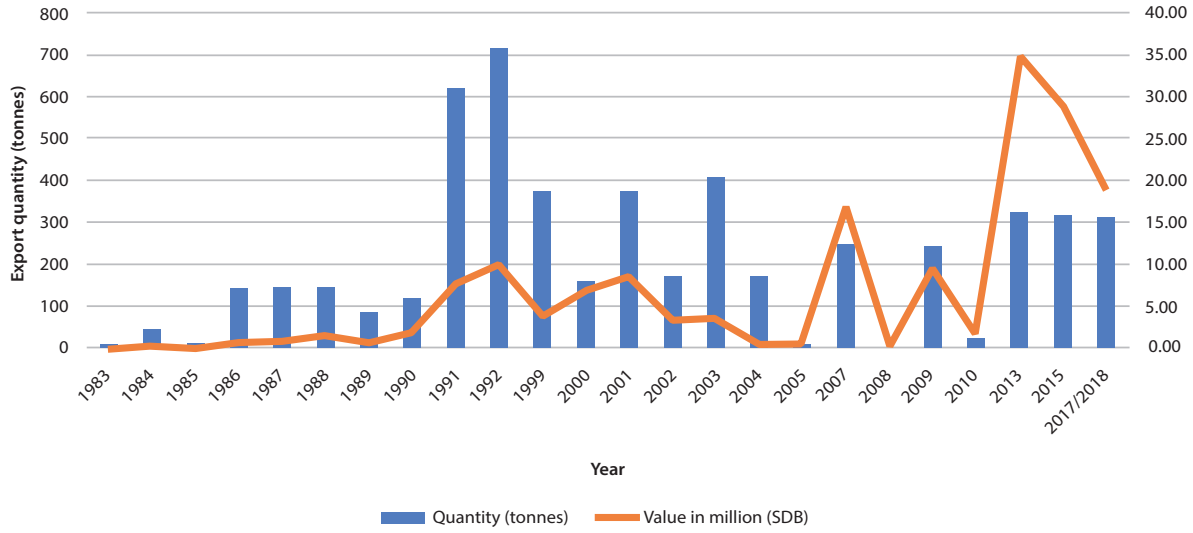

Figure SOL1: Solomon Islands beche-de-mer exports by volume and value from 1983–2018.[130]

Updated export data provided by MFMR is shown in Table SOL1. The data show that the value of exports has progressively declined such that the income of SBD 3.1 million received in 2022 was less than 10% of the peak that occurred about ten years previously.

Table SOL1: Weight and value of BDM exports from Solomon Islands, 2015–2022.

Year	Weight (kg)	Value (SBD)	Price (SBD/kg)
2015	287,189	26,417,785	91.99
2016	0	0	-
2017	257,954	16,348,313	63.38
2018	315,010	19,067,801	60.53
2019	83,315	7,802,166	93.65
2020	0	0	-
2021	27,255	1,722,695	63.21
2021	**45,131**	**3,791,906**	**84.02**
2022	23,060	3,109,511	134.84
2022	**31,028**	**3,099,994**	**99.91**

[128] Kinch, J. (2004). The status of commercial invertebrates and other marine resources in Santa Isabel Province, Solomon Islands. United Nations Development Programme, Suva, Fiji; and Isabel Province Development Programme, Buala, Solomon Islands.

[129] Pakoa, K., R. Masu, J. Teri, J. Leqata, P. Tua, D. Fisk and I. Bertram (2014). Solomon Islands sea cucumber resource status and recommendations for management. Secretariat of the Pacific Community, Noumea, New Caledonia.

[130] MFMR (undated). Solomon Islands National Sea Cucumber Fishery Policy, 2021-2031. Ministry of Fisheries and Marine Resources, Honiara, Solomon Islands.

Two separate spreadsheets provided by Claudius Halumwane and James Teri of MFMR gave different data for 2021 and 2022. Both sets of values are listed for reference.

MFMR states that in recent years exports have increasingly moved away from high-value species to include medium- and low-value types.[131] In 1999 the high-value white teatfish comprised 50% of export volumes, but dropped to 2% in 2002. In contrast the low-value lollyfish, which made up 22% of exports in 2000, increased to 60% in 2003 (Ramofafia, 2004)[132].

Table SOL2, kindly provided by MFMR, provides more details on the species exported in 2021 and 2022.

Table SOL2: Solomon Islands BDM export volumes and values, 2021–2022

Scientific name	Common name	2021			2022		
		Quantity (kg)	Export value (SBD)	Price (SBD/kg)	Quantity (kg)	Export value (SBD)	Price (SBD/kg)
Actinopyga lecanora	Stone fish	855	405,870	475	922	458,647	497
Actinopyga mauritiana	Surf redfish	1,110	396,250	357	1,099	412,219	375
Actinopyga miliaris	Black fish	244	92,176	378	161	68,264	424
Bohadschia argus	Tiger fish	1,935	423,375	219	1,629	380,014	233
Bohadschia similis	Chalkfish	440	198,000	450	95	42,750	450
Bohadschia vitiensis	Brown sandfish	3,024	541,296	179	3,719	702,796	189
Holothuria flavomaculata	Red snakefish	1,080	97,200	90	230	20,700	90
Holothuria atra	Lolly fish	22,996	1,789,424	78	14,867	1,248,824	84
Holothuria atra	MOU lolly	660	19,800	30			
Holothuria coluber	Snakefish	2,830	244,580	86	3,956	356,000	90
Holothuria edulis	Pinkfish	24,510	794,700	32	44,905	1,347,164	30
Holothuria edulis	Lemon/candy fish	2,815	315,280	112	200	22,400	112
Holothuria flavomaculata	White snake fish	2,301	172,575	75	2,420	181,500	75
Holothuria fuscogilva	White teatfish	1,406	843,600	600	3,800	2,311,602	608
Holothuria fuscopunctata	Elephant trunkfish	21,110	316,650	15	22,398	335,964	15
Holothuria lessoni	Golden sandfish	925	265,500	287	2,095	715,560	342
Holothuria scabra	Sand fish	80	60,000	750	120	90,000	750
Holothuria sp.	BS4	4,960	595,200	120	2,129	259,732	122
Holothuria Species	Hong pay fish	34,819	1,536,570	44	40,133	1,203,990	30
Holothuria whitmae	Black teat fish				625	375,408	601
Pearsonothuria graeffei	Orange fish	6,935	333,420	48	7,760	403,520	52
Pearsonothuria graeffei	Ripple fish	18,388	945,636	51	17,002	884,096	52
Pearsonothuria graeffei	Flower	11,575	520,300	45	1,950	101,400	52
Stichopus chloronotus	Greenfish	40	12,000	300			
Stichopus herrmanni	Curryfish	587.5	256,875	437	865	389,250	450
Stichopus horrens	Peanutfish	2,065	935,665	453	1,510	726,310	481
Stichopus vastus	Brown curryfish	675	202,500	300	1,109	332,760	300
Thelenota ananas	Prickly fish	655	258,750	395	502	225,698	450
Thelenota anax	Amberfish	2,410	261,280	108	240	26,880	112
	Red lollyfish	1,660	49,800	30			
	Rainbow fish	140	15,680	112	90	10,080	112
Total		**45,131**	**3,791,906**	**84**	**31,028**	**3,099,994**	**100**

