

A comparison of commercial sea cucumber communities in the French Polynesia and New Caledonia atolls listed as UNESCO Man and Biosphere and World Heritage Areas

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Abstract

Sea cucumber communities in the UNESCO² Man and the Biosphere Fakarava Reserve of French Polynesia and in the Entrecasteaux group of the Lagoons of New Caledonia's World Heritage Area were assessed in 2012–2013. These two UNESCO-listed areas only include atolls, of various sizes and depth. The 2012–2013 period marked the official end of recent exploitations of sea cucumbers in both areas. The same survey methodology was used at both locations, which allowed us to compare the commercial communities. The Entrecasteaux group had more commercial species than Fakarava Reserve, but densities overall were similar. *Bohadschia* was the most abundant genus in the Man and Biosphere Reserve, while *Thelenotia ananas* was the most abundant species in Entrecasteaux. Compared with many sites in the Pacific, these atolls still harbour significant sea cucumber populations, and it is expected that their status will remain positive in 2020 due to their protection and management. The two locations, however, have been fished since at least 2016: Entrecasteaux is exposed to international poaching, and several of the Fakarava Reserve atolls are legally fished every year. This exploitation, legal or illegal, calls for the periodic re-assessment of the status of sea cucumbers through dedicated holothurian surveys.

Key-words: UNESCO, Man and the Biosphere, Fakarava Reserve, Entrecasteaux, World Heritage Area, Lagoons of New Caledonia, Atoll

Introduction

Among the French overseas territories of the Pacific Ocean, two groups of atolls have received the recognition of the United Nations Educational, Scientific and Cultural Organization (UNESCO) for their remarkable environment or cultural values. In the Tuamotu Archipelago in French Polynesia, the Man and the Biosphere (MAB) Fakarava Reserve includes – since 2006 and after a revision of its legal status in 2016 – seven atolls (Taiaro, Niau, Aratika, Kauehi, Raraka, Toau, Fakarava) that are all within the Fakarava municipality (DRMM 2017). To the northwest of New Caledonia, the Entrecasteaux Group, which is under the jurisdiction of the Government of New Caledonia, is one of the six clusters that together makes up, since 2008, the Lagoons of New Caledonia World Heritage Area (Andréfouët and Wantiez 2010). It includes seven atolls, namely Huon, Surprise, Mérite, Portail, Pelotas, Gros Guilbert and Petit Guilbert.

In addition to these prestigious listings, the Entrecasteaux group is part of the Natural Park of the Coral Sea (*Parc Naturel de la Mer de Corail*, or PNMC) implemented by the New Caledonia government in 2014. It was also since 2013 a no-take area, including for holothurians. The area

also benefits since 2018 from a new zoning plan with several natural reserves and strict nature reserves³. The atolls of the MAB Fakarava Reserve also benefit from zoning plans that should limit fishing for large areas within each atoll lagoon (DRMM 2017; Andréfouët et al. 2019).

The comparison of the commercial sea cucumber communities for these two areas is based on data collected in December 2012 for French Polynesia, and in December 2013 for New Caledonia. This was a key period for both regions, as 2013 marked the transition towards a no-take area for Entrecasteaux, which was significantly fished before that time (Purcell et al. 2009). No precise statistics exist to our knowledge, but Purcell et al. (2009) reported that fishing was extensive around and within “Surprise” (often, for New-Caledonian locals, “Surprise” is the name for the entire Entrecasteaux group). The only professional fisher who legally fished the area was catching there half of his production, around 1–5 tonnes of sea cucumber (wet weight) during regular three-week fishing trips (Kronen et al. 2009; Purcell et al. 2009). How long this exploitation went on for was not reported, but it took place for at least several years. Similarly, the survey in the MAB Fakarava Reserve in December 2012 was achieved only a few weeks after the French Polynesia moratorium was

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² UNESCO = United Nations Educational, Scientific and Cultural Organization

³ <https://www.iucn.org/theme/protected-areas/about/protected-area-categories>

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instated (Andréfouët et al. 2019). This moratorium ended three years of exploitation that ranged from extensive to nonexistent within the MAB reserve, depending on the atoll (Andréfouët et al. 2019).

