Sea urchins of Hong Kong: Corrections of misidentifications and an updated species list

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The monograph by Yiu & Mah (2024) on the ecology and occurrences of echinoderms in Hong Kong reported 25 echinoid species observed during more than 1500 SCUBA dives, including 11 new species records. However, the identifications of five species are problematic. The specimen identified as *Echinometra mathaei* (Blainville) (Figure 7, page 16) is the yet unnamed species *Echinometra* sp. A, which was discovered in the 1980s. The specimens identified as *Pseudoboletia indiana* (Michelin) (Figure 15, page 25) are *Pseudoboletia maculata* Troschel. The specimen identified as *Brissus latecarinatus* (Leske) (Figure 18, page 28) is *Brissus agassizii* Döderlein. The specimen identified as *Metalia spatagus* (Linnaeus) (Figure 19, page 29) is *Metalia angustus* de Ridder. The specimen identified as *Peronella lesueuri* (Agassiz) (Figure 21, page 31) is *Laganum decagonale* (Blainville). After these corrections, updated Hong Kong echinoid records from published literature were provided and discussed herein (Table S1). The species list of sea urchins in Hong Kong water includes 42 species (18 families) to date.

There are six recognized species and four unnamed species of the genus *Echinometra* worldwide (Kroh & Mooi 2025). Four of them are the most common in the western Pacific, including *E. mathaei*, *E. oblonga* (Blainville), *Echinometra* sp. A (temporary name; Kroh & Mooi 2025), and *Echinometra* sp. C (temporary name; Kroh & Mooi 2025). The two unnamed species, *Echinometra* sp. A and *Echinometra* sp. C, were first identified through cross-fertilization experiments by Uehara & Shingaki (1985) and later confirmed by genetic analyses (e.g., Matsuoka & Hatanaka 1991). *Echinometra* sp. A is distinguished by its white-tipped spines and bright milled rings, whereas *E. mathaei* lacks white-tipped spines and has very faded milled rings (Arakaki et al. 1998; Bronstein & Loya 2013; Lin et al. 2024). Therefore, the specimen (Figure 7, page 16) in Yiu & Mah (2024) is clearly *Echinometra* sp. A based on its obvious white-tipped spines and bright milled rings (Table S2).

The two species, *Pseudoboletia indiana* and *P. maculata*, are extremely similar. The species *P. maculata* was established based on distinct dark spots and patterns on the denuded test, which is the only difference from *P. indiana*, whose denuded test is completely white (Mortensen 1943; Schultz 2006). Because of the almost identical structure of the test between *P. indiana* and *P. maculata* and the presence of intermediate forms, they were usually treated as synonyms in many early studies (e.g., Liao & Clark 1995). However, Zigler et al. (2012) conducted genetic analyses on *P. indiana*-like, *P. maculata*-like, and intermediate forms, and the results supported that *P. indiana* and *P. maculata* remain distinct species with differences in color pattern, egg size, mtDNA, and nuclear DNA, whilst the intermediate forms are the result of natural hybridization. The World Echinoidea Database (Kroh & Mooi 2025) also recognize that they are separate species. Considering all of the above, it is clear that the specimens (Figure 15, page 25) in Yiu & Mah (2024) are *P. maculata* based on their obvious dark patterns (Table S3).

The three brissid echinoid species *Brissus latecarinatus*, *B. agassizii*, and *B. unicolor* (Leske) closely resemble each other. Their high morphological variability, especially in aboral petal patterns, has caused much confusion (Mortensen 1951). The most obvious difference between these species is the pedicellariae, with *B. agassizii* having peculiarly shaped globiferous pedicellariae (Mortensen 1951). Apart from this, *B. latecarinatus* differs from *B. agassizii* and *B. unicolor* in its periproct, which is overhung by the posterior interambulacrum, making it visible from the oral view and producing a keeled posterior interambulacrum in lateral view (Döderlein 1885; Mortensen 1951; Schultz 2006). As for *B. agassizii* and *B. unicolor*, the former has a vertically truncated posterior end, whilst the latter is lower and more rounded (Mortensen 1951; Schultz 2006). The brissid specimen (Figure 18, page 28) in Yiu & Mah (2024) is a denuded test, so its pedicellariae are unavailable, making identification possible only based on test morphology. Its vertically truncated posterior end and a periproct not visible from the oral view indicate it is not *B. latecarinatus*. Instead, its high posterior end suggests it is *B. agassizii*. Furthermore, the slight indent in the middle of the posterior end when viewed orally matches the original diagnosis in Döderlein (1885). Although this specimen may be a young adult with potential ontogenetic variation, based on the available traits, it should be identified as *B. agassizii* (Table S4).