[131] MFMR (undated). Solomon Islands National Sea Cucumber Fishery Policy, 2021-2031. Ministry of Fisheries and Marine Resources, Honiara, Solomon Islands.
[132] Ramofafia C. (2004). The sea cucumber fisheries in Solomon Islands: Benefits and importance to coastal communities. Australian Centre for International Agricultural Research. Sydney, NSW, Australia

According to the 1999 Solomon Islands census, 12% of the coastal households surveyed sold processed BDM, and close to 6,000 households were involved in harvesting and selling fresh sea cucumbers (Kinch et al., 2008)[133]. Sea cucumber was ranked the second most important fishing activity after finfish fishing in eight of Solomon Islands' nine provinces. The number is believed to have increased after that time as a result of the ethnic tensions of 2000 onwards. Communities in the smaller island groups of Ontong Java, Reef Islands and Temotu, as well as in Western Province, are especially reliant on BDM.

Until recent years the Solomon Islands sea cucumber fishery was an open fishery with no restrictions. A ban on taking sandfish (*H. scabra*), an especially high-value species at the time, was introduced in 1998 to protect this species as it was the subject of research, but was lifted again in 2000. Continued unsustainable exploitation of the resource led to the Solomon Islands Government enacting the first fishery closure, in December 2005, which was a national ban on harvesting sea cucumbers and exporting BDM products. However, on 20 April 2007 the ban was lifted in an effort to provide economic relief to communities affected by a recent earthquake and tsunami that caused widespread damage and hardship in Western Province. This opening of the fishery was restricted to Western Province,[134] but this is said to have created confusion and distrust of MFMR, leading to fishers outside Western Province ignoring the ban, which was still in force in the rest of the country[135]. The fishery was reclosed on 7 May 2009.[136]

The sea cucumber fishery has now been closed six times and reopened five times between 2005 and 2019, for periods ranging from two months to two years. On 2 May 2019 MFMR gazetted a notice of fishery closure commencing on 31 May 2019, and a prohibition of BDM exports after 30 June 2019.[137] The fishery was reopened on 1 September 2021, for a period of one year.[138/139] As in some other countries, hardships caused by the COVID-19 pandemic were cited as reasons for opening the fishery.[140] The open season lasted until 1 September 2022, at which time all activities including harvesting, buying, selling, receiving, exporting and being in possession of BDM were required to stop.[141] The requirement to cease exports was subsequently extended until 1 December 2022.[142]

None of the open periods prior to 2014 were subject to any regulations on harvesting practices, and each time the fishery was reopened it was exposed to the same unconstrained fishing that caused its decline prior to the closure. In addition, the difficulties of effective enforcement meant that fishing, processing and exporting often continued even when the fishery was supposed to be closed.

[133] Kinch J., S. Purcell, S. Uthicke and K. Friedman (2008b). Population status, fisheries and trade of sea cucumbers in the Western Central Pacific. In: Toral-Granda V., A. Lovatelli and M. Vasconcellos (eds). Sea cucumbers. A global review of fisheries and trade. Technical Paper. No. 516, Food and Agriculture Organisation of the United Nations, Rome, Italy.

[134] Reopening the sea cucumber fishery in April 2007 undermined MFMR's own efforts to establish a seaweed farming industry in Western Province, since many seaweed farmers simply walked off their farms in order to collect sea cucumbers. In addition, fishers from other provinces quickly moved in, thereby reducing the benefits to those most seriously affected by the earthquake and tsunami (author's personal observations).

[135] Pakoa et al. (2014a). Solomon Islands sea cucumber resource status and recommendations for management. Secretariat of the Pacific Community, Noumea, New Caledonia.

[136] Solomon Islands Government (2009). Fisheries (Amendment) Regulations 2009. Legal Notice No 33, Solomon Islands Gazette No 16, Honiara, Solomon Islands.

[137] Solomon Islands Government (2019). Prohibited Activities (Fishing or Possession or Export of Beche-De-Mer) Order 2019. Solomon Islands Gazette No. 76, 2 May 2019. Honiara, Solomon Islands.

[138] https://www.fisheries.gov.sb/announcements/notifications/88-sea-cucumber-minimum-harvest-purchase-and-export-sizes.

[139] Solomon Islands Government (2021). Prohibited Activities (Fishing and Possession of Beche-De-Mer) Order 2021. Supplement No 168 to the Solomon Islands Gazette.

[140] https://www.fisheries.gov.sb/news/item/40-mfmr-says-lifting-of-ban-is-necessary-to-ease-hardship-faced-by-solomon-islanders. And https://www.fisheries.gov.sb/news/item/37-beche-de-mer-ban-revoked-following-cabinet-decision.

[141] https://www.fisheries.gov.sb/announcements/notifications/99-beche-de-mer-fishery-open-season-ends-on-september-1

[142] https://www.fisheries.gov.sb/news/item/59-beche-de-mere-export-now-closed

Limits on the number of BDM export licences were imposed over the years but were poorly enforced. The lowest number of export licences (7) occurred in 1999 and 2017, and the highest number (28) in 2013. The average annual number of licences issued from 1997 to 2019 was 15.[143]

The various reports already cited have documented some of the challenges of monitoring and managing the Solomon Islands sea cucumber fishery.

- Management has been reactive, responding to observed problems, rather than being systematic, for purposes of stock recovery and conservation. Fishery closures and open seasons have been irregular, unpredictable and of variable duration, from a couple of months to several years. Reopening the fishery after a period of closure has often been for political reasons, and not based on stock assessment or other scientific evidence.
- Fishers often continue to harvest sea cucumbers during periods of fishery closure, as well as in marine protected areas.[144] In some locations this is due to an absence of alternative income-earning opportunities.
- Community-based management arrangements have been largely ineffective. Contributing factors include the increasing value of the product, the absence of economic alternatives, and a decline in the authority exercised by community leaders. Many communities suffer from the activities of poachers from other areas who are not subject to their control or authority.
- Some exports have taken place during periods of fishery closure. This may have been product that was harvested during the closed season. During periods after the fishery reopened, exports may have included BDM that was harvested during fishery closures and stockpiled. The fact the buyers continue to purchase BDM during closed seasons and stockpile it until the fishery re-opens encourages fishers to continue operating during these periods.
- BDM buyers and exporters often provide credit or equipment to fishers, creating an obligation for them to carry on harvesting sea cucumbers irrespective of the management arrangements in place.
- Although MFMR has periodically seized quantities of BDM harvested illegally, the remote nature of the fishery impedes effective monitoring, control and surveillance.
- The involvement of some senior leaders in the business has made it difficult for MFMR to take infringement cases to court, which in any case is a slow and cumbersome process.
- There is political pressure from within the government to lift sea cucumber harvesting bans when they are imposed, and this undermines strategic management approaches and impedes effective enforcement. These pressures have been experienced by MFMR since the first fishery closure in 2005.
- Information on the value of BDM exports is extremely unreliable, and probably falsified by the exporters themselves in order to avoid fees and taxes, and create the impression that the business is less lucrative than it really is.
- BDM product identification has been unreliable, with species being recorded using an inconsistent and often incorrect combination of common and Asian trade names. This has not only affected the record of species and products within the Solomon Islands BDM trade, but also made it difficult to compare BDM export data with those of other PICTs.

