

Species list of Indonesian *trepang*

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Abstract

As is well known, *trepang* (beche-de-mer) is considered not only a delicacy but also as a traditional medicine. In official Indonesian export data, *trepang* is treated as a single species, even though in several national and international scientific publications it is evident that *trepang* from Indonesia includes multiple species. It is difficult to identify processed (dried) *trepang* and, since most *trepang* for export is in its dried form, it is easier to state that *trepang* is a single species. The current study aims to provide a species list of all the species included in Indonesian *trepang* which have ever been, and still are, fished for trade. The result puts in evidence 54 species, of which 33 have been taxonomically confirmed. There are some species that are traded but have not been previously documented.

Introduction

Indonesia is the largest *trepang*-producing country, according to Food and Agriculture Organization of the United Nations global statistics, with Hong Kong SAR (China) as the main importing country (Bruckner et al. 2003; Tuwo 2004; Choo 2008). As in other countries, Indonesian *trepang* has suffered from over exploitation, and unregulated fishing is considered the main cause (Bruckner et al. 2003; Tuwo 2004; Purwati and Yusron 2005; Choo 2008; Purwati et al. 2010; Purcell et al. 2011). It is thought that a huge exploitation has been occurring since the end of the seventeenth century, when Indonesian *trepang* fishermen started to go as far afield as northern Australia because there was no longer enough *trepang* in the waters of Maluku or Sunda to fulfil the demands of the Chinese market (Knaap and Sutherland 2004; Máñez and Ferse 2010).

Trepang accounts for only $\pm 4.5\%$ of the total number of sea cucumber species. Sixty-six species have been fished worldwide, with the majority from Indo-Pacific waters (Purcell et al. 2011; Conand and Byrne 1993). Purwati (2005) reports 26 species that have ever been, or are still being, traded in Indonesian waters. From another report, Choo (2008) lists 35 *trepang* species from Indonesia that entered the international markets. Both resources are compiled mostly from fishery reports, which do not include taxonomic information. Meanwhile, in export statistics published by the Ministry of Marine Affairs and Fisheries in 2011, *trepang* is still considered a single product (mono-species).

Indonesia is known as an area with a very high diversity of marine organisms, distributed in a total area of 5.2 million km². It is difficult to determine the main areas where particular species are found because fishermen are scattered over a vast area and protect their information about precise fishing locations (Tuwo 2004; Purwati 2005; Choo 2008). Furthermore, it is difficult to identify the *trepang* species that enter the market, partly because the local names for species differ from area to area, and because the *trepang* traded are in the form of processed products (dried or gutted and salted) which damage the taxonomic characteristics.

In order to list the *trepang* species traded in Indonesia, we started from four fish-landing locations that provided easy access. As these locations offered fresh and processed *trepang*, we evaluated whether the species of dried and gutted-salted ones could still be identified.

Methods

Between December 2011 and February 2013, we collected *trepang* samples from four locations (Fig. 1): Karimunjawa, northern Central Java (six fresh specimens), Situbondo, northern East Java (11 fresh specimens), Spermonde, South Sulawesi (nine salted specimens) and Ambon, Central Moluccas (eight dried specimens).

All samples were collected from either *trepang* divers/fishermen or collectors to ensure that those species were gathered for trade. The fresh samples

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Figure 1. Locations where *trepang* specimens were collected from. Study sites: (1) Karimunjawa; (2) Situbondo; (3) Spermonde; (4) Ambon.

were preserved in 96% alcohol for a week, then in 70% alcohol for long-term storage. The salted ones were rinsed in tap water to remove the salt and then preserved in the same way, and the dried samples were kept in plastic bags until identified, then preserved in 70% alcohol for long-term storage. All the samples were deposited in the Museum Zoological Bogoriense Indonesia.

Species identification was based on morphology, and ossicle types and composition. Ossicles were collected from the dorsal body wall, the ventral body wall, the dorsal papillae, the ventral tube feet, the tentacle, the collar, the anal papillae, the cuvierian tubules, the gonad, the rete mirabile, the longitudinal muscle, the cloacal wall and the cloacal retractor muscle. Small pieces of tissue from each sample were dipped in domestic bleach for several minutes. The ossicles were rinsed with tap water, followed by 70% alcohol before being identified under a compound microscope.

