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RESEARCH ARTICLE

Terrestrial snails diversity of Lower Dibang Valley, Arunachal Pradesh

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Abstract

A total of 75 species belonging to 36 genera, 14 families under 3 orders from 256 specimens were reported during the study from the Lower Dibang Valley district of Arunachal Pradesh. Surveys were conducted in various parts of the district under different institutional projects conducted during 2015 and 2016. Snails were hand-picked and randomly preserved in 70% Ethanol. Order Stylommatophora with 49 species under 10 families and 25 genera was the most common group, followed by Architaenioglossa with 26 species under 3families and 10 genera. The present study is the first of its kind under this group of animals since no work has been done on the comprehensive taxonomy of terrestrial mollusca of the district.

Keywords: Mollusca, terrestrial, biodiversity hot spot, Endemic, Arunachal Pradesh

Introduction

Lower Dibang Valley is a district located on the eastern side of Arunachal Pradesh, India, between 27^{0}30′ N to 28^{0}33′ N and 95^{0}15′ E to 96^{0}30′ E with a total geographical area of 3900 sq km. The district with about 80% of the area being notified as reserved forest, wildlife sanctuaries, or unclassified state forests, is known for its largest cover of thick forest. The district has a sub-tropical climate and the topography of the district is mountainous with rugged and steep slopes and snow-capped peaks, turbulent rivers and lush green valleys. The district rises from the foothills near the Assam boundary on the southern part to the middle ranges of the Himalaya with the highest point of Mayudia at a height of 8629 feet above mean sea level. With a maximum record of rainfall at 5794.10 mm, the district experiences very heavy rainfall from March to September. The district is a part of the Himalayan Biodiversity hotspots, which are included among the 36 Biodiversity Hotspots of the world (*Myers et al., 2000).* The name of the district was derived from the mighty river Dibang that flows through the heart of the district, and is one of the tributaries of the Brahmaputra River. The district with its headquarters at Roing is bordered by Dibang Valley District and China on the North, Lohit District on the East, East Siang & Upper Siang on the West and Assam on the South. Important water bodies of the district include Dibang, Eze, Sisiri, Ephi, Chipu, Abha-Johro, Dotung, Kundil rivers and Mehao and Sally lakes and housed the Mehao Wild Life Sanctaury which is famous for Mishmi Takin (*Budorcas taxicolor*) and Eastern Hoolock gibbon (*Hoolock leuconedys*). Though the district is home to many endemic plants and animals, no studies have been made on the terrestrial snail of the district except the fragmentary works seen during the British period (Benson,1851; Blanford, *et al.,* 1908; Ghosh, 1813; Godwin-Austen, 1882, 1888,1920; Gude, 1914, 1921; Preston, 1915. Therefore, the present study was taken up to document the terrestrial snail fauna of the district.

Mollusca is the second largest phylum, next to Arthropoda. Under the phylum, the class Gastropoda accounts for 80% of the total. Land snails are the terrestrial Gastropoda characterized by a head, fleshy foot, and paired tentacles and form an important component in the forest ecosystem. It provides unique ecosystem services, including recycling of nutrients, and it provides a prey base for small mammals, birds, snakes and other reptiles. North-Eastern India, with many hill-streams, ample rainfall and rich wet evergreen forests, accounts for over one third of the total number of species of land and freshwater molluscs, known from India (Dey *et al.,* 1985). To date, 1,138 species of land snails are recorded from Indian territory (https://zsi.gov.in/

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Table 1 : List of Terrestrial mollusca species of Lower Dibang valley, Arunachal Pradesh

