

**ANNOTATED CHECKLIST OF THE TERRESTRIAL MOLLUSCS
(MOLLUSCA: GASTROPODA) FROM DONG VAN DISTRICT,
HA GIANG PROVINCE, VIETNAM**

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Abstract. An annotated checklist of the terrestrial molluscs from Dong Van District is presented. The checklist combines data from all material collected from March 2018 to December 2020 and previous studies. The checklist provides an overview of the diversity of the terrestrial molluscs occurring in the Dong Van area. A total of 59 species representing 16 families are documented. Three species (or 5.08%) of these species are endemic to Ha Giang Province. A species recorded for Northern Vietnam and 28 species of the terrestrial molluscs for Ha Giang Province are herein published for the first time. We also briefly discuss the extent of diversity and endemism in the terrestrial molluscs of the Dong Van area.

Keywords: distribution, karst, new records, Northern Vietnam, terrestrial molluscs.

1. Introduction

Limestone karst areas are sedimentary rock outcrops that consist primarily of calcium carbonate, and these are known to contain reservoirs of biodiversity with a high level of endemism. Terrestrial molluscs occur most abundantly in limestone karst areas, both in numbers of species as well as in numbers of individuals. They need the limestone to build their shells [1, 2].

Dong Van District is one of the most important conservation sites in Vietnam and contains a significant number of endemic and native species in flora and fauna. This area is located within the Dong Van Karst Plateau Geopark, bordered by South China to the north. This plateau is one of the special limestone areas of Vietnam, housing prominent imprints that depict the development of the earth's crust [3]. Dong Van area is also highly evaluated for its diverse and unique ecosystems [3, 4].

To date, in Vietnam, there is a total of more than 850 terrestrial molluscs species and subspecies, representing 160 genera in over 30 families [5-8]. Many of these species are considered to be limestone dependent, recorded mainly in the limestone karst areas in the Northwest, Northeast (including Dong Van Karst Plateau Geopark),

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North Central, and a part of South Vietnam. Limestone dependent species mostly belong to the Cyclophoridae, Pupinidae, Ariophantidae, Camaenidae, Clausiliidae, Diapheridae, Enidae, Plectopylidae, Streptaxidae, and some other families [2, 9-12].

There has been no comprehensive information on the terrestrial molluscs species found in Dong Van area, even during the last biodiversity survey conducted in 2011–2017 [4, 7, 8]. Therefore, this paper aims to provide baseline information on the biodiversity of terrestrial molluscs within the Dong Van area. This information will be useful in updating the status of individual species and will contribute to the design of conservation efforts for the Dong Van Karst Plateau Geopark.

2. Content

2.1. Materials and methods

The samples examined for this paper were collected from March 2018 to December 2020 in different habitats: limestone, forest over limestone, plantation forest, cultivated area and the cultivated area adjacent to the forest, residential areas. Terrestrial molluscs were mostly collected by hand in the targeted sampling sites. All snails, slugs, empty shells, and shell fragments were collected. Living animals were relaxed in deoxygenated water and preserved in 70% ethanol. Shells specimens have been studied as regards size, colour, morphology, sculpture, aperture, plicae, and lamellae, lunella, and clausilium. Photographs were taken with a digital camera.

Specimens were collected from the following localities: Ma Le Commune: 23.314494 N, 105.309326 E, 845 m a.s.l., 15 August 2019; Ta Lung Commune: 23.234429 N, 105.351404 E, 902 m, 21 September 2020; Lung Tao Commune: 23.283954 N, 105.271289 E, 955 m, 12 March 2018; Ta Phin Commune: 23.239551 N, 105.314869 E, 876 m; 22 September 2020; Dong Van Town: 23.280836 N, 105.360511 E, 876 m; 23 September 2020; Thai Phin Tung Commune: 23.262518N, 105.298503 E, 991 m; 14 August 2019; Lung Cu: Commune: 23.364116 N, 105.314781 E, 1138 m; 16 August 2019.

The classification systematic of the terrestrial molluscs follows MolluscaBase (12/2020) [13], and other references herein cited. Families, genera, and species, are listed in alphabetical order for ease of reference. The effort has been made to provide the most updated nomenclatural and taxonomic statuses of all taxa listed. All specimens examined are deposited in the Zoological Collection of Biological Museum (ZVNU) of the University of Science, Vietnam National University (Hanoi, Vietnam).