Results

From the studied areas, we identified 27 species of *trepang* (Table 1). The taxonomic accounts have been reported in Setyastuti (2013). This result added *trepang* species that have ever been, and/or are still being, fished in Indonesia, giving a total of 54 species (Table 2).

Discussion

Sea cucumber species in Indonesian trading

Karimunjawa is one of the *trepang* producing areas in Java. Purwati et al. (2010) successfully identified

18 species of *trepang* fished and traded in this area. From this study, we added two other species i.e. *Holothuria (Metriatyla) cf. lessoni* (Massin, Uthicke, Purcell, Rowe and Samyn, 2009) and *Stichopus cf. monotuberculatus* (Quoy and Gaimard, 1833).

Unlike other locations in this study, Situbondo has never been included as a research site for *trepang* or holothurian studies. Out of eight species from this area, three species (*Holothuria turriscelsa*, *H. excellens*, and *Stichopus noctivagus*) have been found only in Spermonde Island previously, as reported by Massin (1999).

Generally, fishermen may not be aware of the small differences in the appearance of *trepang* when they collect them. Consequently, many species that were not in market demand were fished. *Stichopus cf. monotuberculatus* was rarely reported as a traded species. Local fishermen called it teripang pace, the same name for *Stichopus vastus*, because they are similar in their external morphology. *Stichopus vastus* was more frequently reported as being traded than *S. quadrifasciatus*. This species was the most common species found in shallow water and easily distinguishable from its morphology, such as the reticulate black-brown "tiger" pattern covering the dorsal body wall (Massin et al. 2002). Choo (2008) mentions the presence of *S. quadrifasciatus* in her list and one of the origin countries is Indonesia, but Purcell et al. (2010) does not include it. Purwati et al. (2010) assumes that this situation is generated by insufficient volume or lack of regular supplies entering the market. In Indonesia, this species was reported from two locations: Lombok waters and Seribu Archipelago (Wirawati et al. 2007; Setyastuti 2011).

Table 2. List of all *trepanig* species which have ever been, and/or are still being, fished and traded in Indonesia. Specimen condition was related to the specimen when it was identified. Other sources refer to [A] Purwati (2005); [B] Purwati (2005); [C] Choo (2008); [D] Máñez and Ferse (2010); [E] Purwati et al. (2010); [F] Setyastuti (2013). (*) not a valid name or needing taxonomic confirmation.

No.	Species	Specimen condition	Local names	World market names	Other sources
1	<i>Actinopyga bannwarthi</i>	Fresh	Sepatu	-	E
2	<i>Actinopyga caerulea*</i>	-	Kossong	-	D
3	<i>Actinopyga echinites*</i>	-	Kunyit, ladu-ladu, kapok / kapukbillala, bilado, kassi	Deepwater redfish	A,B,C,D
4	<i>Actinopyga lecanora</i>	Fresh (E,F)	Batu, balibi, hitam	Stonefish	A,B,C,D,E,F
5	<i>Actinopyga mauritiana*</i>	-	Buntal, ballang ulu	Surf redfish	A,B,C,D
6	<i>Actinopyga miliaris</i>	Fresh (E)	Kapok / kapuk, lotong, gamet, sepatu, hitam	Blackfish	A,B,C,D,E
7	<i>Bohadschia</i> sp. 1	Salted	Bintik	-	F
8	<i>Bohadschia</i> sp. 2	Fresh	Pulut	-	F
9	<i>Bohadschia</i> sp. 3	Dried	Kawasa merah	-	F
10	<i>Bohadschia argus*</i>	-	Ular mata, gamat bati, bintik, cempedak, patola	Leopardfish / Tigerfish / Spottedfish	A,B,C,D
11	<i>Bohadschia marmorata*</i>	-	Kawasa, olok-olok, getah putih, pulut, benang, krido polos	-	A,C,D
12	<i>Bohadschia similis*</i>	-	Karido getah bintik / laos	-	B,C
13	<i>Bohadschia subrubra</i>	Fresh (E), Salted (F)	Teripang bintik, kapok	Leopardfish	E,F
14	<i>Bohadschia tenuissima*</i>	-	Karet	-	A,C
15	<i>Bohadschia vitiensis</i>	Fresh (E), Salted (F)	Olok-olok, gatta, gama, polos	Brown sandfish	B,D,E,F
16	<i>Holothuria</i> cf. <i>albiventer</i>	Dried	Kunyit	-	F
17	<i>Holothuria atra</i>	Fresh (E,F)	Lakling hitam / coklat, hitam, dara, keling, cera	Lollyfish / Black trepang	A,B,C,D,E,F
18	<i>Holothuria coluber</i>	Fresh (E,F)	Taikokong, talengko	Snakefish	A,B,C,D,E,F
19	<i>Holothuria conusalba*</i>	-	-	-	C
20	<i>Holothuria edulis</i>	Fresh (E,F) and Salted (F)	Dada / cera / perut / aklung merah, takling, batu keling	Pinkfish / Pink lollyfish / Trepang rose	A,C,D,E,F
21	<i>Holothuria excellens</i>	Fresh	Hitam	-	F
22	<i>Holothuria fuscocinerea</i>	Fresh (E,F)	Coklat, lakling coklat	-	E,F
23	<i>Holothuria fuscogilva*</i>	-	Susu putih, bissawa	White teatfish	A,C,D
24	<i>Holothuria fuscopunctata</i>	Dried (F)	Susu putih, kuning, kunyit,	Elephant trunkfish	A,B,C,D,F
25	<i>Holothuria hilla*</i>	-	Batuna	-	A,C,D
26	<i>Holothuria</i> cf. <i>imitans</i>	Dried	Coklat	-	F
27	<i>Holothuria impatiens</i>	Fresh (E)	Pulut	-	A,C,E
28	<i>Holothuria lessoni</i>	Fresh	Ugai, gosok	Golden sandfish	F