Systematic position	*Reference*	*Distribution/Endemicity*
Phyllum Molusca Class Gastropoda Order Architaenioglossa Family Alycaeidae *Chamalycaeus oglei* (Godwin-Austen, 1914)	ZSI/M-25089/5, MWLS, 21/10/2015 (1ex)	Type locality : Arunachal Pradesh and endemic to the state.
Dicharax crenatus (Godwin-Austen, 1871)	ZSI/IV/APRC/M-257, Theta river bank near Roing, 13/1/2017 (1 ex.)	Endemic to North east India and Bhutan : Arunachal Pradesh, Assam, Meghalaya, Nagaland and Bhutan.First time reported from the state.
Dicharax pachitaensis (Godwin-Austen, 1886)	ZSI/M-30226/8, Abango, 20/10/2015 (2 exs)	Type locality : Arunachal Pradesh and endemic to the state.
Metalycaeus brahma (Godwin-Austen, 1886)	ZSI/M-25200/5, MWLS, 20/10/2015 (3 exs),	*Alycaeus chanjukensis* Godwin-Austen, 1914 has been synonymised with *Alycyaeus brahma* Godwin-Austen, 1886 (Páll-Gergely, *et al.,* 2020). Endemic to Northeast India : Reported from Arunachal Pradesh and Assam
Metalycaeus burtii (Godwin-Austen, 1874)	ZSI/APRC/M-247, Abango forest, 2/5/2015 (1ex)	Godwin-Austen (1914) described a variety of the species, *Metalycaeus burtii yetayensis* from Arunachal Pradesh. Endemic to North east india and Bhutan : Reported from Arunachal Pradesh, Assam, Mizoram and Bhutan.
Metalycaeus dikrangensis (Godwin-Austen, 1914)	ZSI/M-2500, MWLS, 17/5 (4 exs).	Type locality : Arunachal Pradesh and endemic to the state.
Metalycaeus rotundatus (Godwin-Austen, 1914)	ZSI/M-25090/5, MWLS, 21/10/2015 (2 exs)	Type locality : Arunachal Pradesh and endemic to the state.
Metalycaeus sibbumensis (Godwin-Austen, 1914)	ZSI/M-25087/5, MWLS, 21/10/2015 (1 ex),	Type locality : Arunachal Pradesh and endemic to the state.
Metalycaeus toruputuensis (Godwin-Austen, 1914)	ZSI/M- 30229/8, MWLS, 18/10/2015 (3 exs),	Type locality : Arunachal Pradesh and endemic to the state.
Family CYCLOPHORIDAE *Cyclophorus aborensis* Godwin-Austen, 1915	ZSI/APRC/M-185, Mehao Lake, 23/10.2015 (2exs);	Type locality : Arunachal Pradesh and endemic to the state.
Cyclophorus aurantiacus (Schumachar, 1817)	ZSI/APRC/M-249, Mayodia Forest, 8/4/2016 (1 ex)	Widely distributed species. First report from the state.
Cyclophorus koboensis Godwin-Austen, 1915	ZSI/M-32911/9, Anini road, 5/05/2015 (1 ex),	Type locality : Arunachal Pradesh and endemic to the state.
Cyclophorus muspratti Godwin-Austen and Beddome, 1894	ZSI/M-25147/5, MWLS, 20/10/2015 (1 ex),	Endemic to North east India: Arunachal Pradesh, Nagaland. First report from the state.
Cyclophorus pearsoni (Benson, 1851)	ZSI/M-32912/9, Anini road, 5/05/2015 (3 exs),	Nevill (1878) recorded a variety, *fuscicolor* from Arunachal Pradesh. Reported from Arunachal Pradesh, Assam, Meghalaya alonf with Bangladesh and Myanmar
Cyclophorus sidiensis Godwin-Austen, 1915	ZSI/APRC/M-117, Abango forest, 23/10/2015 (6 exs);	Type locality : Arunachal Pradesh and endemic to the state. The species is one of the most commonly encountered mollusca.