[143] MFMR (undated). Solomon Islands National Sea Cucumber Fishery Policy, 2021-2031. Ministry of Fisheries and Marine Resources, Honiara, Solomon Islands.
[144] See for example https://www.fisheries.gov.sb/news/item/16-fisheries-director-warns-public-against-illegal-bech-de-mer-harvesting.

In December 2014 MFMR gazetted a Beche-De-Mer Management Regulation and associated National Sea Fishery Cucumber Management and Development Plan (NSCFMDP) which aimed to address some of these problems (SIG, 2014)[145]. The BDM Regulation (2014):

- revised the previous Fisheries Amendment Regulation (2009)[146] for the period from 1 December 2014 to 31 March 2015, thereby creating a 4-month sea cucumber open season;
- increased the fine from SBD 100,000 to a maximum of SBD 500,000 and/or a 4-month prison term for those who: fish without a permit; possess undersized BDM; possess prohibited species; use prohibited fishing methods; fish in a protected area; or, in the case of licensed BDM exporters, fail to submit required records and data reports.

These were the first measures taken in Solomon Islands to manage sea cucumber resources during periods when the fishery was open.

The NSCFMDP appears as Schedule 1 to the BDM Regulation (2014), and makes the following provisions.

- Issuance of up to a maximum of 15 annual BDM export licences (with 10 licences reserved for Solomon Islands citizens) by the Director of Fisheries, with a total allowable catch (TAC) by species and area to be assigned to each licence. The annual licence fee is SBD 200,000 (about USD 24,000), a significant increase since 2013 when an export licence fee cost SBD 10,000. The increase is said to reflect the increased value of the fishery.[147]
- Issuance of sea cucumber processing licences by Provincial Governments, with licences restricted to Solomon Island citizens and subject to species quotas and an annual fee of SBD 50,000 (about USD 6,000).

Schedule 5 of the NSCFMDP provides a list of minimum harvest sizes (length) for live sea cucumbers (applicable to fishers) and for dried whole BDM (applicable to buyers and exporters). The list covers 26 species, categorised into high-, medium- or low-value groups. Minimum sizes for dried product range between 40% and 66% of the minimum live size, depending on species. On 9 September 2021 this list was republished by the Solomon Islands Government as a media release.[148]

Applications for licences are reviewed by the MFMR Licensing Committee and are subject to various criteria, which include "the prices the applicant will be offering to local sea cucumber processors" (for export licences) and "the prices the applicant will be offering to local sea cucumber harvesters" (for processing licences). On 24 September 2021 MFMR issued documents specifying benchmark local buying prices and export prices for all the main sea cucumber species harvested in Solomon Islands.[149] Both documents restate the size limits for wet and dry sea cucumbers, but the pricing guidelines, shown in Table SOL3, apply to dried BDM.

The minimum benchmark local buying price serves as a floor for the prices that applicants include in their licence applications. In other words, the prices offered by licence applicants must be at least as high, or higher,

[145] Solomon Islands Government (2014). Fisheries (Beche-De-Mer) (Amendment) Regulations 2014. Supplement No 79 to the Solomon Islands Gazette. Honiara, Solomon Islands.
[146] Solomon Islands Government (2009). Fisheries (Amendment) Regulations 2009. Legal Notice No 33, Solomon Islands Gazette No 16, Honiara, Solomon Islands..
[147] MFMR (undated). Solomon Islands National Sea Cucumber Fishery Policy, 2021-2031. Ministry of Fisheries and Marine Resources, Honiara, Solomon Islands.
[148] MFMR (2021b). Beche-de-mer minimum harvest sizes (Wet Length) and minimum purchase and export sizes (Dry Length). (Media Release). https://solomons.gov.sb/beche-de-mer-minimum-harvest-sizes-wet-length-and-minimum-purchase-and-export-sizes-dry-length/
[149] MFMR (2021a). 2021/2022 Beche-de-Mer Minimum Benchmark Local Buying Price and 2021/2022 Beche-de-Mer Minimum Benchmark Export Price. Ministry of Fisheries and Marine Resources, Honiara, Solomon Islands.

than those on the minimum benchmark list. In addition, publication of the lists of minimum buying prices and minimum export prices is intended to ensure that fishers are aware of the expected prices for each species. If they then agree to sell their product at a price lower than the specified minimum, that is a private matter for them.[150]

Table SOL3 shows the reference minimum buying prices for wet and dry product as specified by MFMR, and the ratio between them (buying price divided by export price) as a percentage.

Table SOL3: Solomon Islands minimum BDM buying and export prices and the ratio between them

		Reference minimum dry BDM price (SBD/kg)			Actual export price 2021–2022 avg	
		A-Buying	B-Export	Ratio (A/B) %	C-	Ratio (C/B)
Scientific name	Common name				SBD/kg	%
Value Group H – High Grade Species						
Holothuria fuscogilva	White teatfish	400	800	50%	604	76%
Holothuria scabra	Sandfish	520	680	76%	750	110%
Holothuria whitmaei	Black teatfish	400	560	71%	600	107%
Stichopus chloronotus	Greenfish	300	600	50%	300	50%
Stichopus herrmanni	Curryfish	300	680	44%	444	65%
Stichopus monotuberculatus[151]	Peanutfish/dragon fish	321	680	47%	467	69%
Thelenota ananas	Prickly redfish	300	680	44%	423	62%
Actinopyga lecanora	Stonefish	332	680	49%	486	72%
Bohadschia marmorata	Chalkfish	300	600	50%	450	75%
Value Group M – Medium Grade Species						
Actinopyga miliaris	Blackfish/hairy blackfish	283	600	47%	401	67%
Actinopyga mauritiana	Surf redfish	250	680	37%	366	54%
Actinopyga palauensis	Deepwater blackfish	240	450	53%	-	-
Holothuria lessoni	Golden sandfish	200	600	33%	314	52%
Stichopus vastus	Brown curryfish	200	350	57%	300	86%
Bohadschia argus	Tigerfish/leopard fish	150	280	54%	226	81%
Actinopyga echinites	Deepwater redfish	135	200	68%	-	-
Bohadschia vitiensis	Brown sandfish	126	350	36%	184	53%
Thelenota rubralineata	Lemon/rainbow/candy fish	100	200	50%	112	56%
Value Group L – Low Grade Species						
Thelenota anax	Amberfish	85	280	30%	280	39%
Holothuria coluber	Snakefish	67	240	28%	88	37%
Holothuria fuscopunctata	Elephant trunkfish	70	240	29%	15	6.3%
Holothuria atra	Lollyfish	56	200	28%	81	41%
Holothuria edulis	Pinkfish	60	280	21%	31	11%
Holothuria flavomaculata	Red snakefish	60	200	30%	75	38%
Pearsonothuria graffei	Ripple/flower/orange fish	35	50	70%	48	97%
Holothuria leucospilota	White snakefish	50	200	25%	-	-
Holothuria sp.	Hong pay/pig fish	40	200	20%	37	19%

The table indicates that the expected minimum buying prices for processed dry BDM are between 20% and 76% of the expected export value. Contrary to the findings described in section 5.2, the ratio of buying to export price in Solomon Islands is considerably lower than the ratio for medium- and high-value species.

