A review of Diplommatina species in eastern Thailand with the descriptions of five new species

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Abstract

Background

Microsnails in the genus Diplommatina Benson, 1849 from eastern Thailand are revised, based on the collection of the Zoological Research Collection, Burapha University, Chonburi Province, Thailand and on recently-collected materials.

New information

Five new species, Diplommatina burapha sp. n., D. chadathongae sp. n., D. chantaburiensis sp. n., D. fusiformis sp. n. and D. khwantongae sp. n., are described as new to science. The geographic distribution of these eastern species is presented.

Keywords

Diplommatina, Diplommatinidae, taxonomy, Thailand
Introduction

Terrestrial microsnails in the genus Diplommatina Benson, 1849 show some of the greatest diversity and are distributed in southern, south-eastern and eastern Asia. At present, a total of 18 Diplommatina species have been reported from Thailand. Of the 18 described species, ten (55.55%) were recorded from the south and seven (38.9%) from the north, whereas only one species, D. crispata khaocchamoensis Panha et al., 1998, was described from Khaochamao National Park, Chantaburi Province (Maassen 2001, Panha 1996, Panha and Burch 1996, Panha and Burch 2001, Panha and Burch 2005, Panha et al. 1998, Tongkerd et al. 2013). This study is focused on a survey of microsnail diversity recorded in eastern Thailand since 2005 and focused on five species of the genus Diplommatina (D. burapha sp. n., D. chadathongae sp. n., D. fusiformis sp. n., D. khwantongae sp. n. and D. khaowongensis) as new to science, based on the external shell characters. The geographic distribution of these eastern Thai species is also presented.

Materials and methods

The specimens from the Zoological Research Collection of Burapha University (ZRCBUU) which have been collected since 2005 and recently obtained shell specimens from the field survey were studied. Shells were collected by hand searching and leaf litter sieving in several areas in eastern Thailand (Fig. 1 and Table 1). Empty shells were cleaned with tap water and a fine hairbrush and then air-dried. Only live specimens of one species, Diplommatina khwantongae were collected. Digital photographs of shells were obtained using a Canon MP-E 65 Macro lens camera. Shell measurements (in mm), including shell height (SH), shell width (SW), aperture height (AH) and aperture width (AW), were determined using ImageJ software. Taxonomic identification and shell terminology (e.g. whorl number and shell sculpture) of the specimens were recorded according to Panha et al. (1998) and Tongkerd et al. (2013). Type specimens were deposited in the collection of the Zoological Research Collection of Burapha University (ZRCBUU), Chon Buri, Thailand.

| Province | Code | Location                  | Coordination (Lat. Long)       |
|----------|------|---------------------------|--------------------------------|
| Chonburi | CHON 001 | Khaocha-ang Pluangtong | 13°11'56.4”N 101°34’47.0”E |
|          | CHON 002 | Khao Mhe Cave           | 13°09'04.0”N 101°35’35.0”E |
|          | CHON 003 | Lublae Cave              | 13°09'09.0”N 101°35’52.1”E |
| Rayong   | RA 001 | Khao Pratun              | 13°07’36.9”N 101°35’56.6”E |
|          | RA 002 | Wat Tam Wattana Mongkol  | 13°05’49.4”N 101°36’25.1”E |
|          | RA 003 | Pradoo Cave              | 13°05’40.8”N 101°36’25.1”E |
|          | RA 004 | Khao Loi Cave            | 13°03’26.8”N 101°36’26.2”E |
|          | RA 005 | Wat Tam Khaobote         | 13°02’14.5”N 101°38’04.4”E |
| Province | Code | Location                  | Coordination (Lat. Long) |
|----------|------|---------------------------|-------------------------|
| RA 006   |      | Wat Tam Suwannaphupha     | 12°59'20.2"N 101°39'36.0"E |
| RA 007   |      | Samnaksong Tam Naeramitir | 12°58'13.7"N 101°39'45.7"E |
| RA 008   |      | Wat Tam Rakangtong        | 12°45'48.3"N 101°47'47.2"E |
| RA 009   |      | Wat Rattanatrikoon        | 12°56'53.1"N 101°46'37.1"E |
| Chantaburi | CTB 001 | Wat Tam Khaowong       | 14°35'15.5"N 101°20'33.5"E |
|          |      | Wat Khao Tam Rat         | 13°23'30.3"N 101°44'39.6"E |
| Srakeo   | SRA 001 | Wat Tam Khao Chakan     | 13°39'38.0"N 102°05'02.8"E |
|          | SRA 002 | Samnaksong Phuming       | 13°38'52.5"N 102°05'52.4"E |
|          | SRA 003 | Wat Tam Khaochan         | 13°34'43.2"N 102°05'34.8"E |
|          | SRA 004 | Wat Peltapananikorn      | 13°29'17.9"N 102°04'48.3"E |
|          | SRA 005 | Wat Khao Singto          | 13°59'22.4"N 102°00'29.3"E |
|          | SRA 006 | Wat Tam Maka             | 13°47'49.6"N 101°57'54.3"E |
|          | SRA 007 | Wat Khao Sampung         | 13°39'07.2"N 101°56'53.5"E |
|          | SRA 008 | Wat Saitong              | 13°32'48.1"N 101°57'17.4"E |
|          | SRA 009 | Khao Phaphueng            | 13°28'27.1"N 102°17'00.9"E |
|          | SRA 010 | Khao Saraphee            | 13°28'36.8"N 102°19'06.3"E |
|          | SRA 011 | Khao Laeum               | 13°24'23.3"N 102°18'05.3"E |
|          | SRA 012 | Wat Tam Khao Phuheap      | 13°23'12.5"N 102°15'13.0"E |
|          | SRA 013 | Wat Sabthavorn            | 13°24'19.9"N 102°16'29.6"E |
|          | SRA 014 | Tam Pet Phoe Tong         | 13°24'49.2"N 102°19'31.3"E |
|          | SRA 015 | Tam Nam Pra Shiva         | 13°19'15.2"N 102°19'40.1"E |
|          | SRA 016 | Tam Saengtien             | 13°18'57.2"N 102°19'57.2"E |
| Pracheenburi | PRA 001 | Wat Khao Teppitak        | 13°39'37.4"N 101°54'52.5"E |
|          | PRA 002 | Khao Tam Nantip          | 13°39'19.2"N 101°55'44.1"E |