2.2. Results and discussion

*** *Species composition***

Studies on the terrestrial molluscs in Dong Van District revealed a rich diversity and high abundance. 59 species of terrestrial molluscs were recorded of which one species was documented for the first time in Northern Vietnam (*Discartemon* sp.), 28 species for Ha Giang Province. Of the 59 species, 55 are native and four are introduced (*Allopeas clavulinum*, *Allopeas gracile*, *Lissachatina fulica*, and *Chalepotaxis infantilis*) (Table 1 and Figures 1-5).

Species diversity is the highest in the family Camaenidae and Pupinidae with ten species (16.95% of all species found) for each; and then in Cyclophoridae with seven species (11.86%), in Clausiliidae and in Ariophantidae it with six species (10.17%), in Streptaxidae with four species (6.78%). Other families were less diverse (Table 1).

Table 1. Checklist of terrestrial molluscs of Dong Van District, Ha Giang Province

No.	Species	No. of specimens	Remarks/Records
	Phylum Mollusca		
	Class Gastropoda		
	Subclass Caenogastropoda		
	Cyclophoridae Gray, 1847		
1.	<i>Cyclophorus courbeti</i> Ancey, 1888	5	Colour patterns highly variable. New species recorded for Ha Giang Province
2.	<i>Dioryx dautzenbergi</i> Páll-Gergely, 2017	3	New species recorded for Ha Giang Province
3.	<i>Dioryx pocsi</i> Varga, 1972	20	New species recorded for Ha Giang Province
4.	<i>Japonia mariei</i> (Morlet, 1886)		New species recorded for Ha Giang Province
5.	<i>Lagocheilus</i> sp.	17	Shell small, conical, with rounded dorsal whorls, which has numerous spiral ridges
6.	<i>Pterocyclos</i> sp.	30	Shell patterns vary from dense zigzags and peripheral band over brown whorls to fugitive brown zigzags over white or yellow whorls
7.	<i>Scabrina tonkiniana</i> (Mabille, 1887)	30	New species recorded for Ha Giang Province
	Diplommatinidae Pfeiffer, 1857		
8.	<i>Diplommatina balansai</i> Morlet, 1886		Previously recorded from Ha Giang, but did not include

			specific locality
9.	<i>Diplommatina messengeri</i> Ancey, 1904	21	New species recorded for Ha Giang Province
10.	<i>Diplommatina</i> sp.	2	Spire height, radial rib density, and whorl shape variable. Differ from <i>D. messengeri</i> in having rounder whorls, finer but distinct radial ribs, and the peristome double thickened and expanded
Hydrocenidae Troschel, 1857			
11.	<i>Georissa decora</i> Möllendorff, 1900	30	New species recorded for Ha Giang Province
Pupinidae Pfeiffer, 1853			
12.	<i>Pseudopomatias amoenus</i> Möllendorff, 1885	8	The species inhabits a large geographic area of over 1300 km from Northern Vietnam until the Chinese Chongqing and Hubei Provinces [14].
13.	<i>Pseudopomatias maasseni</i> Páll-Gergely & Hunyadi, 2015	15	The species is very variable in terms of shell size, the extent of ribs on the surface shell, and whorls
14.	<i>Pupina brachysoma</i> Ancey, 1904	10	New species recorded for Ha Giang Province
15.	<i>Pupina douvillei</i> Dautzenberg & Fischer, 1906	2	The species was described based on specimens from the Mansuy collection, which was collected from Ha Giang, but did not include specific locality [15, 16]
16.	<i>Pupina exclamationis</i> Mabilie, 1887	2	Mabilie (1887) described this species from Tonkin without more exact locality data
17.	<i>Pupina sonlaensis</i> Do, 2017	9	New species recorded for Ha Giang Province
18.	<i>Pupina verneau</i> Dautzenberg	1	This species was described based on material from Ha

