



# A STUDY ON MOLLUSCAN DIVERSITY OF GOMTI RIVER LUCKNOW, UTTAR PRADESH, INDIA

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**Abstract** -The survey aimed to evaluate the diversity of freshwater molluscs within the Gomti River. Near Saidpur, a village situated in the Jaunpur district of Uttar Pradesh, the Gomti River converges with the Ganga River, with approximate coordinates of around 25.7355° N latitude and 82.6853° E longitude. Despite its ecological significance, this riverine system remains largely understudied, particularly regarding information on its molluscan fauna. Throughout the present investigation, a total of 9 molluscan species were documented within the Gomti River. Among the collected specimens, these 9 species were identified across seven families, namely *Viviparidae*, *Ampullariidae*, *Assimineidae*, *Pachychilidae*, *Lymnaeidae*, *Planorbidae*, and *Unionidae*, encompassing both the Gastropoda and Bivalve classes. The molluscan community observed in this habitat holds promise as effective bio-indicators for assessing the ecological diversity of freshwater environments.

**Keywords**- Molluscs, Bivalve, Gastropods, Gomti River.

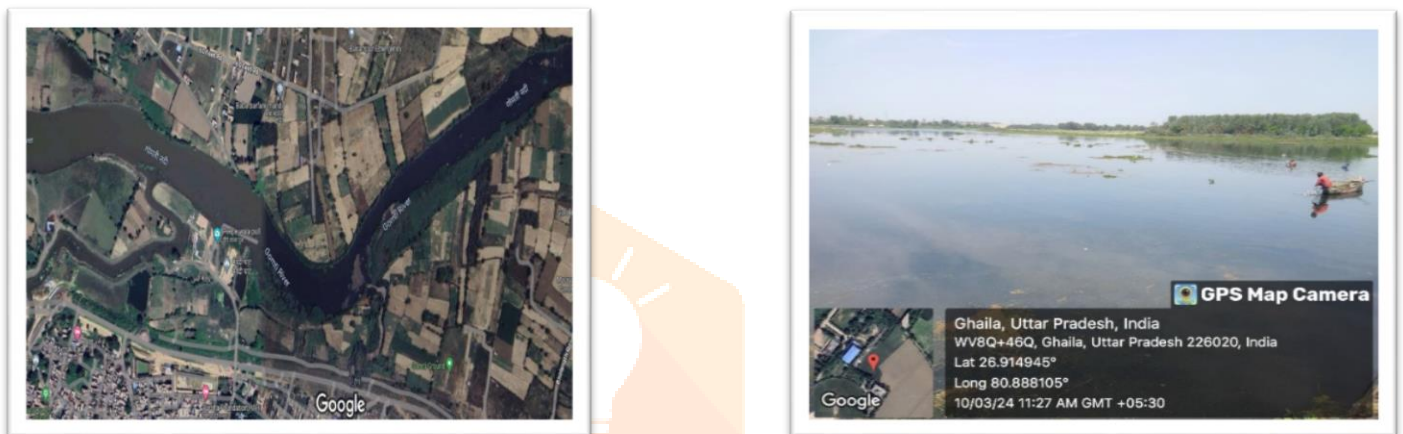
**Introduction**- Mollusca, the second-largest phylum, thrives in diverse habitats and is categorized into marine, terrestrial, and freshwater forms. Literature credits Preston as the pioneering scientist who first documented Indian freshwater mollusks. In his seminal work "Fauna of British India," Preston meticulously described approximately 370 species of freshwater Gastropods and Pelecypods from the regions encompassing undivided India, Burma, and Ceylon. The term "Molluscs" denotes one of their defining characteristics: a soft body. This specialized group within the animal kingdom possesses at least two distinctive features—mantle and radula—that are not found elsewhere. Molluscs represent a significant category of true coelomate animals. Soft-bodied and pivotal in aquatic ecosystems, molluscs play a vital role in maintaining water quality and the health of aquatic systems, as highlighted by Strong *et al.* (2008). Primarily dwelling in marine and freshwater environments, some molluscs also inhabit terrestrial regions, often found in moist soil. They display an organizational level of organ systems with a body cavity. The general appearance of molluscs typically comprises a head, visceral mass, and muscular foot. Their bodies are bilaterally symmetrical, usually unsegmented, with a distinct head region. Possessing a well-developed digestive system, they commonly

