A checklist of land snails (Mollusca, Gastropoda) of Batu Caves, Selangor, Malaysia

JUNN KITT FOON[1,2]* and MOHAMMAD EFFENDI BIN MARZUKI[1,3,4]

Abstract : A land snail checklist based on multiple collections between 2009 and 2011 on the Batu Caves limestone hill yielded a total of 48 species of land snails. Eight species are synanthropic and non-native, two are restricted to Selangor limestone hills and 11 are known only from Sgr 01 Batu Caves to date. This collection did not account for the 20 species reported from previous studies at Batu Caves. Systematic malacofaunal surveys are recommended for Batu Caves and all limestone hills in its vicinity to better understand endemism and biogeography of land snails on these hills. The ecological effects of activities like open burning, land clearing and infrastructure developments must be investigated to identify and mitigate threats to the land snail community on Batu Caves.

Keywords: biogeography, conservation, Klang Valley, limestone karst, Peninsular Malaysia

INTRODUCTION

Land snail research in Peninsular Malaysia has intensified in recent years. In fact, the National Policy on Biological Diversity has acknowledged the need to prioritise the conservation of limestone hill ecosystems and their organisms, including molluscs (Ministry of Natural Resources and Environment Malaysia 2016). This has led to in-depth land snail biodiversity and biogeography studies on Perak limestone hills (Foon *et al.* 2017; Phung *et al.* 2018).

However, the land snails on Selangor limestone hills – consisting of Sgr 01 Batu Caves, Sgr 02 Bukit Takun and Sgr 03 Anak Bukit Takun (see Liew *et al.* 2016, for national code for Malaysian limestone outcrops), have received relatively little recent attention. The only exception to this is the malacofauna of Sgr 02 Bukit Takun, which was inventoried as part of biogeographical and methodological studies of Malaysian land snails (Clements *et al*. 2008; Liew *et al*. 2008).

The best malacologically studied limestone hill in Selangor is Sgr 01 Batu Caves (hereon referred to as "Batu Caves"). Between the beginning of malacological interest on Batu Caves in the 1900s and now, there have been a total of 16 studies on land snail taxonomy (Godwin-Austen 1907; Lindholm 1922; Peile 1926, 1929; Ghosh 1929; Tomlin 1931; Laidlaw 1932; Hoffmann 1940; van Benthem Jutting 1952, 1949, 1950, 1961; Loosjes 1953; Venmans 1956; Vermeulen and Whitten 1998; Foon and Liew 2017), nine checklists on land snail species (Laidlaw 1932, 1933, 1949; van Benthem Jutting 1949, 1960; Tweedie 1961; McClure *et al.* 1967; Chan 1997; Moseley *et al*. 2012) and one ecological research of land snail (Berry 1965). Most of the 20th Century collections are housed in the Zoological Reference Collection (ZRC) of the Lee Kong Chian Museum of Natural History (Singapore), the Natural History Museum, London (BMNH) collection (United Kingdom) and the Naturalis (RMNH and ZMA) collection (Netherlands).

[1] Institute for Tropical Biology and Conservation, Universiti Malaysia Sabah, Jalan UMS, 88400 Kota Kinabalu, Sabah, Malaysia.
[2] Rimba, 22-3A, Casa Kiara 2, Jalan Kiara 5, 50480 Kuala Lumpur, Malaysia.
[3] Institute of Biodiversity and Environmental Conservation, Universiti Malaysia Sarawak, Jalan Datuk Mohammad Musa, 94300 Kota Samarahan, Sarawak, Malaysia.
[4] 102, Jalan Muut, Kampung Sekaan Besar, 96250 Matu, Sarawak, Malaysia.
***Corresponding author : jkfoon.research@gmail.com**

In the last decade, malacologists in Malaysia have begun studies of land snails of Batu Caves. A new species *Alycaeus selangoriensis* Foon and Liew 2017, was described from Batu Caves and types were deposited at the BORNEENSIS (BOR/MOL) collection of the Institute for Tropical Biology and Conservation, Universiti Malaysia Sabah. Páll-Gergely *et al.* (2020) subsequently treated this taxon as a subspecies – *Stomacosmethis kapayanensis selangoriensis* (Foon and Liew 2017). Also, several collections of land snails were made by the second author between 2009 and 2011.

This report provides an annotated and illustrated checklist of land snails from the second author's 2009–2011 collections, as well as a list of species reported in the literature, but not re-encountered in this study.

MATERIALS AND METHODS

In this checklist, three sites on Batu Caves were sampled for land snails over five trips in the years 2009, 2010 and 2011. Site 1 or "Railway Station" (3.2397°N, 101.6811°E) is located at the base of a limestone cliff north of the Batu Caves railway station. Site 2 or "Dark Cave entrance" (3.2377°N, 101.6838°E) is located along a steep limestone scree slope near the Dark Cave entrance. Site 3 or "Taman Sunway Batu Caves" (3.2374°N, 101.6872°E) is located at the base of a limestone cliff behind an apartment in Taman Sunway Batu Caves. These sites were chosen due to their accessibility and vegetated environment. Samples were sorted to morphospecies based on literatures and comparisons with type specimens (http://malaypeninsularsnail.myspecies.info). For morphospecies whose name cannot be found in the literature, provisional species names such as "sp." or "sp. 'Batu 1'" were assigned. Land snail vouchers were catalogued in the M.E. Marzuki (ME) collection database. These specimens are housed at the Zoological Museum (MZU) of Universiti Malaysia Sarawak (UNIMAS).