The objectives of this study were to make a comparative assessment between two atoll regions, both recognized by UNESCO, and just after sea cucumber exploitation ceased officially. It was not expected to have similar figures considering that the two regions belong to two very different biogeographical provinces, but the results can be used as a baseline if new surveys occur, and to bracket the statistics from other atoll regions in other exploited Pacific atoll regions or countries. To the best of our knowledge, these are still the most recent surveys dedicated to sea cucumbers for the two regions. Recommendations for scientific monitoring are also discussed specifically for the Tuamotu Atolls and New Caledonia.

Methods

Observations in the Fakarava Reserve and the Entrecasteaux group took place from 21 November 2012 to 9 December 2012 and from 11 November 2013 to 24 November 2013, respectively. The census activity was hosted by the Global Reef Expedition of the Khaled bin Sultan Living Ocean Foundation (LOF) on board the R/V *Golden Shadow*. In the Fakarava Reserve, four atolls were surveyed: Fakarava, Raraka, Toau and Aratika. In Entrecasteaux, all atolls were surveyed except Pelotas. The number of sites were different for each archipelago ($n = 31$ for Entrecasteaux, $n = 47$ for Fakarava Reserve) and per atoll (Fig. 1), as different priorities were given to different sites by the authorities, especially in French Polynesia where Fakarava was more extensively sampled (Andréfouët et al. 2019). More sites were also surveyed at Surprise and Huon atolls than on the other, smaller, Entrecasteaux atolls. The large differences in sampling effort between atolls prompted us to generally focus on the best sampled atolls and compare trends with simple descriptive statistics.

The census method used in both regions was the same as described in Andréfouët et al. (2019). In short, the daytime census was done at depths between 30 m and the shallowest part of the visited location. All observed sea cucumber individuals were counted during a one-hour dive that was staged by depth (5' several times at 30 m, 20 m, 10 m, 5 m, 2–0 m). Most of the stations were selected by the LOF scientific cruise director, who prioritised coral and fish surveys; hence, many stations were located on oceanic forereefs dominated by corals, which are not necessarily a prime habitat for sea cucumbers. However, we could complete lagoonal surveys as a separate team when possible, especially for Raraka, Fakarava, Surprise and Huon atolls. Hereafter, densities per species are provided per minute of search time, but a correspondence with densities per surface area is reasonably possible due to the surveyor's constant swimming speed and visual coverage (Andréfouët et al. 2019). Data collected (richness, densities per species or for all species pooled together) was reported per depth range, per habitat (forereef *vs* lagoon), per station,