Table 2. List of all *trepaning* species which have ever been, and/or are still being, fished and traded in Indonesia. Specimen condition was related to the specimen when it was identified. Other sources refer to [A] Purwati (2005); [B] Purwati (2005); [C] Choo (2008); [D] Máñez and Ferse (2010); [E] Purwati et al. (2010); [F] Setyastuti (2013). (*) not a valid name or needing taxonomic confirmation (*cont.*).

No.	Species	Specimen condition	Local names	World market names	Other sources
29	<i>Holothuria leucospilota</i>	Fresh (E)	Getah, cera, jepun, keling, talengko	-	A,C,D,E
30	<i>Holothuria nobilis</i>	Salted and Dried (F)	Koro, cera hitam	Black teatfish	A,B,D,F
31	<i>Holothuria ocellata*</i>	-	Kacang goreng	-	A,C
32	<i>Holothuria pardalis*</i>	-	-	-	C
33	<i>Holothuria perficax*</i>	-	-	Tiger spotted <i>trepaning</i>	A,C
34	<i>Holothuria rigida*</i>	-	Kebo, puti	-	C,D
35	<i>Holothuria scabra</i>	Fresh (E,F)	Gosok, pasir, buang kulit, putih, kamboa	Sandfish	A,B,C,D,E,F
36	<i>Holothuria scabra versicolor*</i>	-	-	-	C
37	<i>Holothuria similis*</i>	-	Krido, krido bintik	Chalkfish / Whitefish	A,C
38	<i>Holothuria turriscelsa</i>	Fresh	Hitam	-	F
39	<i>Holothuria vagabunda*</i>	-	-	-	C
40	<i>Holothuria vatiensis*</i>	-	-	-	C
41	<i>Holothuria whitmaei*</i>	-	-	-	C
42	<i>Pearsonothuria graeffei</i>	Fresh (E), Salted and Dried (F)	Bintik merah, gombyok, sutra, cera duri, gemuk, bati, donga	Flowerfish / Blackspotted sea cucumber	A,B,C,D,E,F
43	<i>Stichopus chloronotus</i>	Fresh (E), Dried (F)	Jepung, japon, jepun,	Greenfish / Squarefish	A,B,C,D,E,F
44	<i>Stichopus herrmanni</i>	Fresh (E)	Gamet emas, gamet kacang, taikongkong	Curryfish	B,C,D,E
45	<i>Stichopus horrens</i>	Fresh (E)	Kacang goreng, taikongkong, kacang, susu, rengget	Dragonfish	A,B,C,D,E
46	<i>Stichopus monotuberculatus</i>	Fresh	Gamet pace	-	F
47	<i>Stichopus noctivagus</i>	Fresh	Gamat	-	F
48	<i>Stichopus pseudohorrens</i>	Salted	Teripang duri	-	F
49	<i>Stichopus quadrifasciatus</i>	Fresh	Gamat	-	C,F
50	<i>Stichopus variegatus*</i>	-	Gamet, kasar, taikongkong, anjing, kapok, gama	Curryfish / Yellow meat	A,D
51	<i>Stichopus vastus</i>	Fresh (E,F), Salted (F)	TKK, gamet, gamet pace, kacang goreng	Curryfish	C,E,F
52	<i>Thelenota ananas</i>	Fresh (F)	Nanas / nenas,	Prickly redfish / Plum flower <i>trepaning</i>	A,B,C,D,F
53	<i>Thelenota anax</i>	Fresh (E), Salted (F)	Donga, duyung, babi	Amberfish	A,B,C,D,E,F
54	<i>Thelenota rubralineata*</i>	-	Bati	-	D