Each species in the checklist was compared with available literatures to verify the species distribution on Batu Caves and other limestone hills. The list of synonyms for each species is available elsewhere (Maassen 2001; Foon and Liew 2017; Páll-Gergely *et al.* 2020). Due to financial and logistical constraints, we did not re-examine all past collections of Batu Caves molluscs housed in ZRC, BMNH, ZMA and RMNH. Instead, a list of species reported from Batu Caves in the literature but not found in our survey, is provided in Table 1, in addition to the ME collection checklist. Notes of species that were re-encountered but not collected during field visits on Batu Caves and in the Dark Cave (Entrance: 3.2379° N, 101.6837° E, see Lim *et al.* 2010) in 2018 were also included.

RESULTS AND DISCUSSION

To our knowledge, this is the most comprehensive checklist of land snails produced for Batu Caves to date. The three sites sampled for ME collection yielded a total of 48 species. Of these, eight species are synanthropic and non-native (*Allopeas clavulinum*, *Allopeas gracile*, *Bradybaena similaris*, *Gastrocopta servilis*, *Gulella bicolor*, *Macrochlamys indica*, *Solenomphala scalaris* and *Subulina octona*), two species or subspecies have ranges restricted to Selangor limestone hills (*Stomacosmethis kapayanensis selangoriensis* and *Sinoennea butleri*), 11 species are known only from Batu Caves (*Acmella* sp.7, *Diplommatina seimundi*, *Georissa* sp. 'Batu 1', *Microcystina* sp. 'Batu 1', *Microcystina* sp. 'Batu 2', *Opisthostoma obtusum*, *Sundacharopa* sp. 'Batu 1', *Philalanka floweri*, *Pterocyclos spaleotes*, *Sinoennea ridleyi* and *Speleocyclotus* sp.). The remaining 27 species have ranges that span across several Malaysian states to the whole of Southeast Asia. Overall, the Batu Caves malacofauna is charcteristically representative of Peninsular Malaysia. Also, the proliferation of synanthropic and non-native land snail species on Batu Caves is not surprising considering its highly urbanised surroundings.

We strongly emphasise that the above 11 species that are known only from Batu Caves should not be considered as endemic to Batu Caves until their distributional ranges have been verified through a systematic malacofaunal survey for Batu Caves limestone hill, as well as all other nearby limestone hills namely Sgr 02 Bukit Takun, Sgr 03 Bukit Anak Takun, Phg 05 Bt. Cintamanis and limestone outcrops in Pasoh, Negeri Sembilan to obtain clear information on the endemism and biogeography of land snails on each of these hills (*sensu* Foon *et al*. 2017). These biodiversity data will be vital for conservation prioritisation of limestone hills (Clements *et al.* 2008; Foon *et al.* 2017).

The ME collection checklist did not account for 20 species reported in previous studies of Batu Caves land snails (Table 1). Out of these species, the record of three species were confirmed through examination of museum materials (*Alycaeus conformis*) and field observations (*Cyclophorus perdix aquila* and *Achatina fulica*). To confirm the species identity of the remaining 17 species, examination of original materials linked to literature is required.

Three land snails are known to live in the Dark Cave in the southwest of Batu Caves. Historical records indicated *Subulina octona* and *Paropeas tchehelense* live in the cave (Ghosh 1929; McClure *et al.* 1967, but see Table 1). During a visit to the Dark Cave by the first author, individuals of *Philalanka carinifera* were also observed living on moist rocks in the cave. These three species are not troglobitic (exclusively cave-dwelling) and can be found inhabiting surface ecosystems as well.

We note that the snail *Gabbia minuta* (Ghosh 1929) is not included in this study as it is aquatic, inhabiting shallow freshwater rimstone pools within the Dark Cave in the southwest of Batu Caves limestone hill (Laidlaw 1940; McClure *et al.* 1967; Brandt 1968; MolluscaBase 2019). This taxon was recorded under the name *Paludomus baccula* var. *minuta* Ghosh 1929, and *Bithynia pulchella* (Benson, 1836) by various authors (Brandt 1968; Maassen 2001). To date, *Gabbia minuta* is known to occur only in the Dark Cave and may be stygobitic (exclusively subterranean water-dwelling). The ecology and endemism of this species should be further investigated.

Table 1. Annotated list of species from Batu Caves not found in the ME collection but reported by previous studies.

Taxa reported	Sources	Remarks
Family Achatinidae Swainson 1840		
Achatina fulica (Bowdich 1822)	van Benthem Jutting 1960; McClure *et al.* 1967	Confirmed record. Shells of this species were found *in-situ* in 2018 by the first author but not collected.
Curvella jousseaumei (de Morgan 1885)	Laidlaw 1932, 1933; Maassen 2001	Unconfirmed record. Materials need examination. May be conspecific with *Paropeas achatinaceum* materials in this study.
Paropeas tchehelense (de Morgan 1885)	Laidlaw 1932; van Benthem Jutting 1960; Lindholm 1922; Ghosh 1929; Chan 1997	Unconfirmed record. Materials need examination. May be conspecific with *Paropeas achatinaceum* materials in this study. Both *Prosopeas troglodytes* Lindholm 1922, and *Opeas dimorpha* Ghosh 1929, described from Batu Caves are junior synonyms for *Paropeas tchehelense* (*sensu* Laidlaw 1949).