**Taxon treatments**

*Diplommatina (crispata) khaochamaoensis* Panha et al., 1998

**Materials**

a. scientificName: *Diplommatina crispata khaochamaoensis*; country: Thailand;
stateProvince: Rayong; locality: Khao Pratun, Khaochamao District; verbatimCoordinates:
13°07'36.9"N 101°35'56.6"E; georeferenceProtocol: GPS; samplingProtocol: hand
collecting; eventDate: 2004; habitat: limestone hills; individualCount: 8; lifeStage: adult;
preparations: dry shell material; catalogNumber: ZRCBUU0019; recordedBy: Pongrat
Dumrongrojwatattana; identifiedBy: Pongrat Dumrongrojwatattana; dateIdentified: 2004;
language: en; collectionCode: Mollusc; basisOfRecord: PreservedSpecimen

b. scientificName: *Diplommatina crispata khaochamaoensis*; country: Thailand;
stateProvince: Rayong; locality: Khao Pratun, Khaochamao District; verbatimCoordinates:
13°07′36.9″N 101°35′56.6″E; georeferenceProtocol: GPS; samplingProtocol: hand collecting; eventDate: 2004; habitat: limestone hills; individualCount: 16; lifeStage: adult; preparations: dry shell material; catalogNumber: ZRCBUU0029; recordedBy: Pongrat Dumrongrojwattana; identifiedBy: Pongrat Dumrongrojwattana; dateIdentified: 2004; language: en; collectionCode: Mollusc; basisOfRecord: PreservedSpecimen

c. scientificName: *Diplommatina crispata khaochamaoensis*; country: Thailand;
stateProvince: Chonburi; locality: Lublae Cave, Bothong District, Chonburi province;
verbatimCoordinates: 13°09′09.0″N 101°35′52.1″E; georeferenceProtocol: GPS; samplingProtocol: hand collecting; eventDate: 2004; habitat: limestone hills; individualCount: 15; lifeStage: adult; preparations: dry shell material; catalogNumber: ZRCBUU0042; recordedBy: Pongrat Dumrongrojwattana; identifiedBy: Pongrat Dumrongrojwattana; dateIdentified: 2004; language: en; collectionCode: Mollusc; basisOfRecord: PreservedSpecimen

d. scientificName: *Diplommatina crispata khaochamaoensis*; country: Thailand;
stateProvince: Rayong; locality: Wat Tam Wattana Mongkol, Khaochamao District;
verbatimCoordinates: 13°05′49.4″N 101°36′25.1″E; georeferenceProtocol: GPS; samplingProtocol: hand collecting; eventDate: 2008; habitat: limestone hills; individualCount: 10; lifeStage: adult; preparations: dry shell material; catalogNumber: ZRCBUU0047; recordedBy: Pongrat Dumrongrojwattana; identifiedBy: Pongrat Dumrongrojwattana; dateIdentified: 2008; language: en; collectionCode: Mollusc; basisOfRecord: PreservedSpecimen

e. scientificName: *Diplommatina crispata khaochamaoensis*; country: Thailand;
stateProvince: Chonburi; locality: Lublae Cave, Bothong District; verbatimCoordinates: 13°09′09.0″N 101°35′52.1″E; georeferenceProtocol: GPS; samplingProtocol: hand collecting; eventDate: 2008; habitat: limestone hills; individualCount: 10; lifeStage: adult; preparations: dry shell material; catalogNumber: ZRCBUU0051; recordedBy: Pongrat Dumrongrojwattana; identifiedBy: Pongrat Dumrongrojwattana; dateIdentified: 2008; language: en; collectionCode: Mollusc; basisOfRecord: PreservedSpecimen