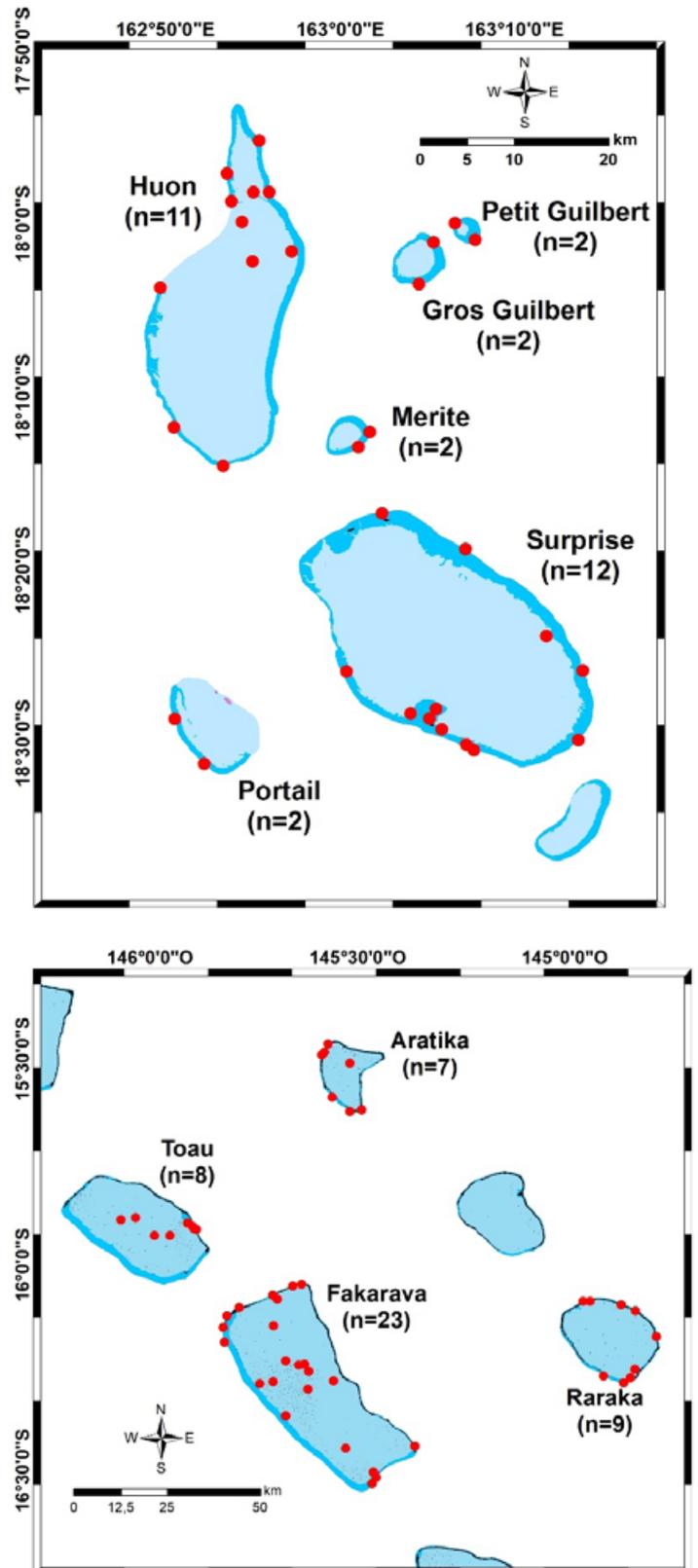


Figure 1. Study sites and survey locations. Top: The Entrecasteaux Group. Bottom: The four sampled atolls of Fakarava Reserve. n = the total number of stations per atoll (stations without any records are included).

per island, and per archipelago. Here, we focus on archipelago, island and habitat scales.

Species list considered here for the censuses was adapted to each location. French Polynesia species were *Holothuria fuscogilva*, *Holothuria whitmaei*, *Thelenota ananas*, *Thelenota anax*, *Actinopyga mauritiana*, *Stichopus chloronotus*, and *Bohadschia* spp. For Entrecasteaux, *Actinopyga miliaris* and *Holothuria fuscopunctata* also occurred. Similar to Andréfouët et al. (2019) who, for French Polynesia, pooled together all *Bohadschia* species for reasons of unsolved taxonomy, we did the same for New Caledonia for the sake of comparison and added together the records for *B. argus* and *B. vitiensis*. Small species such as *H. atra* or *H. edulis* were not censused systematically and their densities are not reported here, but these species were taken into account for the overall richness.

Results and discussion

In terms of richness, Entrecasteaux had more commercially valuable sea cucumber species (11) than Fakarava Reserve (8). Note that the prized *Holothuria scabra* and *H. lessona* were not found during the surveys at either Entrecasteaux or Fakarava Reserve. These values are underestimations of the true richness, and other species have been reported elsewhere. Wantiez et al. (2013) for instance observed fewer species than here using a 50-m-long, transect-based protocol, but found different species (*Actinopyga palauensis*, *A. lecanora* and *Holothuria scabra*).

In Entrecasteaux, all 31 surveyed stations at Huon, Surprise, Mérite, Portail, Gros Guilbert and Petit Guilbert atolls had records of sea cucumbers (Figs. 2 and 3). At the scale of