Paropeas turricula (von Martens 1860)	van Benthem Jutting 1949, 1960	Unconfirmed record. Materials need examination. May be conspecific with *Paropeas achatinaceum* materials in this study.
Prosopeas anceyi Pilsbry 1906	van Benthem Jutting 1949; Maassen 2001	Unconfirmed record. Materials need examination. May be conspecific with *Paropeas achatinaceum* materials in this study.
Family Alycaeidae Blanford 1864		
Alycaeus conformis Fulton 1902	Laidlaw 1932; Venmans 1956; Chan 1997; Foon and Liew 2017	Confirmed record. The first author has examined these materials in ZRC (Foon and Liew 2017). Widespread in Peninsular Malaysia and southern Thailand.
Family Ariophantidae Godwin-Austen 1888		
Hemiplecta humphreysiana (Lea 1840)	Laidlaw 1932; Maassen 2001	Unconfirmed record. Materials need examination.
Hemiplecta densa (Adams and Reeve 1850)	Laidlaw 1932, 1933; Chan 1997, Maassen 2001	Unconfirmed record. Materials need examination.
Macrochlamys hatchongi (de Morgan 1885)	Laidlaw 1932, 1933; Chan 1997; Maassen 2001	Unconfirmed record. Materials need examination. May be conspecific with *Helicarion permolle* materials in this study.
Sarika resplendens (Philippi 1846)	Chan 1997	Unconfirmed record. Materials need examination. May be conspecific with *Macrochlamys indica* materials in this study.
Microcystis palmicola Stoliczka 1873	Laidlaw 1932, 1933; Maassen 2001	Unconfirmed record. Materials need examination.
Family Chronidae Thiele 1931		
Liardetia angigyra von Möllendorff 1897	Chan,1997; Vermeulen and Whitten 1998	Unconfirmed record. Materials need examination. May be conspecific with *Kaliella barrakporensis* materials in this study.
Family Cyclophoridae Gray 1847		
Cyclophorus perdix aquila (Sowerby 1843)	van Benthem Jutting 1960; Chan 1997; Maassen 2001	Confimed record. Shells of this species were found in-situ in 2018 by the first author but not collected.
Lagocheilus townsendi (Crosse 1879)	Laidlaw 1932, 1933; Chan 1997	Unconfirmed record. May be conspecific with *Japonia rollei* materials in this study. Accurate identification could only be done after a revision of all *Lagocheilus* Blanford 1864, and *Japonia* Gould 1859, species in Peninsular Malaysia.

Platyrhaphe lowi (de Morgan 1886)	Chan 1997	Unconfirmed record. Materials need examination.
Family Diplommatinidae Pfeiffer 1856		
Diplommatina ventriculus (von Möllendorff 1891)	Tweedie 1961; Chan 1997	Unconfirmed record. Materials need examination.
Family Dyakiidae Gude and Woodward 1921		
Quantula striata Gray 1838	Chan 1997	Unconfirmed record. Materials need examination.
Family Pupinidae Pfeiffer 1857		
Pupina artata Benson 1856	Chan 1997	Unconfirmed record. Materials need examination.
Family Succineidae Beck 1837		
Succinea sp.	Chan 1997	Unconfirmed record. Materials need examination.
Family Trochomorphidae von Möllendorff 1890		
Geotrochus sp.	Laidlaw 1932	Unconfirmed record. Materials need examination. Laidlaw (1932) diagnosed the specimen as differing from *Geotrochus lychnia* (Benson 1852) in having taller spire and single carina but stop short of describing it as a new species.

CONCLUSION

Our study suggests that the Batu Caves limestone hill is an important habitat for land snails in Peninsular Malaysia, of which 11 species could be site-endemic. We also noted the presence of one potentially site-endemic and stygobitic snail species in the Dark Cave. A comprehensive regional malacofaunal survey on limestone karsts is needed to ascertain species endemism in Batu Caves. Investigations on the ecological effects of activities like open burning, land clearing and infrastructure developments are required to identify and mitigate threats to the land snail community on Batu Caves (*sensu* Schilthuizen *et al.* 2005; Clements *et al*. 2006).

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CHECKLIST FOR THE ME COLLECTION

Family Achatinidae Swainson 1840

Allopeas clavulinum (Potiez and Michaud 1838) Figure 1A
Materials examined. ME 3568, ME 3591, ME 3604, ME 3611.
Remarks. Native to East Africa, now pantropical (Foon *et al.* 2017).

Allopeas gracile (Hutton 1834) Figure 1B
Materials examined. ME 3566, ME 3576, ME 3593, ME 3606, ME 3610.
Previous Sgr 01 Batu Caves records. Laidlaw 1933.
Remarks. Pantropical, widespread in Peninsular Malaysia (Foon *et al.* 2017).

Opeas hannense (Rang 1831) Figure 1C
Materials examined. ME 3567, ME 3592, ME 3605, ME 3612.
Remarks. Previously known only from Temenggor, Perak, Malaysia and Koh Samui, Thailand (Maassen 2001). First record for Selangor.