	& Fischer, 1906		Giang but did not include a specific locality [16]
19.	<i>Pupina</i> sp.	5	This species is similar to <i>P. exclamationis</i> but has a larger shell, an expanded parietal lamellae, and a double peristome
20.	<i>Pupinella frednaggsi</i> Thach & Huber, 2017	30	New species recorded for Ha Giang Province
21.	<i>Pupinella mansuyi</i> (Dautzenberg & Fischer, 1908)	23	New species recorded for Ha Giang Province
Subclass Heterobranchia J.E. Gray, 1840			
Achatinidae Swainson, 1840			
22.	<i>Allopeas clavulinum</i> (Potiez & Michaud, 1838)	16	This is a synanthropic species and rather widespread in Dong Van. New species recorded for Ha Giang Province
23.	<i>Allopeas gracile</i> (Hutton, 1834)	4	It is likely to occur in cultivated and settled habitats in the Dong Van District
24.	<i>Glessula paviei</i> Morlet, 1893	30	New species recorded for Ha Giang Province
25.	<i>Lissachatina fulica</i> (Bowdich, 1822)	10	Large shell. It is likely to occur in cultivated and settled habitats in the Dong Van District
26.	<i>Prosopeas</i> sp.	7	Distinguished from congeners by its shell shape and the presence of relatively strong and sharp ribs on the protoconch
Ariophantidae Godwin-Austen, 1888			
27.	<i>Macrochlamys douvillei</i> Dautzenberg & Fischer, 1905	3	This species was described based on material from Ha Giang, includes an illustration and one set of shell measurements [15]
28.	<i>Macrochlamys excepta</i>	22	The original description did not

	(Mabille, 1887)		include an illustration, and only one set of measurements was given
29.	<i>Megaustenia messengeri</i> Ancey, 1904	8	New species recorded for Ha Giang Province
30.	<i>Microcystina tongkingensis</i> Möllendorff, 1901	5	The original description did not include an illustration, and only one set of measurements was given. New species recorded for Ha Giang Province
Camaenidae Pilsbry, 1895			
31.	<i>Aegista subinflata</i> (Mabille, 1889)	30	Widespread in Dong Van District. New species recorded for Ha Giang Province
32.	<i>Bradybaena jourdyi</i> (Morlet, 1886)	17	It is likely to occur in cultivated and settled habitats in the Dong Van District
33.	<i>Camaena carpalima</i> (Mabille, 1889)	6	Rediscover after 121 years in Vietnam. New species recorded for Ha Giang Province.
34.	<i>Camaena choboensis</i> (Mabille, 1889)	2	<i>Camaena mansuy</i> is synonym of this species
35.	<i>Camaena connectens</i> Dautzenberg & Fischer, 1906	3	This species was described based on material from Ha Giang but did not include a specific locality [16]
36.	<i>Camaena vorvonga</i> (Bavay & Dautzenberg, 1900)	9	Rediscover after 120 years in Vietnam. New species recorded for Ha Giang Province
37.	<i>Ganesella vatheleti</i> (Bavay & Dautzenberg, 1899)	3	Rediscover after 121 years in Vietnam. New species recorded for Ha Giang Province
38.	<i>Plectotropis bonnieri</i> (Fischer, 1898)	30	Widespread in Dong Van. New species recorded for Ha Giang
39.	<i>Trachia lambineti</i> (Bavay &	11	New species recorded for Ha

	Dautzenberg, 1899)		Giang Province
40.	<i>Trachia limatulata</i> (Bavay & Dautzenberg, 1909)	3	New species recorded for Ha Giang Province
	Chronidae Thiele, 1931		
41.	<i>Kaliella ordinaria</i> Ancey, 1904	6	New species recorded for Ha Giang Province
	Charopidae Hutton, 1884		
42.	<i>Ruthvenia bicincta</i> (Bavay & Dautzenberg, 1912)	25	The only species of family Charopidae discovered from Vietnam
	Clausiliidae Gray, 1855		
43	<i>Hemiphaedusa fistulata</i> (Bavay & Dautzenberg, 1909)	20	New species recorded for Ha Giang Province
44	<i>Hemiphaedusa porphyrostoma regina</i> Nordsieck, 2011	22	This subspecies was described based on material from Ha Giang [4]
45.	<i>Hemiphaedusa thatkheana splendida</i> Nordsieck, 2011	5	This subspecies was described based on material from Ha Giang [4]
46.	<i>Synprophyma oospiroides</i> Nordsieck, 2011	11	This species was described based on material from Ha Giang [4]
47.	<i>Synprosphyma moirati</i> (Bavay & Dautzenberg, 1909)	12	New species recorded for Ha Giang Province
48.	<i>Traupidauchenia ootanii longicollis</i> Nordsieck, 2011	30	This subspecies was described based on material from Ha Giang [4]
	Diapheridae Panha & Naggs, 2010		
49.	<i>Parasinoennea ovulum</i> (Bavay & Dautzenberg, 1912)	13	New species recorded for Ha Giang Province
	Enidae B.B. Woodward, 1903		
50.	<i>Apoecus clausiliaeformis</i>	30	Widespread in Dong Van