f. scientificName: *Diplommatina crispata khaochamaoensis*; country: Thailand;
stateProvince: Rayong; locality: Khao Pratun, Khaochamao District; verbatimCoordinates: 13°07′36.9″N 101°35′56.6″E; georeferenceProtocol: GPS; samplingProtocol: hand collecting; eventDate: 2004; habitat: limestone hills; individualCount: 5; lifeStage: adult; preparations: dry shell material; catalogNumber: ZRCBUU0079; recordedBy: Pongrat Dumrongrojwattana; identifiedBy: Pongrat Dumrongrojwattana; dateIdentified: 2004; language: en; collectionCode: Mollusc; basisOfRecord: PreservedSpecimen

g. scientificName: *Diplommatina crispata khaochamaoensis*; country: Thailand;
stateProvince: Chonburi; locality: Lublae Cave, Bothong District; verbatimCoordinates: 13°09′09.0″N 101°35′52.1″E; georeferenceProtocol: GPS; samplingProtocol: hand collecting; eventDate: 2015; habitat: limestone hills; individualCount: 5; lifeStage: adult; preparations: dry shell material; catalogNumber: ZRCBUU0086; recordedBy: Pongrat Dumrongrojwattana; identifiedBy: Pongrat Dumrongrojwattana; dateIdentified: 2015; language: en; collectionCode: Mollusc; basisOfRecord: PreservedSpecimen

h. scientificName: *Diplommatina crispata khaochamaoensis*; country: Thailand;
stateProvince: Rayong; locality: Wat Rattanatrikoon, Khaochamao District; verbatimCoordinates: 12°56′53.1″N 101°46′37.1″E; georeferenceProtocol: GPS; samplingProtocol: hand collecting; eventDate: 2004; habitat: limestone hills; individualCount: 24; lifeStage: adult; preparations: dry shell material; catalogNumber: ZRCBUU0098; recordedBy: Pongrat Dumrongrojwattana; identifiedBy: Pongrat Dumrongrojwattana; dateIdentified: 2013; language: en; collectionCode: Mollusc; basisOfRecord: PreservedSpecimen

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i. scientificName: Diplommatina crispata khaochamaoensis; country: Thailand; stateProvince: Rayong; locality: Khao Pratun, Khaochamao District; verbatimCoordinates: 13°07'36.9"N 101°35'56.6"E; georeferenceProtocol: GPS; samplingProtocol: hand collecting; eventDate: 2015; habitat: limestone hills; individualCount: 18; lifeStage: adult; preparations: dry shell material; catalogNumber: ZRCBUU0107; recordedBy: Pongrat Dumrongrojwattana; identifiedBy: Pongrat Dumrongrojwattana; dateIdentified: 2015; language: en; collectionCode: Mollusc; basisOfRecord: PreservedSpecimen

j. scientificName: Diplommatina crispata khaochamaoensis; country: Thailand; stateProvince: Chonburi; locality: Lublae Cave, Bothong District; verbatimCoordinates: 13°09'09.0"N 101°35'52.1"E; georeferenceProtocol: GPS; samplingProtocol: hand collecting; eventDate: 2015; habitat: limestone hills; individualCount: 5; lifeStage: adult; preparations: dry shell material; catalogNumber: ZRCBUU0108; recordedBy: Pongrat Dumrongrojwattana; identifiedBy: Pongrat Dumrongrojwattana; dateIdentified: 2015; language: en; collectionCode: Mollusc; basisOfRecord: PreservedSpecimen

k. scientificName: Diplommatina crispata khaochamaoensis; country: Thailand; stateProvince: Rayong; locality: Khao Pratun, Khaochamao District; verbatimCoordinates: 13°07'36.9"N 101°35'56.6"E; georeferenceProtocol: GPS; samplingProtocol: hand collecting; eventDate: 2015; habitat: limestone hills; individualCount: 5; lifeStage: adult; preparations: dry shell material; catalogNumber: ZRCBUU0109; recordedBy: Pongrat Dumrongrojwattana; identifiedBy: Pongrat Dumrongrojwattana; dateIdentified: 2015; language: en; collectionCode: Mollusc; basisOfRecord: PreservedSpecimen

l. scientificName: Diplommatina crispata khaochamaoensis; country: Thailand; stateProvince: Rayong; locality: Khao Pratun, Khaochamao District; verbatimCoordinates: 13°07'36.9"N 101°35'56.6"E; georeferenceProtocol: GPS; samplingProtocol: hand collecting; eventDate: 2015; habitat: limestone hills; individualCount: 22; lifeStage: adult; preparations: dry shell material; catalogNumber: ZRCBUU0107; recordedBy: Pongrat Dumrongrojwattana; identifiedBy: Pongrat Dumrongrojwattana; dateIdentified: 2015; language: en; collectionCode: Mollusc; basisOfRecord: PreservedSpecimen