Paropeas achatinaceum (Pfeiffer 1846) Figure 1D
Materials examined. ME 3570, ME 3578, ME 3589, ME 3602, ME 3613.
Remarks. Widespread in Southeast Asia and the Pacific Islands but has not been recorded from Peninsular Malaysia until now (Maassen 2001).

Subulina octona (Bruguière 1792) Figure 1E
Materials examined. ME 3569, ME 3577, ME 3590, ME 3603, ME 3614.
Previous Sgr 01 Batu Caves records. Lindholm 1922; Laidlaw 1932, 1933; Chan 1997.
Remarks. Pantropical, widespread in Peninsular Malaysia (Foon *et al*. 2017). Besides inhabiting surface ecosystems, this species also lives in the Dark Cave (Ghosh 1929; McClure *et al.* 1967). Opeas doveri Ghosh 1929, described from Batu Caves is a junior synonym for this species (Laidlaw 1932).

Family Alycaeidae Blanford 1864

Stomacosmethis kapayanensis selangoriensis (Foon and Liew 2017) Figure 1F
Materials examined. ME 1027, ME 1039, ME 1045, ME 1046, ME 1057, BOR/MOL 12988, BOR/MOL 6808, BOR/MOL 8314, BOR/MOL 12989.
Previous Sgr 01 Batu Caves records. Laidlaw 1932; Venmans 1956; Foon and Liew 2017.
Remarks. Known from Selangor limestone hills i.e. Sgr 01 Batu Caves and Sgr 02 Bukit Takun only (Foon and Liew 2017). Laidlaw (1932) and Chan (1997) recorded this species as *Alycaeus perakensis* Crosse 1879 while Venmans (1956) recorded this species as *Alycaeus kapayanensis* de Morgan 1885. Named *Alycaeus selangoriensis* by Foon and Liew (2017), this taxon was subsequently handled as a subspecies – *Stomacosmethis kapayanensis selangoriensis* by Páll-Gergely *et al.* (2020).

Dicharax microdiscus (von Möllendorff 1886) Figure 1G
Materials examined. ME 3103.
Remarks. Previously known from Perak limestone hills only (Foon *et al.* 2017). First record for Selangor. Páll-Gergely *et al.* (2020) reassigned this species from the genus *Chamalycaeus* von Möllendorff 1897, to Dicharax Kobelt and von Möllendorff 1900.

Pincerna thieroti (de Morgan 1885) Figure 1H
Materials examined. ME 3132.
Previous Sgr 01 Batu Caves records. Laidlaw 1932; Venmans 1956; Chan 1997.
Remarks. Widespread in Perak, Selangor, Kelantan and Pahang (Foon and Liew 2017).

Family Ariophantidae Godwin-Austen 1888

Macrochlamys indica Godwin-Austen 1883 Figure 1I
Materials examined. ME 1648, ME 3494, ME 3584, ME 3595, ME 3607.
Remarks. Native to the Indian subcontinent but introduced into Southeast Asia and several Indian Ocean islands (Nurinsiyah and Hausdorf 2019). Widespread in human modified areas in Peninsular Malaysia.

Macrochlamys infans (Reeve 1854) Figure 1J
Materials examined. ME 3608, ME 3609.
Remarks. First record for Selangor.

Microcystina muscorum van Benthem-Jutting 1959 Figure 1K
Materials examined. ME 1775, ME 1806, ME 3105.
Remarks. Widespread on Sundaland (Vermeulen *et al.* 2015).

Microcystina sp. 'Batu 1' Figure 1M
Materials examined. ME 11766.
Remarks. Known from Batu Caves only pending surveys of nearby limestone hills.

Microcystina sp. 'Batu 2' Figure 1N
Materials examined. ME 11767.
Remarks. Known from Batu Caves only pending surveys of nearby limestone hills.

Microparmarion malayanus (Collinge 1903) Figure 1O
Materials examined. ME 3594.
Previous Sgr 01 Batu Caves records. Hoffmann 1940.
Remarks. Widespread in Yala (Thailand) and Perak, Selangor, Kedah and Pahang (Malaysia) (Maassen, 2001).

Family Assimineidae Adams and Adams 1856

Acmella sp.7 Figure 1P
Materials examined. ME 2197, ME 2200.
Remarks. Known from Batu Caves only pending surveys of nearby limestone hills. A potentially new species with narrow umbilicus, somewhat similar to *Acmella subcancellata* Vermeulen *et al.* 2015.

Solenomphala scalaris (Heude 1882) Figure 1Q
Materials examined. ME 2213.
Previous Sgr 01 Batu Caves records. Chan 1997.
Remarks. Native to China, introduced to Peninsular Malaysia, Singapore and possibly Italy and Japan (Heude 1882; Maassen 2001; Fukuda and Ponder 2003; Tan and Woo 2010; Benocci *et al.* 2014). This species is relatively amphibious and have been found living on wet vertical limestone surfaces together with *Gastrocopta servilis* (Gould 1843). Probably widespread in human modified areas in Peninsular Malaysia. Chan (1997) recorded this species as *Cyclotropis scalaris* (Heude 1882).

Family Camaenidae Pilsbry 1895

Bradybaena similaris (Férussac 1821) Figure 1R
Materials examined. ME 4898, ME 4899, ME 4900.
Previous Sgr 01 Batu Caves records. Laidlaw 1932; Chan 1997.
Remarks. Native to East Asia, introduced in Southeast Asia and elsewhere in the tropics (Nurinsiyah and Hausdorf 2019). Widespread in human modified areas in Peninsular Malaysia.