Lagocheilus shiplayi (L. Pfeiffer, 1857)	ZSI/APRC/M-128, KVK forest, 2/9/2016 (2 exs),	Arunachal Pradesh, Tamil Nadu. First report from the state.
Lagocheilus tomotremus (Benson, 1857)	ZSI/M-32913/9, MWLS, 21/10/2015 (2 exs),	Endemic to Eastern himala : Reported from Arunachal Pradesh, Meghalaya, Nagaland, West Bengal (Darjeeling).
Pterocyclos brahmakundensis Godwin-Austen, 1915	ZSI/ APRC/M-190, Koronu Forest, 5/4/2016 (16 exs),	Type locality : Arunachal Pradesh and endemic to the state.
Pterocyclos magnus Godwin-Austen, 1876	ZSI/IV/APRC/M-179, Ethun river, Hunli, 7/5/2015 (1 ex).	Endemic to North east India : Reported from Arunachal Pradesh and Nagaland only.
Spiraculum hispidum Pearson, 1833	ZSI/APRC/M-180, Abango Forest 3/9/2016 (7 exs),	Benson's locality (Bihar), quoted by Gude (1921) is rather intriguing. Reported from Arunachal Pradesh and Assam.
Spiraculum oakesi Godwin-Austen, 1915	ZSI/APRC/M-186, Simari river forest, 24/1/2017 (17 exs),	Type locality : Arunachal Pradesh and endemic to the state.
Theobaldius nivicola (Godwin-Austen, 1876)	ZSI/ APRC/M-226, KVK Roing, 1/4/2016 (2 exs).	Type locality : Arunachal Pradesh and endemic to the state.
Family PUPINIDAE *Rhaphaulus oakesi* Godwin-Austen, 1917	ZSI/M- 30262/8, Anini, 5/5/2015 (3 exs),	Type locality : Barhmakhund, Arunachal Pradesh and endemic to the state.
Rhaphaulus shimangensis Godwin-Austen, 1917	ZSI/M- 30263/8, MWLS, 21/10/2015 (1exs),	Type locality: Shimang valley in Arunachal Pradesh and endemic to the state.
Rhaphaulus yamneyensis Godwin-Austen, 1917	ZSI/M-30278/8, MWLS, 21/10/2015 (2 exs),	Type locality : Arunachal Pradesh and endemic to the state.
Streptaulus miriensis Godwin-Austen, 1917	ZSI/M- 30261/8, Anini, 5/5/2015 (2 exs),	Type locality : Arunachal Pradesh and endemic to the state.
Order Stylommatophora Family Achatinidae *Allopeas gracile* (Hutton, 1834)	ZSI/ APRC/M-157, Koronu forest, 04.05.2015 (5exs).	A widely distributed species in the whole of South-east Asia. Causes considerable damage to various vegetable plants
Bacillus daflaensis (Godwin-Austen, 1876)	ZSI/APRC/M-219, Myodia, 5/9/2016 (4 exs),	Type locality : Arunachal Pradesh and endemic to the state.
Bacillus cassicus (Reeve, 1849)	ZSI/IV/APRC/M-251, Abango forest, 3/9/2016 (1 ex),	Endemic to North east India : Reported from Assam, Arunachal Pradesh and Nagaland
Bacillus orthoceras (Godwin-Austen, 1875)	ZSI/APRC/M-222, Abango forest, 25/01/2017 (3 exs).	Type locality of the species is contained in Meghalaya. Endemic to North east India: Arunachal Pradesh, Meghalaya, Nagaland
Glessula aborensis Godwin-Austen, 1918	ZSI/ APRC/M-198, Simari forest area Roing, 31/8/2016 (9 exs);	Type locality: Arunachal Pradesh and endemic to the state.
Glessula crassula (Reeve, 1850)	ZSI/ APRC/M-210, Theta river bank, 13/1/2017 (2 exs).	Endemic to Eastern Himalaya: Arunachal Pradesh, Meghalaya, Mizoram, Nagaland, West Bengal (Darjeeling).
Glessula gemma Reeve,1850	ZSI/ APRC/M-245, Abango forest, 1/4/2016 (1 ex);	This species has an enormous range of distribution but first time reported from the state.
Glessula sarissa (Benson,1860)	ZSI/APRC/M-155, Chedapani forest area, 2/9/2016 (10exs.),	Type locality of the species is Bangladesh and reported for the first time from the state. Reported from Maharashtra, West Bengal
Lissachatina fulica (Bowdich, 1822)	ZSI/M-32916/9, Roing, 30/08/2016 (3 exs),	Commonly known as Giant African snail and an alien invasive species.