m. scientificName: Diplommatina crispata khaochamaoensis; country: Thailand; stateProvince: Chonburi; locality: Lublae Cave, Bothong District; verbatimCoordinates: 13°09'09.0"N 101°35'52.1"E; georeferenceProtocol: GPS; samplingProtocol: hand collecting; eventDate: 2019; habitat: limestone hills; individualCount: 22; lifeStage: adult; preparations: dry shell material; catalogNumber: ZRCBUU0107; recordedBy: Pongrat Dumrongrojwattana; identifiedBy: Pongrat Dumrongrojwattana; dateIdentified: 2019; language: en; collectionCode: Mollusc; basisOfRecord: PreservedSpecimen

n. scientificName: Diplommatina crispata khaochamaoensis; country: Thailand; stateProvince: Rayong; locality: Wat Tam Wattana Mongkol, Khaochamao District; verbatimCoordinates: 13°05'49.4"N 101°36'25.1"E; georeferenceProtocol: GPS; samplingProtocol: hand collecting; eventDate: 2020; habitat: limestone hills; individualCount: 11; lifeStage: adult; preparations: dry shell material; catalogNumber: ZRCBUU0739; recordedBy: Pongrat Dumrongrojwattana; identifiedBy: Pongrat Dumrongrojwattana; dateIdentified: 2020; language: en; collectionCode: Mollusc; basisOfRecord: PreservedSpecimen

o. scientificName: Diplommatina crispata khaochamaoensis; country: Thailand; stateProvince: Rayong; locality: Pradoo Cave, Khaochamao District; verbatimCoordinates: 13°05'40.8"N 101°36'25.1"E; georeferenceProtocol: GPS; samplingProtocol: hand collecting; eventDate: 2020; habitat: limestone hills; individualCount: 11; lifeStage: adult; preparations: dry shell material; catalogNumber: ZRCBUU0740; recordedBy: Piyaporn Muenrit; identifiedBy: Pongrat Dumrongrojwattana;
Distribution

Limestone areas in Chonburi and Rayong provinces

*Diplommatina burapha* Dumrongrojwattana, Kamtuptim & Wongkamhaeng 2020, sp. n.

- ZooBank [B98B3418-9B9F-4F5E-AD09-C6DB5AEBE2AA](https://zoobank.org/B98B3418-9B9F-4F5E-AD09-C6DB5AEBE2AA)

**Nomenclature**

We named this new species “burapha,” which means “eastern.” This refers to the type locality, which is located in the east and is also in honour of Burapha University, the workplace of the authors.
Figure 1. Collecting sites. The code indicated in the map follows the list in Table 1.
Materials

**Holotype:**
- scientificName: *Diplommatina burapha*; country: Thailand; stateProvince: Srakeo; locality: Wat Tam Khaochan, Khaochakan District; verbatimElevation: 120-130 m; verbatimCoordinates: 13°34'43.2"N 102°05'34.8"E; decimalLatitude: 13.525939; decimalLongitude: 102.076315; georeferenceProtocol: GPS; samplingProtocol: hand collecting; eventDate: 2020; habitat: The wall of limestone hills that is located in a temple which is surrounded by variety of plants including the member of Euphorbiaceae, Leguminosae and Orchidaceae.; individualCount: 1; lifeStage: adult; preparations: dry shell material; catalogNumber: ZRCBUU-0747; recordedBy: Pongrat Dumrongrojwattana; disposition: in collection; identifiedBy: Pongrat Dumrongrojwattana; dateIdentified: 2020; language: en; collectionCode: Mollusc; basisOfRecord: PreservedSpecimen

**Paratype:**
- scientificName: *Diplommatina burapha*; country: Thailand; stateProvince: Srakeo; locality: Wat Tam Khaochan, Khaochakan District; verbatimCoordinates: 13°34'43.2"N 102°05'34.8"E; georeferenceProtocol: GPS; samplingProtocol: hand collecting; eventDate: 2020; habitat: The wall of three limestone hills that is located in a temple which is surrounded by variety of plants including the members of Euphorbiaceae, Leguminosae and Orchidaceae.; individualCount: 26; lifeStage: adult; preparations: dry shell material; catalogNumber: ZRCBUU 0748; recordedBy: Pongrat Dumrongrojwattana; identifiedBy: Pongrat Dumrongrojwattana; dateIdentified: 2020; language: en; collectionCode: Mollusc; basisOfRecord: PreservedSpecimen

Description

**Holotype:** Shell height 3.59 mm, shell width 1.91 mm. Aperture height 0.93 mm, aperture width 1.86 mm. Shell width/shell height ratio = 0.53. Aperture width/aperture height ratio = 1.15 (Fig. 2A).

**Paratypes:** Shell height 3.59-4.35 mm (4.11 ± 0.11 mm) shell width 1.91-2.35 mm (2.21 ± 0.07 mm). Aperture height 0.93-1.19 mm (1.08 ± 0.06 mm). Aperture width 1.07-1.47 mm (1.39 ± 0.07 mm). Shell width/shell height ratio = 0.54 ± 0.02. Aperture width/aperture height ratio = 1.29 ± 0.05.