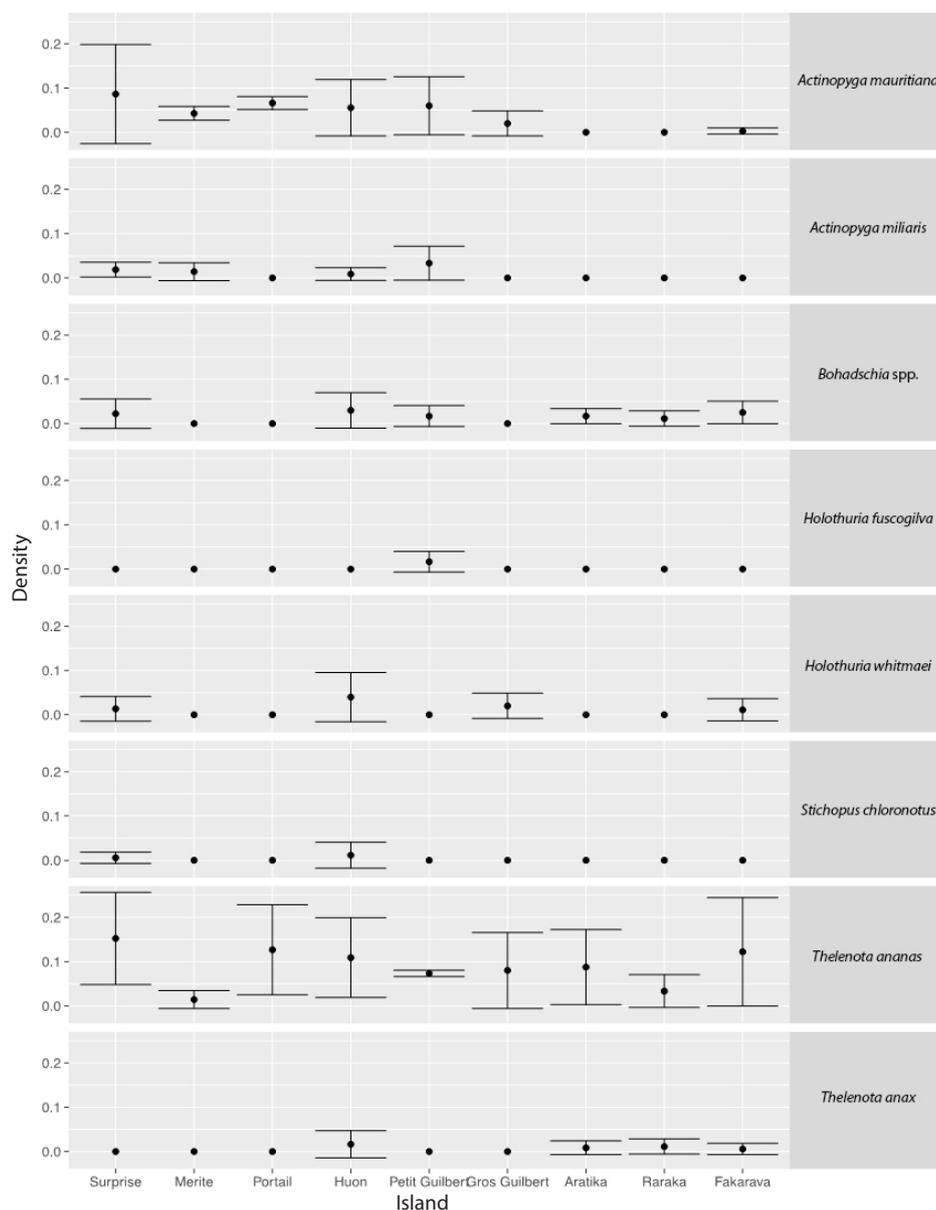


Figure 2. Density (in number of individuals per min, average \pm standard deviation) per atoll, per species, and for ocean foreereef stations for both the Entrecasteaux Islands and Fakarava Reserve.

the archipelago, the most frequently observed species was *Thekenota ananas* (with 142 records total), which was found on both forereefs and lagoons, especially at Huon, Portail and Surprise. *Bohadschia* spp followed *T. ananas* in abundance, at 62 individuals. The average count per station, all species included, is provided in Table 1.

In the lagoons, *Bohadschia* spp. were more abundant than the most abundant species at Entrecasteaux (*Thekenota ananas*) (Fig. 3). Translated into density per surface area of suitable habitat, the timed-census data suggest a *Bohadschia* spp. density of 10.8 ind./ha at Fakarava Atoll vs 7.13 ind./ha and 5.94 ind./ha at Huon and Surprise atolls respectively, for *T. ananas*.

All species included, the densities were moderate at Entrecasteaux except for few remarkable dives at Surprise and Huon atolls (Figs. 2 and 3, Table 1). The highest scores were

obtained for two lagoon stations at Surprise Atoll (47 and 39 individuals of all species) and one lagoon station at Huon (42 individuals of all species). In comparison, at Fakarava, four lagoon stations yielded 86, 74, 66 and 64 individuals. In Toau, three lagoonal stations provided 41, 48 and 78 individuals. Overall, the average abundance (all species included) found at both habitats (lagoon and oceanic forereef) are fairly similar between the two regions (Table 1). The average is slightly higher for Toau and Fakarava (22–29 individuals) than for Huon and Surprise (13–20 individuals), but much lower for all other sites. For all sites, standard deviations are high, highlighting the large differences from one habitat to another when pooling oceanic and lagoonal stations (Figs. 2 and 3, Table 1).