	(Bavay & Dautzenberg, 1912)		District
Gastrocoptidae Pilsbry, 1918			
51.	<i>Boysidia paviei</i> Bavay & Dautzenberg, 1912	2	New species recorded for Ha Giang Province
Helicarionidae Bourguignat, 1877			
52.	<i>Chalepotaxis infantilis</i> (Gredler, 1881)	20	New species recorded for Ha Giang Province
53.	<i>Sivella latior</i> (Bavay & Dautzenberg, 1909)	30	Widespread in Dong Van. New species recorded for Ha Giang Province
Plectopylidae Möllendorff, 1898			
54.	<i>Gudeodiscus cyrtochilus</i> (Gude, 1909)	10	Shell characters rather stable
55.	<i>Sicradiscus mansuyi</i> (Gude, 1908)	15	Shell characters rather stable
Streptaxidae J.Gray, 1860			
56.	<i>Discartemon</i> sp.	7	This is the second species of the genus <i>Discartemon</i> from Vietnam, after <i>D. discus</i> (Pfeiffer, 1851). New species recorded for Northern Vietnam
57.	<i>Elma mansuyi</i> (Dautzenberg & Fischer, 1905)	2	Previously recorded from Ha Giang by Dautzenberg & Fischer (1906), but did not include specific locality
58.	<i>Elma messengeri</i> (Bavay & Dautzenberg, 1903)	3	Previously recorded from Ha Giang by Dautzenberg & Fischer (1906), but did not include specific locality
59.	<i>Elma tonkiniana</i> (Bavay & Dautzenberg, 1903)	3	Previously recorded from Ha Giang by Dautzenberg & Fischer (1906), but did not include specific locality [17]



1. *Cyclophorus courbeti*



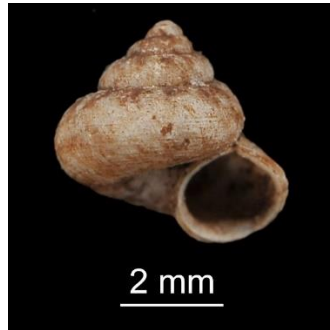
2. *Dioryx dautzenbergi*



3. *Dioryx pocsi*



4. *Japonia mariei*



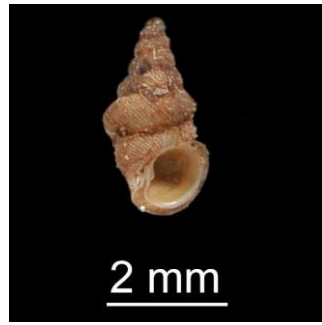
5. *Lagocheilus* sp.



6. *Pterocyclos* sp.



7. *Scabrina tonkiniana*



8. *Diplommatina balansai*



9. *Dip. messageri*



10. *Diplommatina* sp.



11. *Pse. amoenus*



12. *Pse. maasseni*

Figure 1. Photos of terrestrial molluscs collected from Dong Van District (1-12)



13. *Pupina brachysoma*



14. *Pupina douvillei*



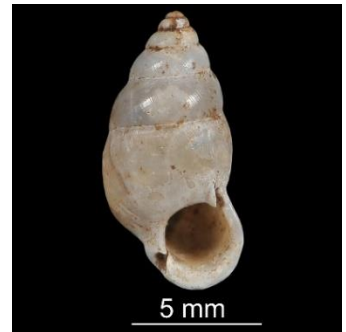
15. *Pupina exclamtionis*



16. *Pupina sonlaensis*



17. *Pupina verneaui*



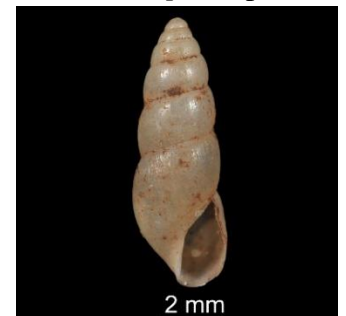
18. *Pupina* sp.