Rishetia nevilli (Godwin-Austen, 1876)	ZSI/M-32915/9, Mayodia Pass, 17/10/2015 (6 exs),	Type locality : Arunachal Pradesh and endemic to the state.
Family Agriolimacidae *Deroceras laeve* (O. F. Müller, 1774)	ZSI/APRC/M-262, Mayodhya Army Check post, 20.01.2017,	Natural range covers whole of Holarctic (Wiktor, 1983), subsequently introduced to other areas.This species and also the family was recorded for the first time from the state.
Family Ariophantidae *Bapuia rengingensis* Godwin-Austen, 1918	ZSI/M-33000/9, Koronu, 4/5/2015 (1ex),	Type locality : Arunachal Pradesh and endemic to the state.
Dihangia koboensis Godwin-Austen, 1916	ZSI/M-30250/8, MWLS, 20/10/2015 (1ex),	Type locality : Arunachal Pradesh and endemic to the state.
Khasiella austeni (W. T. Blanford, 1870)	ZSI/APRC/M-223, Theta river bank near Roing, 13/1/2017 (1 ex),	Endemic to North east India : Arunachal Pradesh, Meghalaya (Garo Hills). This is the new record from the state.
Khasiella climacterica (Benson, 1836)	ZSI/ APRC/M-165, Koronu forest, 05.04.2016 (5exs);	Widely distributed and abundantly occurring species commonlu encountered during the surveys. Reported from Assam, Meghalaya, Mizoram, Nagaland and Myanmar
Khasiella falcata (W. T. Blanford, 1870)	ZSI/APRC/M-242, Abango forest, Roing 1/4/2016 (1 ex.),	Endemic to North east India and Myanmar : It is a new record from the state. Meghalaya (Garo Hills) and Myanmar.
Khasiella serrula (Benson, 1836)	ZSI/APRC/M-206, Theta river bank near Roing, 18/1/2017 (1 ex),	Endemic to North east India : Arunachal Pradesh, Meghalaya. It is a new record from the state.
Khasiella vidua (Hanley & Theobald, 1876)	ZSI/ APRC/M-229, Theta river bank,Roing, 13/1/2017 (1 ex),	Manipur, Meghalaya, Nagaland and Bangladesh It is a new record from the state.
Macrochlamys aborensis (Godwin-Austen, 1918)	ZSI/M-33001/9, Mayoida , 17/10/2015 (2 exs),	Type locality : Arunachal Pradesh and endemic to the state.
Macrochlamys atricolor (Godwin-Austen, 1875)	ZSI/ APRC/M-92, Chedapani, upstream area, 18.01.2017 (1 ex);	Endemic to North east India and Myanmar Arunachal Pradesh, Assam, Manipur, Meghalaya, Nagaland and Myanmar. The species is one of the abundantly occurring species.
Macrochlamys glauca (L. Pfeiffer, 1846)	ZSI/APRC/M-205, Theta river bank near Roing, 18/1/2017 (2 exs).	Arunachal Pradesh, Himachal Pradesh, Kashmir, Uttaranchal
Macrochlamys hippocastaneum Godwin-Austen, 1918	ZSI/M-4073/1, Roing, 20/4/1991 (3 exs),	Type locality : Arunachal Pradesh and endemic to the state.
Macrochlamys indica Godwin-Austen, 1833	ZSI/ APRC/M-215, Forest inside KVKK Roing, 2/9/2016 (5 exs);	The most common species abundantly occurring throughout the country. It is commonly known as garden snails of India.
Macrochlamys petasus (Benson, 1859)	ZSI/M-32918/9, 5 km away from Korunu basti, 04/05/2015(7 exs),	Distributed in Eastern Himalaya and Maharastra, Blanford and Godwin-Austen (1908) expressed doubt about some of the recorded localities.
Macrochlamys vesica Godwin-Austen, 1910	ZSI/M-32919/9, 2 km away from koronu basti,04/05/2015(2 exs	Reported from Arunachal Pradesh, Assam, Meghalaya, Mizoram and Bangladesh.