[150] James Teri, MFMR Official, pers. comm.
[151] Probably Stichopus horrens.

Table SOL2 earlier in this section shows the species-specific export prices achieved in 2021 and 2022. The right-hand column of Table SOL3 draws on this information to show the average 2021–2022 actual price received as a percentage of the stipulated minimum export price for each major species. These data indicate that, for high- and medium-value species, exporters achieve reasonable prices compared to the specified minimum export prices – sometimes slightly more than 100% but more usually between 50% and 80%. For low-value species, however, actual prices received are more usually less than 40% of the minimum price specified by MFMR. Possible reasons for this include:

- unrealistic minimum prices set by MFMR
- poor quality of BDM processing, resulting in lower export prices
- inaccurate reporting of prices received by exporters.

The latter issue has been recognised as a concern for Solomon Islands and other PICTs.

The NSCFMDP also provides for:

- the issuance of sea cucumber aquaculture licences
- authorisations for the production of pharmaceutical or cosmetic products from sea cucumbers
- establishment of community BDM management plans, covering areas subject to the customary rights of the community concerned.

The most recent BDM fishery management document in Solomon Islands is the National Sea Cucumber Fishery Policy (SINSCFP) 2021–2031[152]. In its introduction, the document states "the fishery is currently overfished and this policy provides a clear direction of how the government intends to improve the fishery…".

The SINSCFP summarises these challenges as:

- current fishery being over-exploited despite the many short duration bans of the fishery to date
- low annual collection of stock assessment data
- weak compliance (monitoring and control) and enforcement of regulatory measures.

Policy objectives are to:

1. ensure the sea cucumber fishery is sustainably managed;
2. increase monetary contributions to community well-being;
3. enhance effective monitoring and enforcement; and
4. promote aquaculture development of sea cucumber resources.

Each objective is broken down into a series of implementation strategies, many of which are to be delivered through a national sea cucumber management plan. Under Policy objective 2, implementation strategies included are to:

- conduct market and value chain analysis for the sea cucumber fishery; and
- regulate efficient price-control measures.

[152] MFMR (undated). Solomon Islands National Sea Cucumber Fishery Policy, 2021-2031. Ministry of Fisheries and Marine Resources, Honiara, Solomon Islands.

It is not entirely clear how the regulation of efficient price-control measures will be implemented in practice. No new sea cucumber fishery management plan has yet been developed as a vehicle for delivery of the SINSCFP policy directives. The 2014 Beche-De-Mer Management Regulation and National Sea Cucumber Fishery Management and Development Plan remain in force, but they do not fully cover all of the strategic directions articulated in the SINSCFP. Section 7.1 of the SINSCFP states that "MFMR will develop all the national management and development plans and community management and development plans required under the policy", but it is understood that this has not yet happened.

TONGA

Tonga is one of the few PICTs where sea cucumber species are consumed locally. The body wall and viscera of lollyfish, snakefish, brown sandfish, chalkfish and curryfish are all considered as local delicacies, and growing demand from urban populations has expanded the domestic market for these products. There are therefore three components to the Tongan sea cucumber fishery, for home consumption, domestic commercial sales, and exports (Pakoa et al., 2013b)[153]. However by far the biggest and most lucrative component is the export fishery.

The first records of BDM exports from Tonga are from the early 1980s, and exports grew from around 10 t in 1983 to a peak of 160 t in 1987 before falling off over the next 10 years to a level of 35 t in 1997. In 1996 a survey to assess the effect of the fishery on standing stocks showed significant declines in sea cucumber populations, particularly for high value species (Lokani et al., 1996)[154]. As a result, the Government of Tonga closed the sea cucumber fishery for 10 years to allow stocks to recover, effective from 31 December 1997. A follow-up survey in 2004 found that stocks, with the exception of the slow-growing black teatfish *H. whitmaei*, had recovered sufficiently to reopen a sustainable small-scale fishery, provided that an appropriate fisheries management plan was developed and implemented (Friedman et al., 2004)[155].

A sea cucumber fishery management plan was therefore developed in the mid-2000s to guide the sustainable management of the fishery.[156] Some of the main measures included in the plan were:

- separate licenses for processing and exporting beche-de mer
- a quota on the number of licenses issued each year
- a total export quota per season
- short harvest seasons
- a restriction on the use of underwater breathing apparatus
- a requirement for licence applicants to provide information on the buying prices they intend to pay, and those they expect to receive when exporting.

The sea cucumber fishery subsequently reopened in 2008, but the provisions of the management plan were not closely followed. An excessive number of licences was issued, resulting in sea cucumber stocks declining further. Export data showed that as high value species were depleted, catches of medium and low value species increased, including species that were previously caught for subsistence only (e.g. snakefish (*H. coluber*) and dragon fish (*S. horrens*)).

In March 2011, the recorded declines prompted preliminary advice from SPC to the Ministry of Fisheries, recommending the closure of the fishery for a minimum of three to five years to allow stocks to recover. However, the fishery remained open for another five seasons from 2011 to 2015, which subsequently reduced existing

[153] Pakoa, K. M., P. V. Ngaluafe, T. Lotoahea, S. V. Matoto and I. Bertram (2013b). The status of Tonga's sea cucumber fishery, including an update on Vava'u and Tongatapu. Secretariat of the Pacific Community, Noumea, New Caledonia.

[154] Lokani, P., S. V. Matoto and E. Ledua (1996). Survey of sea cucumber resources at Ha'apai, Tonga, May/June 1996. South Pacific Commission, Noumea, New Caledonia.

[155] Friedman, K., P. Lokani, P. Fale, S. Mailau, P. Ramohia and C. Ramofafia (2004). Survey of sea cucumber resources of Ha'apai, Tonga. Secretariat of the Pacific Community, Noumea, New Caledonia.