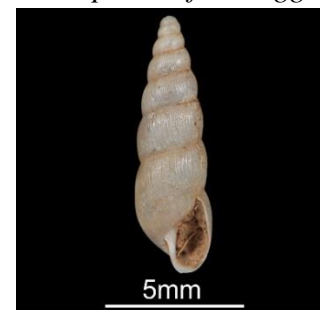
19. *Pupinella frednaggsi*



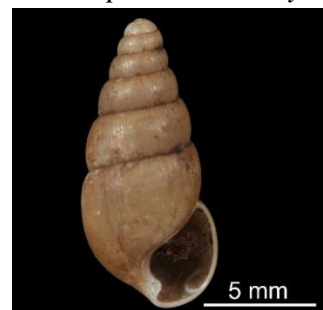
20. *Pupinella mansuyi*



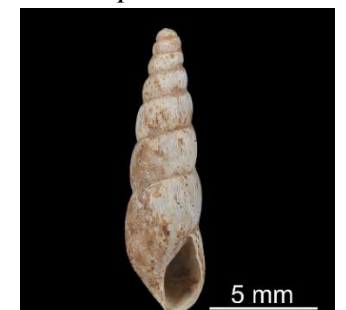
21. *Allopeas clavulinum*



22. *Allopeas gracile*



23. *Glessula paviei*



24. *Prosopeas* sp.

Figure 2. Photos of terrestrial molluscs collected from Dong Van District (13-24)