Oxytesta oxytes (Benson, 1836)	ZSI/APRC/M-199, Chedapani forest area Roing, 2/9/2016 (4 exs);	The speciest is one of the most commonly encountered species during the surveys. Endemic to Eastern himala : Arunachal Pradesh, Assam, Meghalaya, Sikkim.
Oxytesta pollux (Theobald,1858)	ZSI/ APRC/M-184, KVK forest, 2/9/2016 (5 exs.)	Type locality contained in Meghalaya and Endemic to Arunachal Pradesh and Meghalaya
Oxytesta sylvicola (Blanford, 1880)	ZSI/APRC/M-253, Forest inside KVK Roing, 2/9/2016 (1 ex)	Endemic to North east India : Earlier it was only recorded from Assam, Arunachal Pradesh, Assam. It is the new record from the state.
Family Camaenidae *Bradybaena cestus* (Benson, 1836)	ZSI/APRC/M-182, Near Forest IB, Roing, 30/8/2016 (42 exs	There is huge population inside the inspection bunglows of every districts.
Bradybaena similaris (Ferussac, 1822)	ZSI/M-32920/9, Near Forest IB, Roing, 30/8/2016 (2 exs),	It is an invasive species commonly available through out Asia.
Bouchetcamaena delibrata (Benson, 1836)	ZSI/APRC/M-231, Simari forest area, Roing, 31/8/2016 (1 ex),	Arunachal Pradesh, Assam, Meghalaya, Mizoram, Nagaland, West Bengal and also Bangladesh and Myanmar.
Burmochloritis fasciata (Godwin-Austen, 1875)	ZSI/M-25204/5, Koronu, 4/5/2015 (1ex),	Reported from Arunachal Pradesh, Assam, Meghalaya, Mizoram, Nagaland and Bangladesh, Myanmar.
Ganesella acris (Benson, 1859)	ZSI/APRC/M-172, Koronu forest, 05.04.2016 (1 ex),	Endemic to Eastern himalaya, Arunachal Pradesh, Meghalaya, Nagaland, West Bengal (Jalpaiguri).
Family CHRONIDAE *Kaliella barrakporensis* (L. Pfeiffer, 1853)	ZSI/ APRC/M-258, Abago forest, 20/10/2015 (2 exs);	One of the most widely occurring land snails in Asia and South Africa.
Family Clausiliidae *Cylindrophaedusa annandalei* (Preston, 1915)	ZSI/M- 30303/8, Mayodia, 17/10/2015 (1 ex),	Type locality: Arunachal Pradesh. *Clausilia aborensis* Godwin-Austen, 1918 has been designated as sub species of this species as *Cylindrophaedusa annandalei aborensis* (Godwin-Austen, 1918) (ZSI/M- 30299/8, Mayodia, 17/10/2015 (3 exs), Coll: SD Gurumayum and party). *Euphaedusa shimangensis* (Godwin- Austen,1916) has been synonymised to the above taxon.
Cylindrophaedusa ios (Benson, 1852)	ZSI/M- 30311/8, Mayodia, 17/10/2015 (2 exs),	Endemic to eastern Himalaya, Arunachal Pradesh, Sikkim, West Bengal (Darjeeling) Bhutan, Nepal.
Oospira loosjesiana (Ray & Roychoudhuri, 1968)	ZSI/M- 30291/8 MWLS, 21/10/2015 (4 exs),	Type locality: Arunachal Pradesh and endemic to state.
Oospira loxostoma (Benson, 1836)	ZSI/M- 30290/8 MWLS, 21/10/2015 (3 exs),	Assam, Meghalaya, Nagaland, West Bengal (Darjeeling, 4000-5000 ft.) and also reported from Bangladesh
Family Helicarionidae *Austenia annandalei* Godwin-Austen, 1910	ZSI/M-33701/9, Korunu , 21/10/2015 (1ex),,	Endemic to eastern Himalaya and new record from the state. Arunachal Pradesh, West Bengal (Darjeeling)
Austenia rotungensis Godwin-Austen, 1914	ZSI/APRC/M-167, Myodiya forest, 17/10/2015 (2 exs.);	Type locality : Arunachal Pradesh and endemic.
Sivella castra (Benson, 1852)	ZSI/ APRC/M-225, Forest inside KVK Roing, 2/9/2016 (2 exs),	Widely distributed: Arunachal Pradesh, Assam, Meghalaya, Maharashtra, West Bengal and also Malaysia, Myanmar and Thailand.
Tadunia oakesi Godwin-Austen, 1918	ZSI/M-33700/9, Koronu, 21/10/2015 (2 exs),	Type locality : Arunachal Pradesh and endemic.