**Shell** minute dextral, elongated narrow, turreted with 7 ¾ round whorls that increase regularly in size and diameter until the last whorl; **protoconch** orange, smooth, consisting of 1 ¼ whorls, covered with minute pits; **teleoconch** light orange, consists of about 5 ¾ whors that increase regularly in size and diameter until the last whorl; spires shouldered; **sculpture** consists of rather even and rather widely-spaced radial ribs with about 8 ribs/mm on the penultimate whorl and about 6 ribs/mm on the body whorl, the discernible spiral striae between the ribs present; **sutures** deep; **umbilicus** closed; **aperture** round; **peristome** is thickened and expanded and doubled; **columellar** lamella rather bluntly rounded (Fig. 4).
Figure 2. Four Diplommatina species from eastern Thailand. A) Diplommatina crispata khaochamaoensis Panha et al., 1998, B) D. burapha sp. n., C) D. chadathongae sp. nov. and D) D. chantaburiensis sp. n. Each species shows a frontal view, lateral view, dorsal view and the number of ribs per 0.5 mm on the penultimate whorl and body whorl, respectively.

Figure 3. Two Diplommatina species from eastern Thailand. A) D. fusiformis spec. nov., B-E) D. khwantongae spec. nov., B) Holotype, C-D) Living snail. (Photos by Ms. Rattanawadee Tekavong). Each species shows a frontal view, lateral view, dorsal view and the number of ribs per 0.5 mm on the penultimate whorl and body whorl, respectively.
Diagnosis
Shell minute, dextral, turreted, translucent, whitish; protoconch smooth; teleoconch sculpture of widely-spaced radial ribs with discernible spiral striae between the ribs, Aperture rounded, columellar lamella well developed, peristome doubled, thickened and expanded.

Etymology
We named this new species “burapha,” which means “eastern.” This refers to the type locality, which is located in the east and is also in honour of Burapha University, the workplace of the authors.

Distribution
This species is known only from the type locality.

Taxon discussion
The size of the shell, shape of the shell and protoconch of D. burapha sp. n. are similar to D. doichiangdao Panha & Burch, 1998 from Doi Chiang Dao, northern Thailand and Laotian species, D. belonis Möllendorff, 1900. The spire of D. burapha sp. n. is relatively broader than that of those two species. The enlarged penultimate whorl and the body whorl of D. burapha sp. n. are relatively similar in diameter, while the last whorls of both D. doichiangdao and D. belonis are smaller in diameter than the
enlarged penultimate whorl. This new species columellar is poorly developed, while well developed in *D. doichiangdao* and *D. belonis*.

*Diplommatina chadathongae* Kamtuptim, Dumrongrojwattana & Wongkamhaeng 2020, sp. n.

- **ZooBank** [4ACB0FCD-80A2-44C1-A213-3734A0F3B5F0](https://zoobank.org/4ACB0FCD-80A2-44C1-A213-3734A0F3B5F0)

**Materials**

**Holotype:**

a. **scientificName:** *Diplommatina chadathongae*; **country:** Thailand; **stateProvince:** Chanthaburi; **locality:** Wat Khaowongkotruiwongsaram, Kanghaengmaeo District; **verbatimCoordinates:** 12°53'11.4"N 101°49'06.2"E; **georeferenceProtocol:** GPS; **samplingProtocol:** hand collecting; **eventDate:** 2020; **habitat:** limestone hills; **individualCount:** 1; **lifeStage:** adult; **preparations:** dry shell material; **catalogNumber:** ZRCBUU-0092; **recordedBy:** Pongrat Dumrongrojwattana; **identifiedBy:** Pongrat Dumrongrojwattana; **dateIdentified:** 2012; **language:** en; **collectionCode:** Mollusc; **basisOfRecord:** PreservedSpecimen

**Paratype:**

a. **scientificName:** *Diplommatina chadathongae*; **country:** Thailand; **stateProvince:** Chanthaburi; **locality:** Wat Tam Khaochan, Khaochakan District; **verbatimCoordinates:** 12°53'11.4"N 101°49'06.2"E; **georeferenceProtocol:** GPS; **samplingProtocol:** hand collecting; **eventDate:** 2020; **habitat:** limestone hills; **individualCount:** 29; **lifeStage:** adult; **preparations:** dry shell material; **catalogNumber:** ZRCBUU-0093; **recordedBy:** Pongrat Dumrongrojwattana; **identifiedBy:** Pongrat Dumrongrojwattana; **dateIdentified:** 2012; **language:** en; **collectionCode:** Mollusc; **basisOfRecord:** PreservedSpecimen

**Description**

**Holotype.** Shell height 1.61 mm, shell width 0.78 mm. Aperture height 0.50 mm, aperture width 0.60 mm. Shell width/shell height ratio = 0.49. Aperture width/aperture height ratio = 1.21 (Fig. 2C).

**Paratypes (6 shells).** Shell height 1.93-2.07 mm (1.98 ± 0.05 mm), shell width 0.84-0.93 mm (0.88 ± 0.03 mm). Aperture height 0.51-0.63 mm (0.58 ± 0.05 mm). Aperture width 0.59-0.67 mm (0.63 ± 0.02 mm). Shell width/shell height ratio = 0.45 ± 0.01. Aperture width/aperture height ratio = 1.09 ± 0.07.