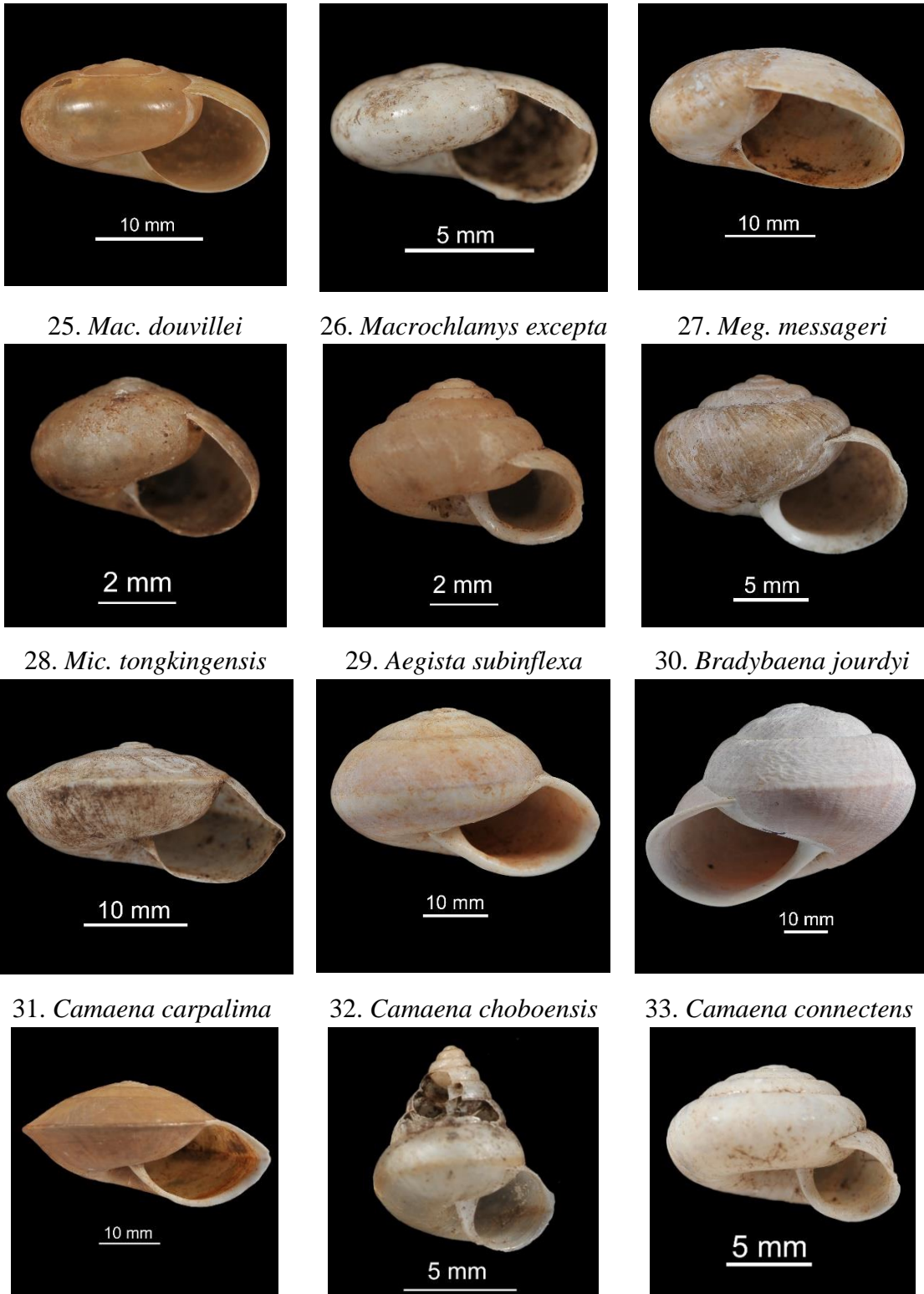