Family PLECTOPYLIDAE *Chersaecia austeni* (Gude, 1899)	ZSI/M-30301/8, Roing (3 exs),	Endemic to North east India : Arunachal Pradesh and Assam.
Endothyrella affinis (Gude, 1897)	ZSI/APRC/M-233, Simari forest area, Roing, 31/8/2016 (1 ex),	Endemic to North east India:Arunachal Pradesh, Meghalaya, Mizoram. New record from the state.
Endothyrella blanda (Gude, 1898)	ZSI/M, Roing, MWLS, 31/8/2016 (1 ex),	Endemic to Eastern himala: Arunachal Pradesh, Nagaland, Sikkim, West -Bengal (Darjeeling)
Endothyrella macromphalus (W.T. Blanford, 1870)	ZSI/APRC/M-158, Koronu forest, 05.04.2016 (6 exs);	Endemic to North east India: Arunachal Pradesh, Meghalaya, Nagaland
Family Staffordiidae *Staffordia daflaensis* (Godwin-Austen, 1883)	ZSI/APRC/M-254, Abango forest, 20/10/2015 (1 ex),	Type locality : Arunachal Prades and endemic
Family Diapheridae *Sinoennea stenopylis* (Benson, 1860)	ZSI/APRC/M-252, Tiwarigaon, 19/1/2017 (1ex.),	Endemic to Eastern himalaya: Arunachal Pradesh, Manipur, Meghalaya, Nagaland, Sikkim.
Order Cycloneritida Family HELICINIDAE *Pleuropoma arakanensis* (W.T. Blanford, 1865)	ZSI/M, Abango forest, MWLS, 20/10/2015 (1 ex),	Type locality contained in Myanmar. Endemic to Eastern Himalaya and Myanmar: Arunachal Pradesh, Meghalaya and West Bengal (Darjeeling).

uploads/documents/checklist/english/044_Mollusca.pdf). Though the state of Arunachal Pradesh is included in Eastern Himalaya biodiversity hotspots and even after the presence of numerous species of land snail abundantly throughout the state and type locality of many species, negligible information on species diversity, endemism and distribution of land snails of the state is available. Information on the divergent mollusca fauna of the state has never been documented so far, except for the reports available during the British era. In the Fauna series of the Zoological Survey of India, published in 2006, the Mollusca part is missing. A perusal of Indian molluscan literature has confirmed that, as of now, research on the systematic account of land snails of northeast India is fragmentary and with a few available scattered historical publications. Very few researchers are working in this group in India, particularly in this region, despite being included in one of the biodiversity hotspots of the world.

Materials and methods

To investigate the terrestrial snail diversity of the lower Dibang valley district, Arunachal Pradesh, surveys were conducted in various parts of the district under the different institutional projects conducted during 2015 and 2016. Snails were hand-picked randomly and after cleaning, it put in the preservative (70% Ethanol). Dried and empty shells, which are bigger in size, were just kept without adding any preservatives. Some of the live specimens were put overnight in a container full of water to kill and to let the internal organs of the animal come out. Then the specimens were transferred to 70% ethanol for further studies. Species deposited in the ZSI Headquarters were also studied and incorporated under this report (Reference column of the Table 1 for each species (ZSI/APRC/M-: Zoological Survey of India/ Arunachal Pradesh Regional Centre/Mollusca and ZSI/M- : Zoological Survey of India/Mollusca HQ.-)

In the laboratory, the specimens were examined and identified up to species level based on the morphological shell characters and standard keys as provided by Blanford & Godwin-Austen (1908); Gude (1914, 1921); Preston (1915), and Mitra *et al*. (2004). Classification of molluscs underwent several changes in its hierarchical categories down the years - In 1758 with Linnaeus, in 1795 with Cuvier, in 1806 by Dumeril and from 1801-1819 through Jean Lamarck. Here, the classification follows as suggested by Bouchet *et al*. (2017) for subfamily, family, and higher-level systematic. The latest nomenclature for the land snails follows that of https://www.molluscabase.org.