Stichopus pseudohorrens has hitherto been documented only in Kupang waters. This *trepang* species is easily misidentified as *teripang nanas* (or *Thelenota ananas*) due to its similar body size and enlarged papillae (Wirawati and Purwati 2012). Only two publications (Purcell et al. 2010, 2012) reported this species being traded internationally. A similar case of misidentification occurred between *A. bannwarthi* and *A. miliaris*. *A. bannwarthi* has been documented once in Timor in 2007 (Purwati et al. 2008).

Species that have never been traded but are being fished in the studied locations were: *Actinopyga bannwarthi*, *H. turriscelsa*, *H. excellens*, *H. cf. albiventer*, *H. cf. imitans* and *Stichopus noctivagus*. From a taxonomical point of view, this was the second report on the presence of *Holothuria turriscelsa*, *H. excellens* and *Stichopus noctivagus* in Indonesia, after their first one from Spermonde by Massin (1999). Both *Holothuria excellens* and *H. turriscelsa* were potentially misidentified as *teripang hitam* (or *Holothuria atra*) due to its body shape and colour. However, *H. excellens* is not black but dark purple and it has longer tube feet than the *H. atra* collected from Karimunjawa. Morphologically *H. turriscelsa* is definitely different from *H. atra* because it possesses yellow tentacles, and substantively this is much closer to *H. coluber*.

Condition of the processed trepang

Since the *trepang* used for trade is mostly in dried form, species recognition is getting more difficult due to processing procedures that alter the colour and shape and damage the ossicles (Uthicke et al. 2010; Purwati et al. 2010). Although most of the processed specimens were still intact, they were not in as good shape as the fresh ones. Salted specimens were more identifiable than dried ones, as the body wall, several internal organs and the ossicles remained. There were several that could be identified from the body appearance alone. These included *Thelenota ananas* (large-sized with large papillae), *Stichopus chloronotus* (medium-sized, dark green, papillae in three distinctive rows), and *Holothuria edulis* (medium-sized, pink on the ventral side).

All the dried specimens collected from Ambon were identifiable using morphology and ossicle examination of the body wall (Table 1). Two specimens, *H. cf. albiventer* and *H. cf. imitans*, could not be identified with certainty to species level because some morphology and ossicles characteristics were lost during processing.

Conclusion

Fifty-four sea cucumber species that have ever been, and/or are still being, fished in Indonesia have been recognised as *trepang*. Of these, 33 species have been

taxonomically confirmed, including 12 species that had rarely, or never, reportedly been traded either in local or international markets (*Actinopyga bannwarthi*, *Bohadshia subrubra*, *Holothuria lessoni*, *H. cf. albiventer*, *H. cf. imitans*, *H. turriscelsa*, *H. excellens*, *H. fuscocinerea*, *Stichopus noctivagus*, *S. pseudohorrens*, *S. monotuberculatus*, *S. quadrifasciatus*). It is still possible to identify processed specimens, salted and dried, since their defining species characteristics, such as ossicles of the body walls and several internal organs, remain.

Focusing on taxonomic study, it will be necessary to collect more samples from an extended area to provide more accurate data on the *trepang* species involved in trade. Molecular studies that have been developed to support species identification could be applied to identify processed *trepang* available in the marketplace.

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