The spatangoid echinoid specimen (Figure 19, page 29) in Yiu & Mah (2024) certainly belongs to the genus *Metalia* based on its overall outline and narrower shield-shaped subanal fasciole with radiating furrows (Mortensen 1951). However, it is clearly distinct from *M. spatagus* in overall outline, having an obvious frontal notch, a more centrally located apical system, thinner petal width, and a smaller angle between the two anterior petals, as evident from all available published descriptions, figures, and specimens (Mortensen 1951; Schultz

2006). In contrast, its characteristics align well with *M. angustus*, including its overall outline, slightly elongated and elevated test with a slightly raised posterior, obvious frontal notch, posterior petals that are divergent and not confluent toward the apical system, primary tubercles present in the posterior interambulacrum, and a moderately inflated plastron (de Ridder 1984; Schultz 2006). These features strongly indicate that the specimen belongs to *M. angustus* rather than other *Metalia* species in adjacent areas (Table S5). The specimen differs from *M. sternalis* (Lamarck) and *M. dicrana* H.L. Clark in having a narrower petal width, a more posteriorly located apical system, and a different lateral outline, and from *M. latissima* H.L. Clark in having a significantly lower test. This record enhances our understanding of the distribution of this species, which was previously only found in its type locality, Australian waters, and south of Sagami Bay, Japan (de Ridder 1984; Schultz 2006; Tanaka et al. 2019).

The laganid echinoid specimen (Figure 21, page 31) in Yiu & Mah (2024) certainly belongs to the family Laganidae rather than its sister group family Fibulariidae and other sand dollar taxa based on its dish-like test, apical system structure, and periproct position (e.g., Mortensen 1948; Schultz 2006; Lee et al. 2023). Although the detailed classifications within Laganidae remain controversial (Mortensen 1948; Schultz 2006), the two largest genera, *Laganum* and *Peronella*, can be easily distinguished by their apical system structures: the former has five gonopores and hydropores in a furrow, whilst the latter has four gonopores with hydropores scattered over the madreporite. Therefore, it is clear that the specimen does not belong to *Peronella*. The specimen is most likely *Laganum decagonale* (Blainville) based on its relatively short, distally closed petals with the widest point about halfway along their length, slightly elevated test with a thin margin, height increasing slightly toward the apical system, and a periproct very close to the posterior margin (Table S6). Compared to laganids with five gonopores in adjacent regions, it differs from *L. fudsiyama* Döderlein, *L. retinens* Koehler, and *Jacksonaster depressum* (L. Agassiz) in having shorter, lanceolate petals and a lower test height, and from *L. laganum* (Leske) in petal shape and a more posteriorly located periproct.

Consequently, incorporating the corrected data from this study, the efforts of Yiu & Mah (2024), Yiu & Chung (2024), comprehensive studies (Clark 1982; Liao & Clark 1995), earlier literatures which are not included in Clark (1982) and Liao & Clark (1995), and the Hong Kong Register of Marine Species, which includes numerous sporadic studies (Astudillo et al. 2025), an updated echinoid species list for Hong Kong waters was compiled (Table S1). A total of 42 species from 18 families are included (Table S1), highlighting the remarkably high echinoid diversity of Hong Kong waters, which host nearly 4% of the world sea urchin species within just 0.0004% of the world ocean area.

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Appendix

Table S1. Updated species list of echinoids in Hong Kong.