Result and Discussion

A total of 75 species belonging to 36 genera, 14 families under three orders from 256 specimens were reported during the study (Table 1 and Fig. 1). Order Stylommatophora with 49 species under 10 families and 25 genera was the most

Table 2 : Taxonomic details of Terrestrials mollusca of Lower dibang valley

S.	*Order*	*Family*	*Genus*	*Species*
1	Architaenioglossa	Alycaeidae	3	9
2		Cyclophoridae	5	13
3		Pupinidae	2	4
4	Stylommatophora	Achatinidae	5	10
5		Griolimacidae	1	1
6		Ariophantidae	5	17
7		Camaenidae	4	5
8		Chronidae	1	1
9		Clausiliidae	2	4
10		Helicarionidae	3	4
11		Plectopylidae	2	4
12		Staffordiidae	1	1
13		Diapheridae	1	1
14	Cycloneritida	Helicinidae	1	1
			36	75

common group, followed by Architaenioglossa with 26 species under 3families and 10 genera. Cycloneritida was the monotypic group represented by a single family, genus and species. Among the families, Ariophantidae with 17 species, Cyclophoridae with 13 species, and Achatinidae with 10 species were the dominant groups in order of species richness. Alycaeidae (9 species), Camaenidae (5 species), Pupinidae, Clausiliidae, Helicarionidae, and Plectopylidae, represented by 4 species each, were the families represented moderately during the study. The remaining 4 families, viz., Chronidae, Staffordiidae, Diapheridae, and Helicinidae, were the monotypic families represented by a single species each (Table 2).

As many as 28 species out of the total report of 75 from the entire district have the type locality as Arunachal Pradesh and are endemic to the state only. Some of them were never recorded after its first discovery from the state. Nine (9) of the species were endemic to eastern Himalaya (*Pleuropoma arakanensis, Sinoennea stenopylis, Endothyrella blanda, Austenia annandalei, Cylindrophaedusa ios*, *Ganesella acris*, *Oxytesta oxytes, Lagocheilus tomotremus*, *Dicharax crenatus*) where as 12 of them are endemic to North eastern India (*Endothyrella macromphalus*, *Endothyrella affinis, Chersaecia austeni*, *Oxytesta sylvicola, Oxytesta pollux, Khasiella serrula, Khasiella austeni, Bacillum orthoceras, Bacillum cassiacum, Pterocyclos magnus, Cyclophorus muspratti, Metalycaeus brahma*)

Eleven (11) terrestrial snail species were recorded for the first time from the state, viz., *Dicharax crenatus, Glessula gemma, Glessula sarissa, Deroceras leave, Khasiella austeni*, *Khasiella falcate, Khasiella serrula, Khasiella vidua, Oxytesta sylvicola, Austenia annandalei* and *Endothyrella affinis*. Species like *Oxytesta oxytes* (Benson, 1836), *Macrochlamys atricolor* (Godwin-Austen, 1875), *Khasiella climacterica* (Benson, 1836) and *Cyclophorus sidiensis* Godwin-Austen, 1915 were found abundantly inside the study area. Widely distributed species like *Sivella castra* (Benson, 1852), *Kaliella barrakporensis* (L. Pfeiffer, 1853), *Macrochlamys indica* Godwin-Austen, 1833, *Glessula gemma* Reeve, 1850 and *Cyclophorus aurantiacus* (Schumachar, 1817) were also reported from the district. During the survey, three exotic species, viz., *Allopeas gracile* (Hutton, 1834), *Lissachatina fulica* (Bowdich, 1822), *Bradybaena similaris* (Ferussac, 1822) and *Deroceras laeve* (O. F. Müller, 1774) were also recorded. *Lissachatina fulica,* which is commonly known as the *Giant African Snail,* is a highly invasive alien species that is included in 100 of the World's Worst Invasive Alien Species of Global Invasive Species Database (http://www.iucngisd.org/gisd/100_worst.php) is a cause for concern for ecologists as the animal may pose a threat to local flora.