**Shell** minute dextral, cylindric, translucent, whitish, with about 5 ¾ whorls that increase regularly in size and diameter until the last whorl; **protoconch** orange, smooth, consisting of 1 ½ whorls; **teleoconch** light orange, consisting of about 4 ¾ keeled whorls; **sculpture** consists of strong, rather narrowly-spaced radial ribs which are about 20 ribs/mm on the penultimate whorl and about 14 ribs/mm on the body whorl; **sutures** well impressed; **umbilicus** closed; **aperture** round; **peristome** thickened and expanded and doubled; **columellar** lamella well developed and directed anteriorly (Fig. 4).
Diagnosis

Shell minute, dextral, cylindrical, translucent, whitish, teleoconch sculpture of narrowly-spaced axial ribs, whorls aperture rounded, columellar lamella well developed, peristome thickened, expanded and doubled.

Etymology

We named this new species “chadathongae” in memory of the second author's beloved mother, Ms. Wiang Chadathong.

Distribution

Only known from the type locality.

Taxon discussion

Diplommatina chadathongae sp. n. is another one of the Thai smallest Diplommatina species (average shell height = 1.69 ± 0.04 mm) and same size as D. krabiensis Panha & Burch, 1998 (shell height of type specimens are 1.6-1.7 mm and average shell height = 1.69 ± 0.04 mm). This new species differs from D. krabiensis by its dextral, cylindrical, narrowly-fine radial ribs, while the smallest species is sinistral, shell fusiform or ovate with widely-spaced radial ribs. This new species differs from Diplommatina miriensis Godwin-Austen, 1917 from Nepal by its shell being more slender and columellar lamella well developed.

Diplommatina chantaburiensis Dumrongrojwattana, Kamtuptim & Wongkamhaeng 2020, sp. n.

- ZooBank 2573D215-407A-42C5-AD42-7E365477CA7D

Materials

Holotype:

- scientificName: Diplommatina chantaburiensis; country: Thailand; stateProvince: Chanthaburi; locality: Wat Khao Wong Kot, Kanghaengmaeo District; verbatimCoordinates: 12°52’47.3"N 101°49’13.8"E; georeferenceProtocol: GPS; samplingProtocol: hand collecting; eventDate: 2020; habitat: limestone hills; individualCount: 1; lifeStage: adult; preparations: dry shell material; catalogNumber: ZRCBUU-0090; recordedBy: Pongrat Dumrongrojwattana; identifiedBy: Pongrat Dumrongrojwattana; dateIdentified: 2012; language: en; collectionCode: Mollusc; basisOfRecord: PreservedSpecimen

Paratype:

- scientificName: Diplommatina chantaburiensis; country: Thailand; stateProvince: Chanthaburi; locality: Wat Khao Wong Kot, Kanghaengmaeo District; verbatimCoordinates: 12°52’47.3"N 101°49’13.8"E; georeferenceProtocol: GPS; samplingProtocol: hand collecting; eventDate: 2020; habitat: limestone hills;
Description

**Holotype.** Shell height 3.56 mm, shell width 1.64 mm. Aperture height 1.03 mm, aperture width 1.23 mm. Shell width/shell height ratio = 0.46. Aperture width/aperture height ratio = 1.19 (Fig. 2D).

**Paratypes (7 shells).** Shell height 2.56-2.85 mm (2.67 ± 0.10 mm) shell width 1.13-1.28 mm (1.24 ± 0.05 mm). Aperture height 0.73-0.85 mm (0.77 ± 0.06 mm). Aperture width 0.73-1.01 mm (0.93 ± 0.08 mm). Shell width/shell height ratio = 0.46 ± 0.02. Aperture width/aperture height ratio = 1.20 ± 0.13. Shell minute dextral, fusiform, translucent, whitish, with about 7 whorls that increase regularly in both size and diameter until the last whorl which is slightly smaller in diameter than the penultimate whorl; protoconch large, whitish, smooth, surface cover with minute pits, consisting of 1 ¼ whorls; teleoconch about 5 ¼ whorls, whitish; sculpture consists of thin, widely-spaced radial ribs which about 9 ribs/mm on the penultimate whorl and about 6 ribs/mm on the body whorl, discernible spiral striae between the ribs absent; sutures deeply impressed; umbilicus closed; aperture rounded; peristome thickened and expanded; columellar lamella is relatively small (Fig. 4).

Diagnosis

Shell minute, dextral, translucent, whitish, protoconch large, teleoconch sculpture consisting of widely-spaced axial ribs, spiral striae between the ribs absent; aperture rounded, columellar lamella relatively small, peristome thickened and expanded.

Etymology

The species name “chantaburiensis” refers to Chantaburi, the Province of the type locality.

Distribution

Only known from the type locality.