Family	Species	Source of Hong Kong record
Arbaciidae	*Coelopleurus maculatus* A. Agassiz & H.L. Clark	Yiu & Mah (2024)
Brissidae	*Anametalia sternaloides* (Bolau)	Mortensen (1951), Baker & Rowe (1990)
Brissidae	*Brissus agassizii* Döderlein	Yiu & Mah (2024), this study
Brissidae	*Brissus latecarinatus* (Leske)	Liao & Clark (1995), Astudillo et al. (2025)
Brissidae	*Metalia angustus* de Ridder	Yiu & Mah (2024), this study
Brissidae	*Metalia spatagus* (Linnaeus)	Wai et al. (2011), Astudillo et al. (2025)
Cidaridae	*Eucidaris metularia* (Lamarck)	Yiu & Mah (2024)
Cidaridae	*Prionocidaris baculosa* (Lamarck)	Yiu & Mah (2024)
Clypeasteridae	*Clypeaster reticulatus* (Linnaeus)	Yiu & Mah (2024)
Clypeasteridae	*Clypeaster virescens* Döderlein	Morton & Morton (1983), Astudillo et al. (2025)
Diadematidae	*Diadema savignyi* (Audouin)	Liao & Clark (1995), Astudillo et al. (2025)
Diadematidae	*Diadema setosum* (Leske)	Agassiz (1864, 1872), Liao & Clark (1995), Astudillo et al. (2025)
Diadematidae	*Echinothrix calamaris* (Pallas)	Liao & Clark (1995), Astudillo et al. (2025)
Echinometridae	*Echinometra mathaei* (Blainville)	Liao & Clark (1995), Astudillo et al. (2025)
Echinometridae	*Echinometra* sp. A	Yiu & Mah (2024), this study
Echinometridae	*Echinostrephus molaris* (Blainville)	Yiu & Mah (2024)
Echinometridae	*Heliocidaris crassispina* (A. Agassiz)	Agassiz (1864), Liao & Clark (1995), Astudillo et al. (2025)
Fibulariidae	*Echinocyamus provectus* de Meijere	Mortensen (1948)
Laganidae	*Jacksonaster depressum* (L. Agassiz)	Agassiz (1872), Liao & Clark (1995), Astudillo et al. (2025)
Laganidae	*Laganum decagonale* (Blainville)	Agassiz (1872), Clark (1982), Yiu & Mah (2024), Astudillo et al. (2025), this study
Laganidae	*Peronella lesueuri* (L. Agassiz)	Agassiz (1864), Clark (1925), Liao & Clark (1995), Astudillo et al. (2025)
Loveniidae	*Lovenia elongata* (Gray)	Liao & Clark (1995), Astudillo et al. (2025)
Loveniidae	*Lovenia subcarinata* Gray	Agassiz (1864, 1872, 1881), Bolau (1873), Clark (1925), Liao & Clark (1995), Astudillo et al. (2025)
Maretiidae	*Maretia planulata* (Lamarck)	Bolau (1873)
Maretiidae	*Nacospatangus altus* (A. Agassiz)	Yiu & Mah (2024)
Palaeostomatidae	*Palaeostoma mirabile* (Gray)	Agassiz (1864, 1872), Liao & Clark (1995), Astudillo et al. (2025)

Parasaleniidae	*Parasalenia gratiosa* A. Agassiz	Liao & Clark (1995), Astudillo et al. (2025)
Pericosmidae	*Faorina chinensis* Gray	Agassiz (1872), Clark (1925), Liao & Clark (1995), Astudillo et al. (2025)
Pericosmidae	*Pericosmus melanostomus* Mortensen	Mortensen (1948), Liao & Clark (1995), Astudillo et al. (2025)
Rotulidae	*Fibulariella volva* (L. Agassiz in L. Agassiz & Desor)	Chen (2007), Astudillo et al. (2025)
Schizasteridae	*Schizaster lacunosus* (Linnaeus)	Agassiz (1872, 1881), Bolau (1873), Liao & Clark (1995), Astudillo et al. (2025)
Stomopneustidae	*Stomopneustes variolaris* (Lamarck)	Yiu & Mah (2024)
Temnopleuridae	*Paratrema doederleini* (Mortensen)	Koehler (1927), Liao & Clark (1995), Astudillo et al. (2025)
Temnopleuridae	*Salmaciella dussumieri* (L. Agassiz in L. Agassiz & Desor)	Agassiz (1864, 1872), Huang & Mak (1982), Astudillo et al. (2025)
Temnopleuridae	*Salmacis sphaeroides* (Linnaeus)	Liao & Clark (1995), Astudillo et al. (2025)
Temnopleuridae	*Salmacis bicolor* L. Agassiz in L. Agassiz & Desor	Environmental Resources Management (1998), Yiu & Mah (2024), Astudillo et al. (2025)
Temnopleuridae	*Temnopleurus reevesii* (Gray)	Agassiz (1864), Liao & Clark (1995), Astudillo et al. (2025)
Temnopleuridae	*Temnopleurus toreumaticus* (Leske)	Agassiz (1872), Liao & Clark (1995), Astudillo et al. (2025)
Temnopleuridae	*Temnotrema maculatum* (Mortensen)	Liao & Clark (1995), Astudillo et al. (2025)
Toxopneustidae	*Pseudoboletia maculata* Troschel	Yiu & Mah (2024), this study
Toxopneustidae	*Toxopneustes pileolus* (Lamarck)	Yiu & Mah (2024)
Toxopneustidae	*Tripneustes gratilla* (Linnaeus)	Liao & Clark (1995), Astudillo et al. (2025)