[156] Ministry of Fisheries, undated. Tonga National Sea Cucumber Fishery Management and Development Plan. Government of Tonga.

breeding populations of all low-, medium-, and high-value species, thereby prolonging the time required for stocks to recover. During these five seasons, the Ministry also increased the length of the open season, which placed further pressure on remaining stocks. Despite the prolonged fishing seasons, exports declined further, finally prompting the Ministry to place another moratorium on the fishery in October 2015.[157] Officially there was no harvesting or export of sea cucumbers for the next five years, although there are numerous newspaper accounts of illegal harvests during the moratorium.[158]

Three and a half years after the 2015 moratorium, another survey was carried out to assess the degree to which sea cucumber stocks had recovered, compare abundance levels to those found in other PICTs, and determine whether the standing stock could sustain a commercial fishery. The survey, which took place between February and April 2019, concluded that adult densities (i.e. above the size at first maturity) remained depressed for most sea cucumber species, and below regional reference points. Given the continuing poor status of most sea cucumber species across Tonga, the survey scientists recommended that the existing moratorium be extended for another five years, and that another survey be carried out in 2023 (Shedrawi et al., 2020)[159].

The sea cucumber fishery nevertheless reopened from 1 July to 30 September 2020, and then from 31 May to 30 September 2021. In both cases the hardships caused by the COVID-19 pandemic were cited as reasons for reopening the fishery. Estimated harvest levels (in number of pieces) and export levels (number of pieces and weight in tonnes) are shown in Table TON1 below, based on MOF (2020)[160] and MOF (2021)[161].

Table TON1: Tongan beche-de-mer harvests and exports by island group, 2020–2021

Island group	Harvest (pieces)		Export (pieces)		Export (tonnes)	
	2020	2021	2020	2021	2020	2021
Tongatapu	532,853	573,465	1,369,452	920,296	39	25
Ha'apai	693,996	971,571	1,333,413	1,344,393	38	35
Vava'u	351,801	751,234	864,917	2,009,872	24	31
Niuatoputapu	14,812	-	36,038	-	1	-
Total	**1,593,462**	**2,296,270**	**3,603,820**	**4,274,561**	**102**	**91**

There is a considerable difference in both years between the Ministry of Fisheries' records of the number of pieces harvested and the number exported. Factors that contribute to the discrepancy include: unrecorded data (50%); handling error in bucket sampling and counting (20%); and others (30%) (MOF, 2020)[162]. The data shortfall concerns the harvest records, so export data is considered more reliable.

The 2020 harvest resulted in the payment of about 4 million Tongan Pa'anga (TOP) to fishers, or an average of TOP 1,300/head among the 3,000 fisheries (2.5% of the Tongan population) who benefitted (MOF, 2020)[163]. Similarly, the 2021 season resulted in harvests worth TOP 4.4 million, and payments of TOP 1,611 to each of 2,779 fishers who made up about 2.8% of the Tongan population (Pohiva, 2021)[164].

[157] Pakoa et al. (2013b). The status of Tonga's sea cucumber fishery, including an update on Vava'u and Tongatapu. Secretariat of the Pacific Community, Noumea, New Caledonia.
[158] See for example: https://matangitonga.to/2019/04/30/fisherman-harvested-sea-cucumbers-out-season and https://matangitonga.to/2021/08/20/two-fishermen-fined-unlawful-sea-cucumbers-harvest.
[159] Shedrawi, G., P. Bosserelle, S. Malimali, V. Fatongiatau, S. Mailau, F. Magron, T. Havea, S. Finau, S. Finau, P. Aleamotua and A. Halford (2020). The status of sea cucumber stocks in the Kingdom of Tonga. Secretariat of the Pacific Community, Noumea, New Caledonia
[160] Ministry of Fisheries (2021). Annual Report 2020-2021. Government of Tonga, Nuku'alofa, Tonga.
[161] Ministry of Fisheries (2022). Annual Report 2021-2022. Government of Tonga, Nuku'alofa, Tonga.
[162] Ministry of Fisheries (2020). Sea Cucumber. PowerPoint presentation.
[163] Ministry of Fisheries (2020). Sea Cucumber. PowerPoint presentation
[164] Pohiva, S. (2021). Sea cucumber brief summary report as of April–September 2021. Ministry of Fisheries, Nuku'alofa, Tonga.

The full list of species exported in 2020, by number of pieces and by weight, is shown in Table TON2.[165] Also shown is the species breakdown (by number of pieces) for 2021, based on Pohiva (2021)[166].

Table TON2: Tongan beche-de-mer exports (2020) and harvests (2021) by species

Species	Tongan name	Common name	2020 – export		2021 – harvest
			Pieces	Weight (kg)	Pieces
Thelenota anax	Saianiti	Amberfish	9,573	2,344.32	24,653
Holothuria whitmaei	Huhuvalu 'uli 'uli	Black teatfish	7,301	1,305.81	4,581
Bohadschia vitiensis	Mula	Brown sandfish	489,187	15,687.81	80,676
Stichopus herrmanni	Lomu curry	Curryfish	87,661	4,910.01	26,676
Actinopyga echinites	Telehea lula loloto	Deepwater redfish	109,665	1,439.84	62,419
Holothuria fuscopunctata	Elefanite	Elephant trunkfish	455	96.60	1,587
Stichopus chloronotus	Holomumu	Greenfish	744,395	2,800.17	640,264
Actinopyga miliaris	Loli fulufulu	Hairy blackfish	5,198	740.70	6,057
Holothuria atra	Loli	Lollyfish	1,131,216	26,876.91	844,230
Thelenota ananas	Pulukalia	Prickly redfish	7,501	949.99	5,674
Holothuria scabra		Sandfish	836	30.30	-
Holothuria coluber	Tungongo	Snakefish	715,044	18,312.21	435,229
Actinopyga lecanora	Telehea maka	Stonefish	24,786	3,133.98	19,668
Actinopyga mauritiana	Telehea kula mamaha	Surf redfish	137,531	9,247.20	55,091
Bohadschia argus	Matamata	Leopard/tiger fish	115,189	9,348.28	69,479
Holothuria fuscogilva	Huhuvalu hinehina	White teatfish	18,282	4,823.16	12,193
Holothuria edulis	Loli pingiki	Pinkfish	-	-	7,793
Total			**3,603,820**	**102,047**	**2,296,270**

Note that the sum of the 2021 harvest quantities in Table TON2 is much less than the export quantities shown in table TON1, for the reasons mentioned above.

The Ministry of Fisheries has an arrangement with the Vast Ocean (Tonga) Aquaculture Co. Ltd for experimental culture of sea cucumbers (Sandfish, *H. scabra*, and white teatfish, *H. fuscogilva*, among others),[167] in which the company does the spawning and gives 10% of what is spawned to the Ministry, with the rest being exported commercially. Several successful sea cucumber spawning events have been achieved: in 2021 393,965 juveniles were released into the ocean and 9,500 distributed to pen cage culture systems established in six of Tonga's Special Management Areas (MOF, 2022)[168].