Taxon discussion

*Diplommatina chantaburiensis* sp. n. is very similar to *D. fusiformis* sp. n. Nevertheless, *D. chantaburiensis* sp. n. has larger protoconch, shell more slender and no spiral striae between the radial ribs. This new species is also similar to the southern species *D. hidagai* Panha, 1998, but differs by its prominent protoconch, more widely-radial ribs and columellar lamella is poorly developed.
**Diplommatina fusiformis** Dumrongrojwattana, Kamtuptim & Wongkamhaeng 2020, sp. n.

- **ZooBank** [92F4C2C9-E2CC-43EA-825A-5052282885ED](https://zoobank.org/92F4C2C9-E2CC-43EA-825A-5052282885ED)

**Materials**

**Holotype:**

a. **scientificName:** Diplommatina fusiformis; **country:** Thailand; **stateProvince:** Rayong; **locality:** Wat Rattanatrikoon, Khaochamao District; **verbatimCoordinates:** 12°56'53.1"N 101°46'37.1"E; **georeferenceProtocol:** GPS; **samplingProtocol:** hand collecting; **eventDate:** 2020; **habitat:** limestone hills; **individualCount:** 1; **lifeStage:** adult; **preparations:** dry shell material; **catalogNumber:** ZRCBUU-0105; **recordedBy:** Pongrat Dumrongrojwattana; **identifiedBy:** Pongrat Dumrongrojwattana; **dateIdentified:** 2015; **language:** en; **collectionCode:** Mollusc; **basisOfRecord:** PreservedSpecimen

**Paratype:**

a. **scientificName:** Diplommatina fusiformis; **country:** Thailand; **stateProvince:** Rayong; **locality:** Wat Rattanatrikoon, Khaochamao District; **verbatimCoordinates:** 12°56'53.1"N 101°46'37.1"E; **georeferenceProtocol:** GPS; **samplingProtocol:** hand collecting; **eventDate:** 2020; **habitat:** limestone hills; **individualCount:** 18; **lifeStage:** adult; **preparations:** dry shell material; **catalogNumber:** ZRCBUU-0104; **recordedBy:** Pongrat Dumrongrojwattana; **identifiedBy:** Pongrat Dumrongrojwattana; **dateIdentified:** 2015; **language:** en; **collectionCode:** Mollusc; **basisOfRecord:** PreservedSpecimen

**Description**

**Holotype.** Shell height 2.66 mm, shell width 1.22 mm. Aperture height 0.76 mm, aperture width 0.94 mm. Shell width/shell height ratio = 0.46. Aperture width/aperture height ratio = 1.23 (Fig. 3A).

**Paratypes (5 shells).** Shell height 2.66-2.74 mm (2.65 ± 0.07 mm) shell width 1.21-1.29 mm (1.25 ± 0.03 mm). Aperture height 0.76-0.87 mm (0.78 ± 0.06 mm). Aperture width 0.82-0.98 mm (0.91 ± 0.06 mm). Shell width/shell height ratio = 0.47 ± 0.02. Aperture width/aperture height ratio = 1.18 ± 0.10.

**Description.** Shell minute dextral, fusiform, translucent, light orange, with about 6 ½ whors that increase regularly in size and diameter until the last whorl which is slightly smaller in diameter than the penultimate whorl; **protoconch** orange, smooth, consisting of 1 ¼ whors; **teleoconch** light orange, about 5 ¼ whors; **sculpture** consists of thin, widely-spaced radial ribs with discernible spiral striae between the ribs; there are about 10 ribs/mm on the penultimate whorl and about 8 ribs/mm on the body whorl; **sutures** deep; **umbilicus** closed; **aperture** rounded, peristome thickened and expanded; **columellar** lamella relatively small (Fig. 4).
Diagnosis

**Diagnosis.** Shell minute, dextral, translucent light orange, teleoconch sculpture consisting of widely-spaced axial ribs with spiral striae between the ribs; aperture rounded, columellar lamella relatively small, peristome, thickened and expanded.

Etymology

We named this new species “*fusiformis*” based on its fusiform shell shape.

Distribution

Only known from the type locality.

Taxon discussion

*Diplommatina fusiformis* sp. n. is similar to the southern species, *D. hidagai* Panha, 1998, but it differs by its more widely-ribbed shell, its more slender spire and its less prominent columellar lamella.

*Diplommatina khwantongae* Dumrongrojwattana, Kamtuptim & Wongkamhaeng 2020, sp. n.