Family Charopidae Hutton 1884

Sundacharopa clarkae (Maassen 2000) Figure 1L
Materials examined. ME 11765
Remarks. Known from Sumatra (Indonesia), Perak and Selangor (Malaysia) (Maassen 2000; Foon *et al*. 2017).

Sundacharopa perlata (Benthem-Jutting 1959) Figure 1S
Materials examined. ME 1786, ME 1787, ME 2270.
Remarks. Previously known only from Sumatra, Indonesia. First record for Peninsular Malaysia.

Sundacharopa sp. 'Batu 1' Figure 1T
Materials examined. ME 0429, ME 2191, ME 9911, ME 11483.
Remarks. Known from Batu Caves only pending surveys of nearby limestone hills. A new species with medium-sized white shell, possessing no striation, angulated periphery, flat top spire and round bottom whorl.

Family Chronidae Thiele 1931

Kaliella barrakporensis (Pfeiffer 1852) Figure 1U
Materials examined. ME 1968, ME 1982, ME 1983, ME 2001, ME 2004.
Remarks. In Peninsular Malaysia, previously known from Perak only (Vermeulen *et al.* 2015; Foon *et al.* 2017). First record for Selangor. Common in human modified areas and likely widespread.

Kaliella doliolum (Pfeiffer 1846) Figure 1V
Materials examined. ME 2019, ME 3572, ME 3575, ME 3585, ME 3596.
Previous Sgr 01 Batu Caves records. Laidlaw 1932, 1933, Chan 1997.
Remarks. Widespread across Southeast Asia and tropical Australasia (Vermeulen et al. 2015).

Kaliella microconus (Mousson 1865) Figure 1W
Materials examined. ME 1944, ME 1953, ME 2010.
Remarks. Widespread across Southeast Asia and tropical Australasia (Vermeulen *et al.* 2015).

Kaliella platyconus (von Möllendorff 1897) Figure 1X
Materials examined. ME 1961, ME 1962, ME 2024, ME 3597.
Remarks. Previously known from Java and Singapore only (Maassen 2001). First record for Malaysia.

Kaliella scandens (Cox 1872) Figure 1Y
Materials examined. ME 2026, ME 6929, ME 9708, ME 9709.
Remarks. Widespread across Southeast Asia and tropical Australasia (Vermeulen *et al.* 2015).

Family Clausilidae Gray 1855

Phaedusa filicostata kapayanensis (de Morgan 1885) Figure 1Z
Materials examined. ME 3133.
Previous Sgr 01 Batu Caves records. Laidlaw 1932, 1933; Loosjes 1953; Chan 1997.
Remarks. Known from Perlis, Kedah, Penang, Perak, Kelantan and Pahang (Maassen 2001; Foon *et al.* 2017).

Family Cyclophoridae Gray 1847

Cyclophorus semisulcatus (Sowerby 1843) Figure 1AA
Materials examined. ME 2034, ME 2036, ME 2038.
Previous Sgr 01 Batu Caves records. Chan 1997.
Remarks. Known from Pahang, Kelantan, Selangor and Perak (Maassen 2001; Foon *et al.* 2017).

Japonia rollei (von Möllendorff 1902) Figure 1AB
Materials examined. ME 0801.
Remarks. Previously known from Kelantan only (Maassen 2001). However, this identification should be treated as tentative because most species assigned to the genera *Lagocheilus* Blanford 1864, and *Japonia* Gould 1859, are poorly defined and are in need of revision (Laidlaw 1932).

Speleocyclotus sp. Figure 1AC
Materials examined. ME 3495.
Remarks. Known from Batu Caves only pending surveys of nearby limestone hills. First record of the genus in Peninsular Malaysia.

Pterocyclos spaleotes (Tomlin 1931) Figure 1AD
Materials examined. ME 0895, ME 2691, ME 2692, ME 2693, ME 2694.
Previous Sgr 01 Batu Caves records. Tomlin 1931; Laidlaw 1932; Chan 1997.
Remarks. Known from Batu Caves only pending surveys of nearby limestone hills (Sutcharit **et al.** 2014).

Family Diapheridae Panha and Naggs 2010

Sinoennea butleri (Peile 1929) Figure 1AE
Materials examined. ME 3573, ME 3574, ME 3588, ME 3601, ME 3616.
Previous Sgr 01 Batu Caves records. Peile 1929; Laidlaw 1932, 1933.
Remarks. Known from Selangor limestone hills only (Maassen 2001).

Sinoennea ridleyi (Peile 1926) Figure 1AF
Materials examined. ME 1386, ME 3583, ME 3600, ME 3615.
Previous Sgr 01 Batu Caves records. Peile 1926; Laidlaw 1932, 1933; Chan 1997.
Remarks. Known from Batu Caves only pending surveys of nearby limestone hills (Maassen 2001).

Family Diplommatinidae Pfeiffer 1856

Diplommatina canaliculata von Möllendorff 1879 Figure 1AG
Materials examined. ME 0559, ME 0560, ME 0592, ME 3131.
Previous Sgr 01 Batu Caves records. Laidlaw 1932; Chan 1997.
Remarks. Widespread on Sundaland (Nurinsiyah and Hausdorf 2017).