[165] Ministry of Fisheries (2021). Annual Report 2020-2021. Government of Tonga, Nuku'alofa, Tonga.
[166] Pohiva, S. (2021). Sea Cucumber brief summary report as of April–September 2021. Ministry of Fisheries, Nuku'alofa, Tonga
[167] Sandfish does not occur naturally in Tonga and is thought to have been introduced (I. Bertram, pers.comm).
[168] Ministry of Fisheries (2022). Annual Report 2020-2021. Government of Tonga, Nuku'alofa, Tonga.

VANUATU

As in other countries of Melanesia, sea cucumbers are a key source of income for coastal communities in Vanuatu. BDM was one of the principal exports of the country since the late 1800s, so much so that the name of the national language, *bislama*, derives from the term BDM and developed from early communications between fishers and traders.

The BDM trade was at low levels from the 1930s to the 1970s for various reasons, including trade disruptions caused by World War II, over-harvesting in some areas, and the dominance of other commodities such as copra (Ward, 1972)[169]. The revival of the trade began in the 1980s, facilitated by the dissipation of trade barriers with China, and peaked at 66 t in the early 1990s. Production then steadily declined until, by mid-2000, the fishery was no longer profitable, even though temporary sea cucumber bans were implemented at local scale by some communities.[170] Assessments conducted by SPC in 2003 confirmed that sea cucumber resources were depleted and it was recommended that the fishery be rested to allow recovery. Regulations on minimum size limits for some species were established in 2005, and then a total ban on harvesting and exporting for five years was put in place in January 2008 (Pakoa et al., 2013)[171].

Resource assessments carried out in 2011 indicated progressive but still partial recovery of sea cucumber stocks. The fishery was reopened in 2014 and a management plan for the resource was developed and gazetted in July 2015.[172] The management plan provided for the establishment of TAC in different provinces and areas, as well as wet- and dry-weight size limits and minimum price levels for 23 sea cucumber species. However, enforcement of the plan proved difficult, and exports rose quickly to 59 t in 2016. This was considered to be an unsustainable level of harvesting and the fishery was subsequently reclosed in 2017 and 2018.

Harvests resumed in 2019, but no exports took place until 2020, when a total of 9.86 t of dried BDM, valued at VUV 31,955,811 (average price VUV 3,241/kg) were exported. According to the Vanuatu Fisheries Department (VFD), 7.53 t were exported by sea while 2.33 t were exported by air before the COVID-19 border lockdowns began[173].

[169] Ward, R.G. (1972). The Pacific beche-de-mer trade, with special reference to Fiji. In Man in the Pacific Islands: Essays on geographical changes in Pacific, (R.G. Ward, ed.), pp. 91-123. Oxford University Press, 337 pp.
[170] Léopold., M. (2016). Evaluating the harvest and management strategies for the sea cucumber fisheries in Vanuatu. Projects No 4860A1 (BICH2MER) and No CS14-3007-101 (BICHLAMAR). IRD, Nouméa.
[171] Pakoa, K., J. Raubani, F. Siaosi, G. Amos and J. Ham (2014b). The status of sea cucumber fisheries and resources in Vanuatu, November 2013. Secretariat of the Pacific Community, Noumea, New Caledonia.
[172] VFD (2015). Vanuatu National Sea Cucumber Fishery Management Plan 2015. Vanuatu Fisheries Department, Port Vila, Vanuatu.
[173] VFD (2021). Catch Production and Market Data Report 2020. Vanuatu Fisheries Department, Port Vila, Vanuatu.

Table VAN1: Vanuatu BDM harvests (2020–2022) and export volumes and prices in vatu (VUV) (2020 only)

Scientific name	English common name	Harvest volume (t) (wet weight)			Export (2020)[174]	
		2020	2021	2022	Volume (t) dry weight	Price received (VUV/kg)
Actinopyga lecanora	Stonefish	-	-	-	0.1	3,574
Actinopyga mauritiana	Surf redfish	13.0	9.28	1.25	4.4	2,601
Bohadschia argus	Tigerfish	3.0	12.37	0.98	1.2	2,883
Bohadschia vitiensis	Brown sandfish	6.0	16.93	3.19	0.3	1,838
Holothuria atra	Lollyfish	5.0	-	-	1.9	648
Holothuria fuscogilva	White teatfish	1.0	1.93	0.50	0.8	10,487
Holothuria whitmaei	Black teatfish	0.6	1.62	-	0.4	13,731
Stichopus chloronotus	Greenfish	3.0	0.72	-	0.4	1,514
Stichopus herrmanni	Curryfish	1.0	0.03	-	0.1	1,945
Thelenota ananas	Prickly redfish	3.0	9.10	2.07	0.3	3,460
Total		**36.0**	**51.98**	**7.99**	**9.86**	

According to the VFD, harvests continued in 2021[175] and 2022[176] as shown in Table VAN1, but no exports took place.

During the 2017–2018 fishery closure period, the BDM management plan was revised and changed quite substantially. The new plan, published in 2019, took into account the findings of a strategic study of the fishery[177] and placed a greater emphasis on the retention of economic benefits in Vanuatu[178]. According to the plan, fishers in Vanuatu have received to date about 20% of the end product value, while a further 20% accrues to exporters and 5% to the government in the form of licence fees and levies. This means that about 45% of the product value is retained in Vanuatu while 55% of value is added after the BDM has been exported. Apart from ensuring that the fishery is sustainable, a key goal of the 2019 plan is to increase the value retained in Vanuatu to 60% of the end product price.

The 2019 Plan is quite unlike BDM Management Plans in other PICTs. The Plan provides for resource surveys, local TACs, rigorous monitoring and 'crop rotation' to avoid the free-for-all harvesting that has characterised previous periods of fishing.

- The plan limits the number of export licences to a maximum of two. At present only one is active, and this is a joint venture with the Government of Vanuatu.
- Harvesting permits are allocated to specified coastal areas based on Vanuatu's local area councils (LAC), of which there are 74 over the whole country.
- Prior to harvesting, the Vanuatu Fisheries Department (VFD) undertakes a sea cucumber resource survey which typically takes 3–4 days. During the survey sea cucumber species are enumerated through 60–80 visual transects.
- Based on the survey results, resource abundance is determined for each major sea cucumber species of interest.

[174] Includes product that was harvested in 2019 but not exported until 2020.
[175] VFD (2022). Catch Production and Market Data Report 2021. Vanuatu Fisheries Department, Port Vila, Vanuatu.
[176] VFD (2023). Catch Production and Market Data Report 2022. Vanuatu Fisheries Department, Port Vila, Vanuatu.
[177] Léopold., M. (2016). Evaluating the harvest and management strategies for the sea cucumber fisheries in Vanuatu. Projects No 4860A1 (BICH2MER) and No CS14-3007-101 (BICHLAMAR). IRD, Nouméa.
[178] VFD (2019). Vanuatu National Sea Cucumber Fishery Management Plan 2019-2024. Vanuatu Fisheries Department, Port Vila, Vanuatu/Secretariat of the Pacific Community, Noumea, New Caledonia.