- **ZooBank** [4311F0B5-9CA7-460F-9637-1C11F9BEDD86](http://zoobank.org/4311F0B5-9CA7-460F-9637-1C11F9BEDD86)

Materials

**Holotype:**

a. scientificName: *Diplommatina khwantongae*; country: Thailand; stateProvince: Chonburi; locality: Lub Lae Cave, Bothong district, Chonburi Province; verbatimCoordinates: 13°09'09.9"N 101°35'52.4"E; georeferenceProtocol: GPS; samplingProtocol: hand collecting; eventDate: 2020; habitat: limestone hills; individualCount: 1; lifeStage: adult; preparations: dry shell material; catalogNumber: ZRCBUU-0190; recordedBy: Kanita Khwantong; identifiedBy: Kanita Khwantong; dateIdentified: 2015; language: en; collectionCode: Mollusc; basisOfRecord: PreservedSpecimen

**Paratypes:**

a. scientificName: *Diplommatina khwantongae*; country: Thailand; stateProvince: Chonburi; locality: Lub Lae Cave, Bothong district, Chonburi Province; verbatimCoordinates: 13°09'09.9"N 101°35'52.4"E; georeferenceProtocol: GPS; samplingProtocol: hand collecting; eventDate: 2020; habitat: limestone hills; individualCount: 5; lifeStage: adult; preparations: dry shell material; catalogNumber: ZRCBUU-0102; recordedBy: Kanita Khwantong; identifiedBy: Kanita Khwantong; dateIdentified: 2015; language: en; collectionCode: Mollusc; basisOfRecord: PreservedSpecimen

b. scientificName: *Diplommatina khwantongae*; country: Thailand; stateProvince: Chonburi; locality: Lub Lae Cave, Bothong district, Chonburi Province; verbatimCoordinates: 13°09'09.9"N 101°35'52.4"E; georeferenceProtocol: GPS; samplingProtocol: hand collecting; eventDate: 2020; year: 2020; month: 7; day: 11; habitat: limestone hills; individualCount: 5; lifeStage: adult; preparations: dry shell material; catalogNumber:
Description

**Holotype**- Shell height 3.59 mm, shell width 1.91 mm. Aperture height 0.93 mm, aperture width 1.86 mm. Shell width/shell height ratio = 0.53. Aperture width/aperture height ratio = 1.15. (Fig. 3B-E).

**Paratypes:** (6 shells). Shell height 1.68-1.76 mm (1.69 ± 0.04 mm), shell width 0.78-0.81 mm (0.81 ± 0.04 mm). Aperture height 0.46-0.58 mm (0.53 ± 0.04 mm). Aperture width 0.53-0.61 mm (0.59 ± 0.03 mm). Shell width/shell height ratio = 0.48 ± 0.03. Aperture width/aperture height ratio = 1.12 ± 0.07.

**Shell** minute dextral, cylindrical, light orange, with about 7 whorls that increase regularly in size and diameter until the last whorl; **protoconch** orange, smooth, consisting of 1 ¼ whorls, covered with minute pits; **teleoconch** light orange, consisting of about 5 ¾ whorls; **spires** shouldered; **sculpture** consists of rather even and widely-spaced thin radial ribs with discernible spiral striae between the ribs; there are about 8 ribs/mm on the penultimate whorl and about 6 ribs/mm on the body whorl; **sutures** deep; **umbilicus** closed; **aperture** round; **peristome** thickened and expanded and doubled; **columellar lamella** rather bluntly rounded.

**Animal.** Living animals had a greyish body, head, tentacles and foot, with an orange eye located at the base of each tentacle (Fig. 3C-E). The operculum was round and corneous. Snails were found living in leaf litter and plant debris in the limestone hills. Due to the small population of each species, the live specimens of all species found in this study are hard to find. More observation and further study on anatomy are needed.

**Diagnosis**

Shell minute, dextral, cylindrical, light orange, teleoconch sculpture of widely-spaced and high radial ribs, aperture rounded, columellar lamella well developed, peristome thickened and expanded.
Etymology
We named this new species “khwantongae” in memory of Ms. Kanita Khwantong, who made the first discovery of this new species.

Distribution
This species is known only from the limestone hills in Chonburi and Rayong Provinces.

Taxon discussion
The shell shape of Diplommatina is generally fusiform or tower-shaped with mostly low and strong radial ribs, which are formed as tubular projections in some species and mostly rounded or angular periphery whorls. For example, the shell of D. hidagai is fusiform covered with low and strong radial ribs or the shell of D. nimannandhi Panha et al., 2002 has tower-shaped, radial ribs forming as semi-tubular peripheral projections. In this new species, Diplommatina khwantongae sp. n. is a very distinct species of epitoniid snail due to its cylindrical, thin radial ribs and shouldered whorls.

Figure 5. doi
Distribution of Diplommatina spp. in Eastern Thailand. Code of location shown in Table 1.
Discussion

In Thailand, a total of 18 Diplommatina species have been reported (Inkhavilay et al. 2019, Panha and Burch 2005, Tongkerd et al. 2013). From that, there is only one species, Diplommatina crispata khaochamaoensis recorded in eastern Thailand. This work increases the number of species reported in the eastern part of Thailand to five species and makes a total of 22 species of the Diplommatina in Thailand. These data imply that eastern Thailand might be a hot spot for the Diplommatina. Previous research on this microsnails’ group reveals the high endemism in almost every species due to their ecology, living on the limestone hill that limits their dispersal ability (Panha and Burch 2005). In this study, the species described also show high endemism except for the Diplommatina crispata khaochamaoensis, which occurred in almost all study sites. (Fig. 5)

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