Diplommatina seimundi Laidlaw 1932 Figure 1AH
Materials examined. ME 0488, ME 0489, ME 0490, ME 0531, ME 3104.
Previous Sgr 01 Batu Caves records. Laidlaw 1932.
Remarks. Known from Batu Caves only pending surveys of nearby limestone hills (Maassen 2001).

Opisthostoma obtusum van Benthem-Jutting 1952 Figure 1AI
Materials examined. ME 0269, ME 0270, ME 0339.
Previous Sgr 01 Batu Caves records. van Benthem-Jutting, 1952.
Remarks. Known from Batu Caves only pending surveys of nearby limestone hills (Maassen 2001).

Family Endodontidae Pilsbry 1895

Philalanka carinifera (Stoliczka 1873) Figure 1AJ
Materials examined. ME 2170, ME 2171, ME 2172.
Previous Sgr 01 Batu Caves records. Godwin-Austen 1907; Laidlaw 1932, 1933.
Remarks. Widespread in Peninsular Malaysia and Sumatra (Maassen 2001). Besides inhabiting surface ecosystems, this species also lives in the Dark Cave (pers. obs.). *Philalanka batuensis* Godwin-Austen 1907, is a junior synonym of this species.

Philalanka floweri Godwin-Austen 1907 Figure 1AK
Materials examined. ME 0450, ME 2000, ME 2189, ME 2190.
Previous Sgr 01 Batu Caves records. Godwin-Austen 1907; Laidlaw 1932, 1933.
Remarks. Known from Batu Caves only pending surveys of nearby limestone hills (Maassen 2001). *Philalanka sericea* Laidlaw 1932, is a junior synonym of this species (Maassen 2001).

Family Ferussaciidae Bourguignat 1883

Cecilioides caledonica (Crosse 1867) Figure 1AL
Materials examined. ME 1241.
Remarks. Widespread in Southeast Asia and Australasia. In Peninsular Malaysia, previously known from Perlis and Perak only (Foon *et al.* 2017). First record for Selangor.

Family Helicarionidae Bourguignat 1877

Helicarion permolle (Stoliczka 1873) Figure 1AM
Materials examined. ME 3571, ME 3579.
Remarks. Previously known from Penang and Perak only (Foon *et al.* 2017). First record for Selangor.

Family Hydrocenidae Troschel 1857

Georissa semisculpta (Godwin-Austen and Nevill 1879) Figure 1AN
Materials examined. ME 1460, ME 1469.
Remarks. Previously known from Perak and Pahang only (Foon *et al.* 2017). First record for Selangor.

Georissa sp. 'Batu 1' Figure 1AO
Materials examined. ME 1410, ME 1415, ME 1448, ME 1450, ME 1451.
Remarks. Known from Batu Caves only pending surveys of nearby limestone hills. Laidlaw (1932) and Chan (1997) records of *Georissa monterosatiana* Godwin-Austen and Nevill 1879, in Batu Caves probably belong to this species.

Family Hypselostomatidae Zilch 1959

Gyliotrachela hungerfordiana (von Möllendorff 1886) Figure 1AP
Materials examined. ME 3580, ME 3587, ME 3598.
Previous Sgr 01 Batu Caves records. Chan, 1997.
Remarks. Widespread in Peninsular Malaysia and southern Thailand (Foon *et al.* 2017).

Paraboysidia frequens van Benthem-Jutting 1950 Figure 1AQ
Materials examined. ME 3581, ME 3586, ME 3599, ME 3618.
Remarks. Widespread in Peninsular Malaysia (Maassen 2001).

Family Streptaxidae Gray 1860

Gulella bicolor (Hutton 1834) Figure 1AR
Materials examined. ME 3582, ME 3617.
Previous Sgr 01 Batu Caves records. Chan, 1997.
Remarks. Widespread in human modified areas in Peninsular Malaysia; Elsewhere, pantropical (Foon *et al.* 2017).

Family Trochomorphidae von Möllendorff 1890

Videna bicolor (von Martens 1864) Figure 1AS

Materials examined. ME 1215.

Remarks. Widespread in Peninsular Malaysia and Southeast Asia (Maassen 2001; Foon *et al.* 2017).

Family Valloniidae Morse 1864

Pupisoma circumlitum Hedley 1897 Figure 1AT

Materials examined. ME 11405.

Previous Sgr 01 Batu Caves records. Vermeulen and Whitten 1998; Maassen 2001.

Remarks. Widespread across Southeast Asia and tropical Australasia (Vermeulen and Whitten 1998).

Pupisoma dioscoricola (Adams 1845) Figure 1AU

Materials examined. ME 6919.

Remarks. In Peninsular Malaysia, previously known from Perlis and Perak only, as *Ptychopatula orcula* (Benson 1850) (Foon *et al*. 2017). First record for Selangor.

Family Vertiginidae Fitzinger 1833

Gastrocopta servilis (Gould 1843) Figure 1AV

Materials examined. ME 3106.

Remarks. Native to the Americas; Introduced into Australasia and the Pacific Islands (Whisson and Köhler 2013, Christensen *et al.* 2018). First record for Peninsular Malaysia.