The highest numbers at several Tuamotu stations, due to the large number of *Bohadschia* individuals, can be explained

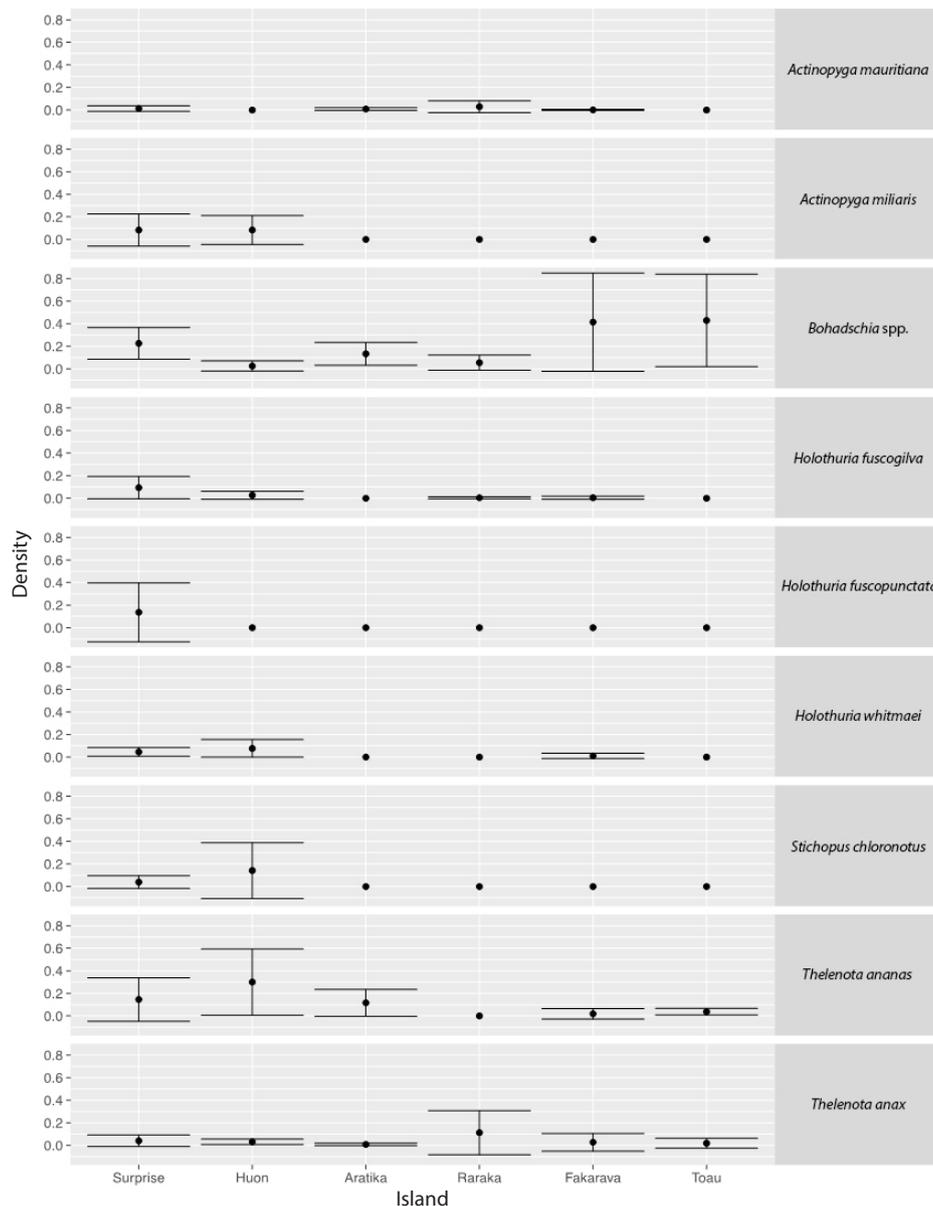


Figure 3. Density (in number of individuals per min, average \pm standard deviation) per atoll, per species, and for the lagoon stations.

Table 1. Average count and standard deviation (all species included) per atoll, considering all stations with non-null records. n = number of stations.