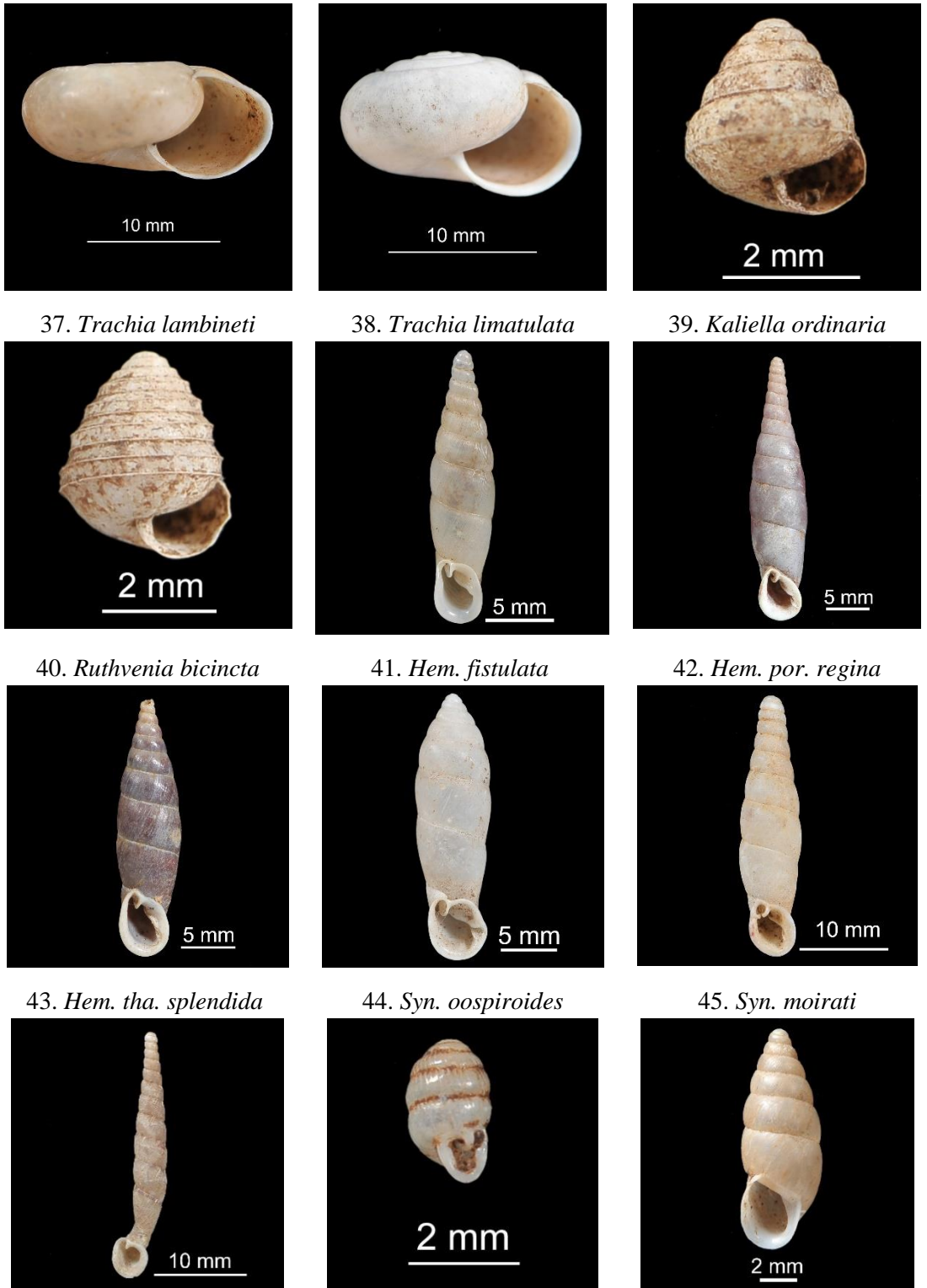