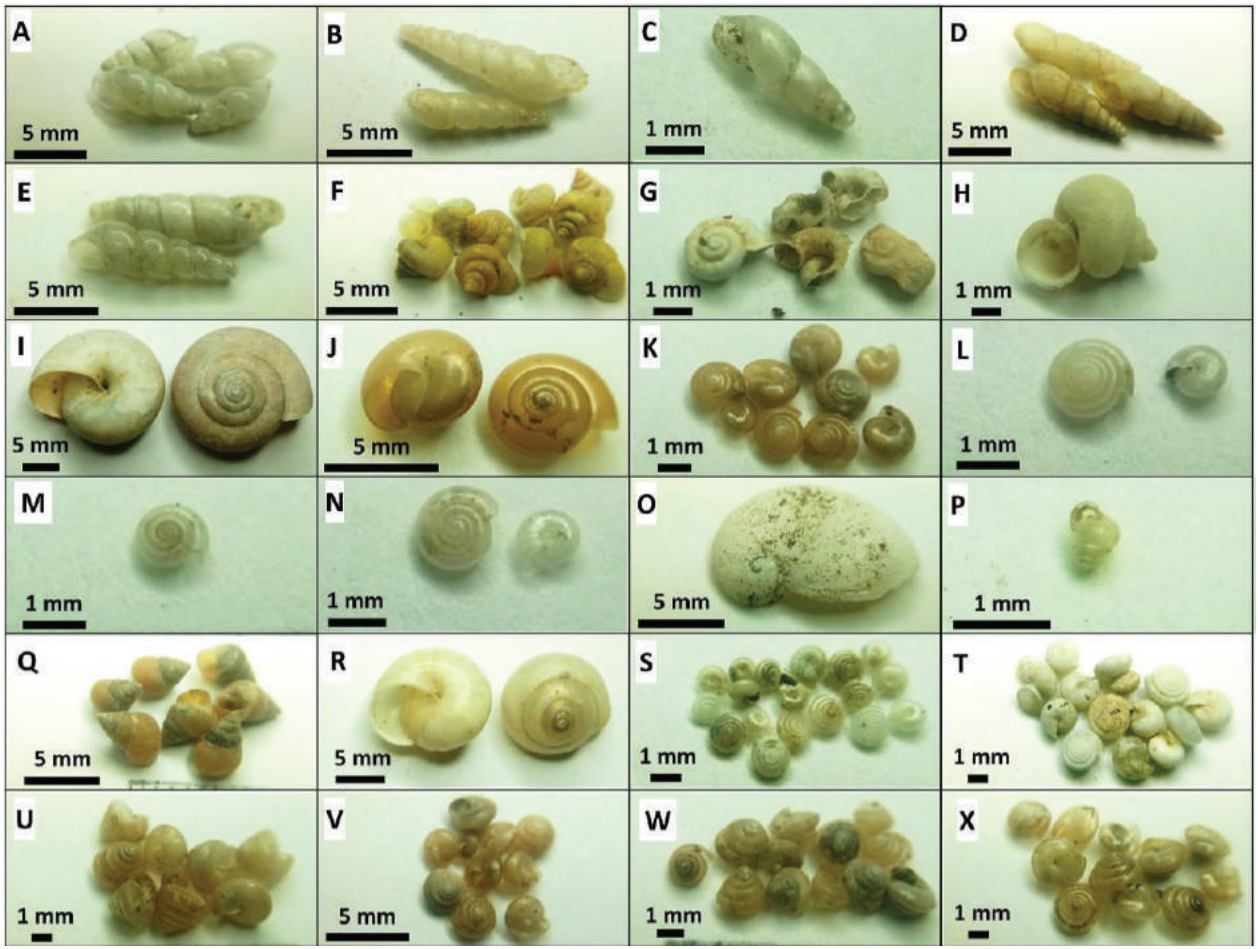

Figure 1. Land snail species of Batu Caves in the ME collection. **A:** *Allopeas clavulinum* (ME 3604); **B:** *Allopeas gracile* (ME 3576); **C:** *Opeas hannense* (ME 3567); **D:** *Paropeas achatinaceum* (ME 3589); **E:** *Subulina octona* (ME 3603); **F:** *Stomacosmethis kapayanensis selangoriensis* (ME 1057); **G:** *Chamalycaeus microdiscus* (ME 3103); **H:** *Pincerna thieroti* (ME 3132); **I:** *Macrochlamys indica* (ME 3595); **J:** *Macrochlamys infans* (ME 3608); **K:** *Microcystina muscorum* (ME 3105); **L:** *Sundacharopa clarkae* (ME 11765); **M:** *Microcystina* sp. 'Batu 1' (ME 11766); **N:** *Microcystina* sp. 'Batu 2' (ME 11767); **O:** *Microparmarion malayanus* (ME 3594); **P:** *Acmella* sp. 7 (ME 2200); **Q:** *Solenomphala scalaris* (ME 2213); **R:** *Bradybaena similaris* (ME 4898); **S:** *Sundacharopa perlata* (ME 2270); **T:** *Sundacharopa* sp. 'Batu 1' (ME 0429); **U:** *Kaliella barrakporensis* (ME 1968); **V:** *Kaliella doliolum* (ME 3585); **W:** *Kaliella microconus* (ME 1944); **X:** *Kaliella platyconus* (ME 3597).