- A TAC is then determined based on 20% of the estimated resource abundance. If a species is scarce (stock estimated to be less than 2 t) no TAC is determined.
- In consultation with provincial and local authorities, resource owners and community representatives, the TAC is allocated to relevant groups for harvesting.
- A fishing open season is declared for the area in question. This is generally quite short – just a few days or weeks.
- Prices for each harvested species are negotiated between fishers and the processing or export licence holder, based on the recommended price list shown in table VAN2.
- Harvesting takes place until the end of the open season. If the TAC for a given species is reached before the end of the open season, harvesting of that species must cease.
- Harvesting, processing and sales activities are monitored by one or more VFD observers, who keep independent records which are then used to verify data submitted by licence holders.
- Once the harvest is complete, no further fishing is authorised in that location for at least two years. At that time the VFD may resurvey the area and determine whether a new harvest period can be permitted.

Eleven areas were harvested for sea cucumbers under this scheme in 2020, 13 in 2021 and six in 2022. In each case species-specific wet-weight TACs were determined for between two and five species of sea cucumber. None of the TACs exceeded 5.5 t, and most were considerably lower, sometimes less than 500 kg. In most cases the TACs were not reached before the fishing period ended, although in a few they were exceeded so that stop-fishing orders were issued for the species concerned. Total TAC allocations across all harvest areas are shown in Table VAN2.

Table VAN2: Sea cucumber total allowable catches (wet weight) in Vanuatu[179]

Scientific name	Common name	Total allowable catch (all areas combined) (t)		
		2020	2021	2022
Actinopyga mauritiana	Surf redfish	33.90	24.60	15.70
Actinopyga miliaris	Blackfish	-	-	1.50
Bohadschia argus	Tigerfish	19.00	12.50	14.16
Bohadschia marmorata	Brown sandfish	5.40	10.60	22.00
Holothuria atra	Lollyfish	11.50	-	1.00
Holothuria fuscogilva	White teatfish	2.60	1.50	2.20
Holothuria whitmaei	Black teatfish	3.10	1.00	2.80
Stichopus chloronotus	Greenfish	5.60	0.80	1.00
Stichopus variegatus	Curryfish	7.50	-	12.50
Thelenota ananas	Prickly redfish	9.50	21.80	13.51
Total		**98.10**	**72.8**	**86.37**

The degree to which processing of the sea cucumbers takes place at the harvesting location depends on its distance and remoteness from Port Vila. If the harvested sea cucumbers can be easily transported, they may be delivered wet to the export company processing facility in the capital. If the harvesting area is too remote, it may be necessary to fully process the sea cucumbers on site, or ship them semi-processed and salted, for final processing later.

[179] Data from VFD (2021), VFD (2022) and VFD (2023). VFD (2021). Catch Production and Market Data Report 2020. Vanuatu Fisheries Department, Port Vila, Vanuatu. VFD (2022). Catch Production and Market Data Report 2021. Vanuatu Fisheries Department, Port Vila, Vanuatu. VFD (2023). Catch Production and Market Data Report 2022. Vanuatu Fisheries Department, Port Vila, Vanuatu.

Table VAN3 shows recommended minimum buying prices for wet and dry sea cucumbers in Vanuatu, as well as the expected price received for exported product.

Table VAN3: Recommended minimum sea cucumber buying prices in Vanuatu[180]

Scientific name	Common name	Bislama name	Minimum price (VUV/kg)		
			Buying (wet)	Buying (dry)	Export price (dry)
Actinopyga echinites	Deepwater redfish	Dipwota redfis			
Actinopyga lecanora	Stonefish	Stonfis	550	2,000	9,000
Actinopyga mauritiana	Surf redfish	Sefredfis	300	4,000	7,000
Actinopyga miliaris	Blackfish	Blakfis			7,000
Actinopyga palauensis	Deepwater blackfish	Dipwota blakfis	500	1,000	6,000
Bohadschia argus	Tigerfish	Taikafis	250	2,000	5,000
Bohadschia similis	Chalkfish	Jokfish	500	1,300	5,000
Bohadschia vitiensis	Brown sandfish	Braon sanfish	200	1,300	4,000
Holothuria atra	Lollyfish	Lolifis	100	1,000	5,000
Holothuria coluber	Snakefish	Snekfis	200	1,500	3,000
Holothuria edulis	Pinkfish	Pinkfis	200	500	5,000
Holothuria flavomaculata	Red snakefish	Red snekfis			5,000
Holothuria fuscogilva	White teatfish	Waet titfis	3,200	8,000	19,000
Holothuria fuscopunctata	Elephant trunkfish	Elefenfis	400	1,000	1,500
Holothuria lessoni	Golden sandfish	Kolten sanfis	2,400	6,000	30,000
Holothuria scabra	Sandfish	Sanfis	3,600	8,500	30,000
Holothuria whitmaei	Black teatfish	Blak titfish	1,200	5,000	18,000
Pearsonothuria graffei	Flower fish	Flaoafis	500	1,300	6,000
Stichopus chloronotus	Greenfish	Krinfis	200	5,000	7,000
Stichopus herrmanni	Curryfish	Karifis	300	2,000	12,000
Stichopus horrens	Peanutfish	Pinatfis			5,000
Stichopus vastus	Brown curryfish	Braon karifis			2,500
Thelenota ananas	Prickly redfish	Paenapolfis	2,500	4,000	6,000
Thelenota anax	Amberfish	Ambafis	400	1,300	2,200

The prices shown in the table are quite varied: for example, for some species (e.g. amberfish, *T. anax*) the dry-product buying price is more than half of the expected export price, while for others (e.g. curryfish, *S. herrmanni*) it is 20% or less. The rationale for these differences is not clear.

Table VAN4 shows the calculated average export prices received for the 10 BDM species exported in 2020[181], compared to the reference prices stipulated in the 2015 Sea Cucumber Management Plan that are still in force.

[180] The prices listed in Table VAN2 are from the 2015 Sea Cucumber Management Plan, and are still being used as a basis for negotiation between fishers and buyers. The 2019 Sea Cucumber Management Plan does not contain a recommended price list.

[181] Data from VFD (2021), VFD (2022) and VFD (2023). VFD (2021). Catch Production and Market Data Report 2020. Vanuatu Fisheries Department, Port Vila, Vanuatu. VFD (2022). Catch Production and Market Data Report 2021. Vanuatu Fisheries Department, Port Vila, Vanuatu. VFD (2023). Catch Production and Market Data Report 2022. Vanuatu Fisheries Department, Port Vila, Vanuatu.