Figure 3. Photos of terrestrial molluscs collected from Dong Van District (25-36)



37. *Trachia lambineti*

38. *Trachia limatulata*

39. *Kaliella ordinaria*

40. *Ruthvenia bicincta*

41. *Hem. fistulata*

42. *Hem. por. regina*

43. *Hem. tha. splendida*

44. *Syn. oospiroides*

45. *Syn. moirati*

46. *Tra. ootanii longicollis*

47. *Parasinoennea ovulum*

48. *Apo. clausiliaeformis*

Figure 4. Photos of terrestrial molluscs collected from Dong Van District (37-48)

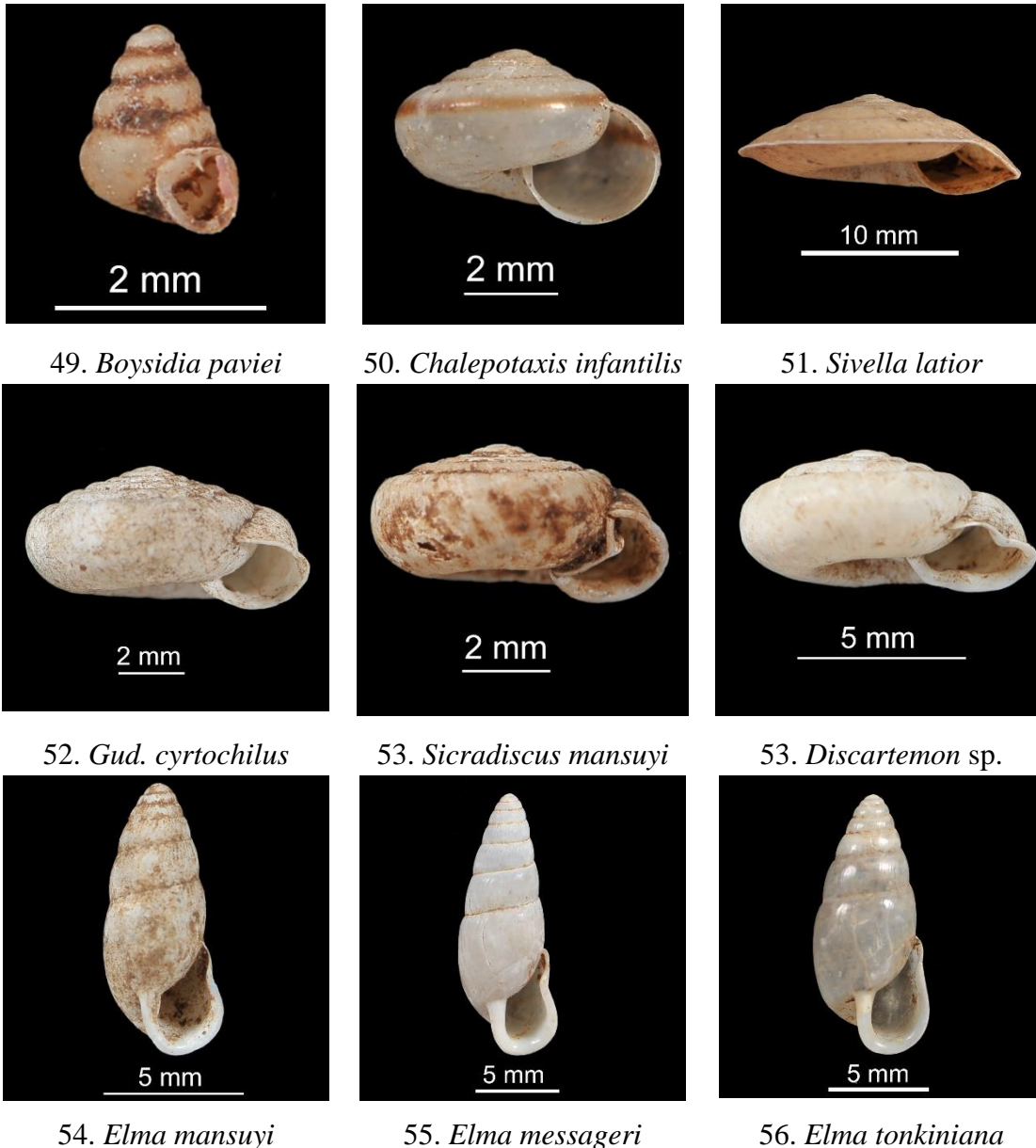


Figure 5. Photos of terrestrial molluscs collected from Dong Van District (49-56)

*** Discussion**

The present study aims at the establishment of an up-to-date list for the terrestrial molluscs of Dong Van. Future research should focus on several points. On the one hand, the distribution patterns of most species are far from being understood, so more fieldwork is needed to finally receive distribution data for all species. Further, more emphasis should be placed on taxonomical research in all groups, which are well represented in the regions, such as Ariophantidae, Camaenidae, Cyclophoridae, Pupinidae, Plectopylidae, and Streptaxidae.

Limestone karst was formed millions of years ago by calcium-secreting marine organisms before tectonic movements lifted them above sea level. Over the years, the

softer sediments covering these limestone karsts were removed by mechanical and chemical weathering. Further, the high species diversity on limestone karsts arises from a multitude of ecological niches afforded by complex terrains and variable climatic conditions. Limestone karst areas are also known to support high species densities of molluscs due to the availability of copious quantities of calcium, a mineral essential for their growth and reproduction [1].

The study area belongs to Dong Van Karst Plateau Geopark, where complex geographical areas associated with different climatic and vegetation conditions provide highly diverse habitats, allowing the notion that Dong Van likely has numerous terrestrial molluscs. Karst areas usually contain high numbers of endemic terrestrial molluscs species, many of which are restricted to limestone habitats because of their high calcium requirements and low dispersal capability [2, 3, 12].

As far as endemic species are concerned there are two strictly endemic species of Ha Giang Province (*Synprophyma oospiroides*, *Traupidauchenia ootanii longicollis*), with the majority of northern Vietnam endemic species. Three species are endemic for Ha Giang Province as follows: *Hemiphaedusa porphyrostoma regina*, *Hemiphaedusa porphyrostoma regina*, and *Ruthvenia bicincta*.

Limestone karst areas have been recently highlighted as one of Vietnam's vulnerable ecosystems due to surrounding forest degradation and quarrying activities [2, 18]. Many terrestrial molluscs species that are endemic to limestone areas in Vietnam are already extinct or on the brink of extinction. In order to prevent further species extinctions, limestone areas that are currently being quarried or intact must be urgently assessed for land snail diversity.

These results may later serve nature conservation politics as well as refined land management strategies.

3. Conclusions

The present paper revealed that from three surveys from March 2018 to December 2020, a total of 59 species of 38 genera in 16 families of terrestrial molluscs were recorded in Dong Van District, Ha Giang Province. Dominant families in the research area are Camaenidae, Pupinidae, Cyclophoridae, Ariophantidae, Clausiliidae, Streptaxidae. It is important to note that *Discartemon* sp. is a new record for the Northern Vietnam, and 28 species are new records for Ha Giang Province. The terrestrial molluscs in habitats of the Dong Van area are diverse and unique due to the possession of many endemic species.

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