Region	Atoll	Average count	Std. dev.	n
Entrecasteaux	Surprise	19.6	12.7	12
	Huon	13.6	12.2	11
	Portail	7.0	4.2	2
	Petit Guilbert	5.5	0.7	2
	Merite	3.5	0.7	2
	Gros Guilbert	3.0	2.8	2
Fakarava	Toau	29.1	26.0	8
	Fakarava	22.0	26.9	21
	Aratika	9.8	6.3	6
	Raraka	8.3	9.2	7

by the surveyed habitats. In the Tuamotu atolls, sampling often occurred around coral pinnacles, where the mosaic of soft bottom, rubble and hard bottom are favourable to *Bohadschia* species, especially *B. argus*. Conversely, at Huon or Surprise, lagoonal surveys were dominated by a sand bottom suitable for *B. vitiensis* (most often found buried in the sediments), but less attractive for *B. argus*. High density locations at Huon and Surprise included pavement bottoms used by *Theleota ananas*.

Given the biogeographical differences and remoteness of the Entrecasteaux Islands, we expected to find higher densities there, but this was not necessarily the case. Only the expected highest species richness was confirmed. We assume that the long period of exploitation of the Entrecasteaux atolls by professional fishing was still impacting the census in November 2013, yielding densities comparable to recently fished areas in the Tuamotu. Seven years later, in 2020, resurveying the same locations should provide a better view of the natural population. This cannot, however, be fully guaranteed as the Entrecasteaux atolls have been significantly poached by the so-called Blue Boats from Viet Nam, which fish illegally in the waters of the Parc Naturel de la Mer de Corail, especially around Entrecasteaux. Between 2016 and 2017, up to 28 tonnes of illegally caught and unprocessed sea cucumbers were seized by authorities (Parc Naturel de la Mer de Corail 2017).

At Fakarava Reserve, fishing was authorised again in 2014, and fishers from Fakarava have been active every year at both Fakarava and Toau lagoons (Andréfouët et al. 2019, DRMM 2017). Raraka was also open to fishing, and Aratika remained unfished as before 2012. The differences today with the 2009–2012 period of fishing in French Polynesia is that fishing authorisations are subjected to a request made by a local atoll management committee, and that quotas are provided by the Direction des Ressources Marines, French Polynesia's fishery department. However, the exact status of resources is unknown, and no monitoring takes place. It is, therefore, strongly suggested to promptly assess sea cucumber stocks in both protected and non-protected areas of the MAB lagoons in the near future.

Conclusion

The UNESCO listings bring prestige and visibility to the awarded locations. It also brings responsibilities to local authorities and communities to maintain the environmental value of the sites. Here, we assessed the status of sea cucumber commercial species at two UNESCO-listed locations by comparing the Man and Biosphere Fakarava Reserve and the Entrecasteaux cluster of the Lagoons of New Caledonia World Heritage Area. These two areas are remarkable in that both include several atolls and include only these type of coral reef formations. The comparison of their sea cucumber commercial populations did not aim to establish a precise unbiased ranking of quality because the two areas are inherently different with regards to their biogeography, and because of the presence of people in the MAB reserve and not in Entrecasteaux. The two regions also have a different history of management regimes, exploitation and zoning plans. Sampling effort was also different at both locations, although we found that resource status appeared fairly similar overall, with variations related to present species and habitats. A main important conclusion is that, compared to many sites in the Pacific, these lagoons still harbour significant sea cucumber populations. This is good news, and even if the surveys were from 2012 to 2013, it is expected that the status remains positive in 2020 due to their protection and management. The two locations, however, have been fished since at least 2016: Entrecasteaux is exposed to international poaching, and several of the MAB atolls are legally fished every year. This exploitation, legal or illegal, calls for periodic re-surveying of holothurian populations.

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From top left, anticlockwise: *Bobadschia* sp. (Fakarava Atoll, French Polynesia), burrowed *Bobadschia vitiensis* (Surprise Atoll, New Caledonia); *Holothuria whitmaei* (Surprise Atoll, NC), *Holothuria fuscogilva* (Raraka Atoll, FP); *Actinopyga mauritiana* (Surprise Atoll, NC); *Thelenota anax* (Raraka Atoll, FP), *Thelenota ananas* (Huon Atoll, NC) - Center: Lagoon floor with numerous holothurian specimen visible (Huon Atoll, NC). (Images: Serge Andréfouët)