Table VAN4: Comparison of stipulated minimum export prices and those actually received in 2020

Scientific name	English common name	Export (2020)			
		Volume (t) dry weight	Price received (VUV/kg) A	Minimum price (VUV/kg) B	Ratio (A/B) (%)
Actinopyga lecanora	Stonefish	0.1	3,574	9,000	39.7%
Actinopyga mauritiana	Surf redfish	4.4	2,601	7,000	37.2%
Bohadschia argus	Tigerfish	1.2	2,883	5,000	57.7%
Bohadschia vitiensis	Brown sandfish	0.3	1,838	4,000	46.0%
Holothuria atra	Lollyfish	1.9	648	5,000	13.0%
Holothuria fuscogilva	White teatfish	0.8	10,487	19,000	55.2%
Holothuria whitmaei	Black teatfish	0.4	13,731	18,000	76.3%
Stichopus chloronotus	Greenfish	0.4	1,514	7,000	21.6%
Stichopus herrmanni	Curryfish	0.1	1,945	12,000	16.2%
Thelenota ananas	Prickly redfish	0.3	3,460	6,000	57.7%
	Total	**9.86**		**Average**	**42.0%**

The table indicates that the prices received by the one Vanuatu exporter operating in 2020 were significantly lower than the established reference price (less than 50% for six out of the ten species exported, and less than 20% for a couple of species, with an average of 42%). This could be due to:

- unrealistic minimum prices set by VFD;
- poor quality of BDM processing, resulting in lower export prices; and/or
- inaccurate reporting of prices received by exporters.

Other factors not fully known may also have an influence on the relatively low prices received.

As well as controlling harvesting, the 2019 Sea Cucumber Management Plan also provides for the issuance of up to two sea cucumber aquaculture permits, two permits to carry out research on sea cucumber value-adding, and an unspecified number of permits for the production of pharmaceutical products. In addition, it makes numerous other provisions, for example: the use of licence fees to support activities that enhance wild sea cucumber stocks; research into value-adding and alternative products; assessment of the potential for auctioning Vanuatu BDM products; and regular monitoring of international wholesale and retail prices. However, many of these supplementary provisions are not yet being implemented.[182]

A 2022 review[183] made the following comments on sea cucumber aquaculture in Vanuatu:

> Current species cultivated commercially: Sea cucumber (*H. scabra)*. Private hatchery on Aore Island in Sanma Province. Seed moved to Havannah Harbour in Efate and some released locally. No harvest yet, so cannot be judged to be fully commercial. Major problems with ownership of end product. Gets feed for larvae in from Netherlands.[184] There is currently one company licensed to produce sea cucumber-based pharmaceutical products in Vanuatu, manufactured form *H. atra*.[185]

[182] Javen Ham and Sammy James, VFD Officers, pers. comm.
[183] Lindsay, S., R. Lindley, M. Lam and H. Lassauce (2022). Assessment of the aquaculture needs, priorities and future direction in the Pacific Islands region. Report by Integrated Aquatic Solutions for the Secretariat of the Pacific Community, Noumea, New Caledonia.
[184] This hatchery has now ceased operation after a dispute between the business partners involved. (Author's personal observation).
[185] Author's personal observation.

Appendix 2: Key informants

The following is a list of individuals who kindly contributed information to the main body of this report.

Designation	Forename	Surname	Organisation	E-mail address	Country
Ms	Shirlene	Anthonysamy	Trade Promotion Division, INFOFISH	shirlene@infofish.org	Malaysia
Dr	Beni	Azari	Sea Cucumber Consultancy Pty Ltd	info@seacucumberconsultancy.com.au	Australia
Mr	Manuel	Ducrocq	Chef de Service, SPNMCP	manuel.ducrocq@gouv.nc	New Caledonia
Dr	Michael	Fabinyi	Associate Professor, University of Technology Sydney	Michael.Fabinyi@uts.edu.au	Australia
Mr	Bernard	Fao	Responsible du bureau des pêches, PS3DT	bernard.fao@province-sud.nc	New Caledonia
Mr	Sompert	Gereva	Director, VFD	sgereva@fisheries.gov.vu	Vanuatu
Mr	Robert	Gillett	Gillett, Preston & Associates Inc	rgillett1@yahoo.com	Fiji
Mr	Leban	Gisawa	Executive Manager, Licensing and Data Management Unit, NFA	lgisawa@fisheries.gov.pg	Papua New Guinea
Dr	Hugh	Govan	Adviser, LMMA Network	hgovan@gmail.com	Fiji
Dr	Tuikolongahau	Halafihi	Chief Executive Officer, MOF	supi64t@gmail.com	Tonga
Mr	Claudius	Halumwane	Chief Fisheries Officer Statistics Section, MFMR	chalumwane@fisheries.gov.sb	Solomon Islands
Mr	Jayven	Ham	Research Officer, VFD	jham@fisheries.gov.vu	Vanuatu
Mr	Edward	Honiwala	Director of Fisheries, MFMR	ehoniwala@fisheries.gov.sb	Solomon Islands
Mr	Justin	Ilakini	Acting Managing Director, NFA	ilakinijay@gmail.com	Papua New Guinea
Mr	Sammy	James	Principal Fisheries Officer Seafood Product Hygiene, VFD	sjames@fisheries.gov.vu	Vanuatu
Ms	Lucy	Joy	Principal Data Officer, VFD	ljoy@fisheries.gov.vu	Vanuatu
Dr	Jeff	Kinch	Principal, National Fisheries College	kinch.jeff@gmail.com	Papua New Guinea
Mr	Rickson	Lis	Sedentary Resource Manager	rlis@fisheries.gov.pg	Papua New Guinea
Ms	Rosalie	Masu	Deputy Secretary Inshore, MFMR	rmasu@fisheries.gov.sb	Solomon Islands
Ms	Gemma	Matainaho	Trade Promotion Division, INFOFISH	gemma@infofish.org	Malaysia
Dr	Christain	Ramofafia	Permanent Secretary, MFMR	cramofafia@fisheries.gov.sb	Solomon Islands
Ms	Atelaite	Rokosuka	Dep. Sec. Fisheries, MOF	atelaite.rokosuka@govnet.gov.fj	Fiji
Mr	Mike	Savins	Atoll Beauties	michaelsavins@hotmail.com	Kiribati
Mr	Karibang	Tamerua	Principal Fisheries Officer, Coastal Fisheries Division, MFMRD	karibanangt@fisheries.gov.ki	Kiribati
Ms	Tooreka	Teemari	Director, Coastal Fisheries Division, MFMRD	tooreka@mfmrd.gov.ki	Kiribati
Mr	James	Teri	Deputy Director – Aquaculture, MSSIF Programme	jteri@fisheries.gov.sb	Solomon Islands
Ms	Magali	Verducci	BDM Manager, DRM	magali.verducci@drm.gov.pf	French Polynesia

Many additional people were contacted but did not respond and are therefore not listed here.

Key informants from SPC included Mr Ian Bertram, Ms Julie-Anne Kerandel, Mr Franck Magron, Ms Ariella D'Andrea, Mr Aymeric Desurmont, Mr Richard Veeran and Mr George Shedrawi.

ISBN 978-982-00-1532-6