Most of the Mollusca recorded during British India are not observed in the subsequent works taken up by researchers and for many of the new species described during that time, no further reports of the collection are available. Consequently, most of the endemic species with a small geographic range will end up as rare species and subsequently threatened. Subba Rao *et al*. (1995) opined that land molluscs are represented by small populations and are quite sensitive to habitat changes, and a few of the species might have become extinct. The present list of land Mollusca of Northeast India contains a large number of such species known by their types and have no subsequent reports after they were first described. Nevertheless, all such species are included in the endemic species list of the region, even though they are subjected to further verification of their validity. A total of 402 terrestrial mollusca species (4 orders, 22 families and 70 genera) with an endemicity level of 65% were reported by Gurumayum and Ramakrishnanan, 2020, from the Northeast Biogeographic zone and Tripathy et.al., 2018, reported 197 species of land snails (53 genera, 15 families, 3 orders) from the eastern Himalayas. So far exclusive mollusca fauna of the state is not available; however, 18 species under 16 genera and 12 families were recorded from Itanagar Wildlife Sanctuary by Ramakrishna *et al*. (2005) and Dey *et al*. (1985) reported 18 species of mollusca from Namdapha National Park, which are fewer in number in comparison to the present finding. Being a soft-bodied animal and with a slightest touch, visceral mass coils inside the shells and there is no definite shape after preservation, in comparison to other major groups of animals, the Mollusca got very little attention from researchers in India and the northeast region in particular. Above this, shells of land Mollusca are very fragile and delicate, besides being highly decomposable. A thorough research is needed through an integrative taxonomy, combining morphological, molecular

Figure 1 : Land snails of Lower Dibang Valley, Arunachal Pradesh

Allopeas gracile (T. Hutton, 1834)

Austenia rotungensis Godwin-Austen, 1914

Bacillum cassiacum (Reeve, 1849)

Bacillum daflaensis (Godwin-Austen, 1876)

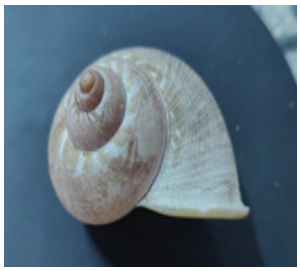
Bradybaena cestus (W. H. Benson, 1836)

Curvella khasiana (Godwin-Austen,

Bacillum orthoceras (Godwin-Austen, 1875)

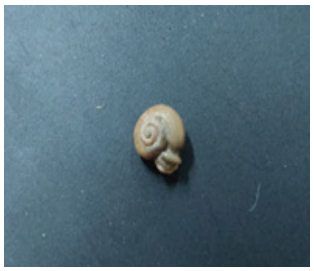
Bouchetcamaena delibrata (W. H. Benson,1836)

Cyclophorus aborensis Godwin-Austen, 1915



Cyclophorus aborensis Godwin-Austen, 1915

Cyclophorus sidiensis Godwin-Austen, 1915



Dicharax crenatus (Godwin-Austen, 1871)

Endothyrella affinis (Gude, 1897)

Endothyrella macromphalus (W. T. Blanford, 1870)

Ganesella acris (W. H. Benson, 1859)

*Glessula aborensis Godwin-*Austen, 1918

Glessula crassula (Reeve, 1850)

Glessula gemma (Reeve, 1850)

G lessula sarissa (W. H. Benson, 1860)

Kaliella barrakporensis (Reeve, 1852

Khasiella austeni (W. T. Blanford, 1870

Khasiella climactерica (W. H. Benson, 1836)

Khasiella falcata (W. T. Blanford, 1870)

Khasiella serrula (W. H. Benson, 1836

*Khasiella vidua (*Hanley & Theobald, 1876)

Lagocheilus shiplayi (L. Pfeiffer, 1857)

*Metalycaeus burtii (*Godwin-Austen, 1874)

*Oospira loxostoma (*W. H. Benson, 1836)

Khasiella austeni (W. T. Blanford, 1870

Oxytesta oxytes (W. H. Benson, 1836)

Pterocyclos brahmakundensis Godwin-Austen, 1915

Pterocyclus magnus Godwin-Austen, 1876

*Scabrina pinnulifer (*W. H. Benson, 1857)

Sinoennea stenopylis (W. H. Benson, 1860)

Sivella castra (W. H. Benson, 1852)

Spiraculum hispidum Pearson, 1833

Spiraculum oakesi Godwin-Austen, 1915

Spiraculum oakesi Godwin-Austen, 1915

Staffordia daflaensis (Godwin-Austen, 1883)

*Tanychlamys atricolor (*Godwin-Austen, 1875)

Khasiella austeni (*W. T. Blanford, 1870*

*Tanychlamys indica (*Godwin-Austen, 1883)

Tanychlamys glauca (L. Pfeiffer, 1846)

and biochemical data of the species to delimit and describe a taxon, along with living photographs of the animal, is needed in this region.

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