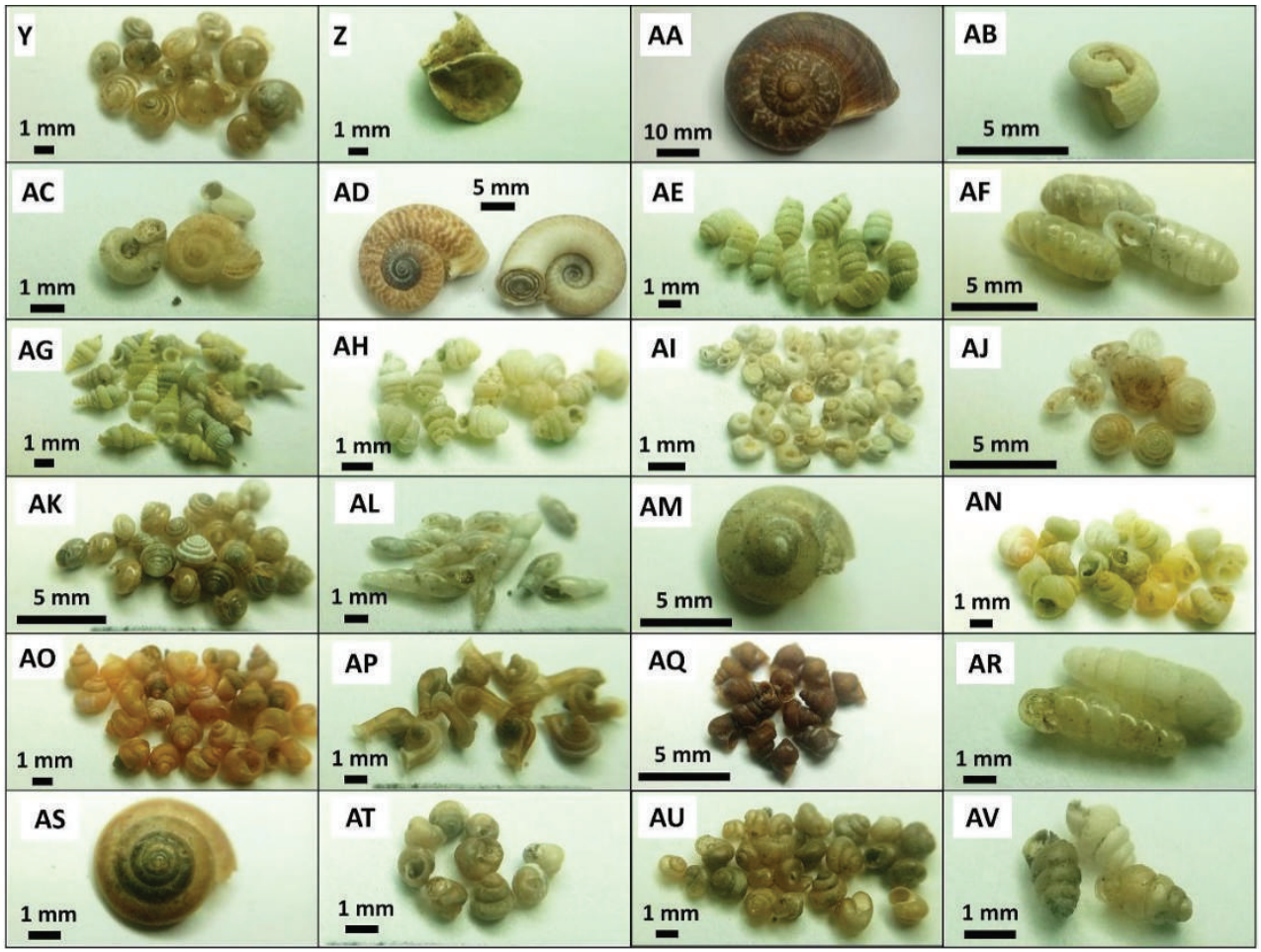

Figure 1 (*cont.*) Y: *Kaliella scandens* (ME 6929); **Z:** *Phaedusa filicostata kapayanensis* (ME 3133, fragment); **AA:** *Cyclophorus semisulcatus* (ME 2034); **AB:** *Japonia rollei* (ME 0801, fragment); **AC:** *Speleocyclotus* sp. (ME 3495); **AD:** *Pterocyclos spaleotes* (ME 2691); **AE:** *Sinoennea butleri* (ME 3588); **AF:** *Sinoennea ridleyi* (ME 3600); **AG:** *Diplommatina canaliculata* (ME 3131); **AH:** *Diplommatina seimundi* (ME 0490); **AI:** *Opisthostoma obtusum* (ME 0339); **AJ:** *Philalanka carinifera* (ME 2172); **AK:** *Philalanka floweri* (ME 0450); **AL:** *Cecilioides calendonica* (ME 1241); **AM:** *Helicarion permolle* (ME 3579); **AN:** *Georissa semisculpta* (ME 1469); **AO:** *Georissa* sp. 'Batu 1' (ME 1410); **AP:** *Gyliotrachela hungerfordiana* (ME 3598); **AQ:** *Paraboysidia frequens* (ME 3586); **AR:** *Gulella bicolor* (ME 3617); **AS:** *Videna bicolor* (ME 1215); **AT:** *Pupisoma circumlitum* (ME 11405); **AU:** *Pupisoma dioscoricola* (ME 11435); **AV:** *Gastrocopta servilis* (ME 3106). All photographs by M.E. Marzuki.

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