Table S2. Comparison of *Echinometra* specimen (Figure 7, page 16) in Yiu & Mah (2024) with similar species. Figures modified from Chung (2025). Test length: *Echinometra* sp. A about 53 mm, *E. mathaei* about 37 mm, Yiu & Mah (2024) specimen about 22 mm.

species	*Echinometra* sp. A	*Echinometra mathaei* (Blainville, 1825)	specimen in Yiu & Mah (2024)
aboral			
white-tipped spine	O	X	O
milled ring	bright	faded	bright

Table S3. Comparison of *Pseudoboletia* specimen (Figure 15, page 25) in Yiu & Mah (2024) with similar species. Figures modified from Schultz (2006) and Kroh & Mooi (2025). Test length: *P. maculata* 43 mm, *P. indiana* 81 mm, Yiu & Mah (2024) specimen 50 mm.

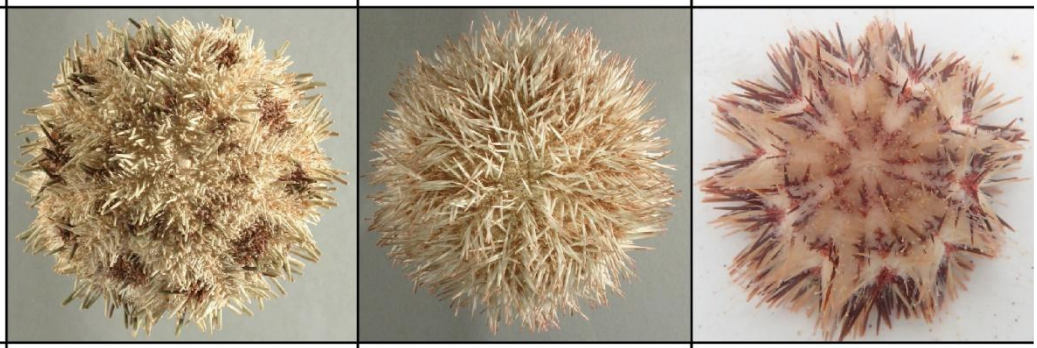
species	*Pseudoboletia maculata* Troschel, 1869	*Pseudoboletia indiana* (Michelin, 1862)	specimen in Yiu & Mah (2024)
aboral			
dark pattern	O	X	O

Table S4. Comparison of brissid echinoid specimen (Figure 18, page 28) in Yiu & Mah (2024) with similar species. Figures modified from Schultz (2006) and Kroh & Mooi (2025). Test length: *Brissus agassizii* 94 mm, *B. latecarinatus* 116 mm, *B. unicolor* 89 mm, Yiu & Mah (2024) specimen 42 mm.

species	*Brissus agassizii* Döderlein, 1885	*Brissus latecarinatus* (Leske, 1778)	*Brissus unicolor* (Leske, 1778)	specimen in Yiu & Mah (2024)
aboral				
oral				
lateral				
periproct	invisible from oral	visible from oral	invisible from oral	invisible from oral
posterior end	high; vertically truncated	keeled	low; rounded	high; vertically truncated

Table S5. Comparison of *Metalia* specimen (Figure 19, page 29) in Yiu & Mah (2024) with similar species. Figures modified from Schultz (2006) and Kroh & Mooi (2025). Test length: *M. angustus* 124 mm, *M. spatagus* 74 mm, Yiu & Mah (2024) specimen 76 mm.

species	*Metalia angustus* de Ridder, 1984	*Metalia spatagus* (Linnaeus, 1758)	specimen in Yiu & Mah (2024)
aboral			
oral			
lateral			
petal	narrow	wide	narrow
frontal notch	O	X	O

Table S6. Comparison of laganid echinoid specimen (Figure 21, page 31) in Yiu & Mah (2024) with similar species. Figures modified from Schultz (2006) and Kroh & Mooi (2025). Test length: *Laganum decagonale* 44 mm, *Peronella lesueuri* 114 mm, Yiu & Mah (2024) specimen 33 mm.

species	*Laganum decagonale* (Blainville, 1827)	*Peronella lesueuri* (Agassiz, 1841)	specimen in Yiu & Mah (2024)
aboral			
oral			
gonopore	5	4	5
hydropore	in a furrow	scattered over madreporite	in a furrow
petal	wide and short	narrow and elongated	wide and short

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