utilize a rasping organ called the radula for feeding. The ventral body wall is specialized as a muscular foot, often modified for various locomotive purposes. The dorsal body wall forms the mantle cavity, which can be modified into gills or a lung and is responsible for shell secretion (although some species lack shells). Gaseous exchange occurs through gills, lungs, mantle, or body surface. Additionally, molluscs contribute to the productivity of aquatic systems, with their abundance serving as an indirect measure of aquatic productivity, as noted by Waghmare and Kulkarni (2015), Padghane *et al.* (2017), and Vaughn (2017). In India, the recorded species of Mollusca from freshwater, land, and marine habitats total 5155, as documented by Subba Rao (1991, 1998, 2000) and the Zoological Survey of India (ZSI, 2011). This diverse array comprises 22 families, 53 genera, and 183 species in freshwater; 26 families, 140 genera, and 1487 species on land; and 242 families, 591 genera, and over 3400 species in marine environments. This rich diversity allows for the identification of areas with particularly abundant molluscan populations, which play crucial roles in ecosystems and offer economic, medicinal, and ecological benefits. The Mollusca Section comprehensively studies various groups including Gastropoda, Bivalvia, Cephalopoda, Scaphopoda, Placophora, and Aplacophora across aquatic and terrestrial habitats, spanning from Kashmir to Kanyakumari and from the Indian Ocean bed to locales like the Chilika lagoon, as well as high-altitude wetlands in Himachal Pradesh and Arunachal Pradesh. With over 50 research programs completed and numerous Fauna volumes published, this section has compiled databases covering 23 States and Union Territories. Freshwater gastropods and bivalves have proven invaluable in bioindication and biomonitoring efforts, offering insights into freshwater ecosystem quality and quantifying exposure to contaminants. Their large size, limited mobility, high abundance, and relative ease of collection and identification make them ideal candidates for such studies, as evidenced by the works of Markert *et al.* (1999), Zuykov *et al.* (2013), and Srivastava and Singh (2020), among others. Freshwater molluscs exhibit sensitivity to various natural disturbances, including floods, droughts, competition with invasive alien species, habitat alterations, and seasonal water level fluctuations in reservoirs, as highlighted by Bandara *et al.* (2021), Sousa *et al.* (2021), and Kolding and van Zwieten (2012). These disturbances often lead to significant fluctuations in molluscan diversity (Dudgeon *et al.* 2006; Régnier *et al.* 2009) and distribution patterns (Geist 2011; Buffagni 2021). The limited availability of comprehensive data on molluscan communities across entire river catchment areas in India has resulted in an underestimation of freshwater molluscan diversity. Future research should prioritize enhancing our understanding of the actual distribution of molluscan fauna in relation to specific habitats and the ecological roles of molluscan species. Pioneering studies on the diversity, distribution, and taxonomy of freshwater molluscs were conducted by Preston (1915), Annandale (1918), Prashad (1920, 1928), and more recently reviewed by Subba Rao (1989), Ramkrishna and Dey (2007), and Neseemann (2007).

## Material and Methods-

**Site Area-** The Gomti River originates from Gomat Taal in Pilibhit district, Uttar Pradesh, India, with approximate coordinates around 28.6312° N latitude and 79.8175° E longitude. Lucknow, the capital city of Uttar Pradesh, lies along its course, with coordinates approximately 26.8467° N latitude and 80.9462° E longitude. Confluence: Near Saidpur, a village in the Jaunpur district of Uttar Pradesh, the Gomti River merges with the Ganga River, with approximate coordinates around 25.7355° N latitude and 82.6853° E longitude. The collection of animals along the Gomti River in Lucknow, Uttar Pradesh, occurred during January, February, and March of 2024, during daylight hours. Various sites were surveyed, including the Balaganj Road bypass bridge, Ghaila, Gau Ghat, and Mehndi Ghat.

**Fig.1 Map of Study Area with Sampling Stations**



**Sample Collection-** The collection was facilitated by fishermen using handheld nets and buckets filled with water for the preservation of the animals. Subsequently, the animals were transferred to glass aquariums at the departmental laboratory, where they were maintained under suitable conditions and closely monitored until the completion of the study. A total of 9 freshwater molluscan species were discovered, representing 2 classes, 5 orders, and 7 families, across various sites along the Gomti River in Lucknow, Uttar Pradesh. The majority of the molluscan species belonged to the Gastropoda class (80%), while the remaining 20% were from the Bivalvia class. All species were identified utilizing the identification key provided by the Zoological Survey of India. Taxonomic studies of Indian freshwater molluscs have been extensively conducted by the Zoological Survey of India, as documented by Subba Rao (1989). The following species were reported from different sites along the Gomti River in Lucknow, Uttar Pradesh: *Bellamya bengalensis*, *Lamellidens marginalis*, *Pila globosa*, *Parreysia*, *Assimineia*, *Brotia*, *Lymnaea*, *Viviparus*, and *Gyraulus* (see Fig. 1). Following collection, the organisms were washed and fixed in a 5% formalin solution, and then enumerated by group. Standard taxonomical keys were employed to identify the preserved organisms, and the abundance of each species was expressed as individuals per square meter.

Fig.2 Samples collected from the different sites of the River Gomti.



**Result and Discussion-** The current study identified a total of 9 species across all sampling sites along the Gomti River, comprising 2 classes, 5 orders, and 7 families. Among these, 7 species belonged to the Gastropoda class, while 2 species were classified as Bivalve. The species observed in the Gomti River include: *Bellamya bengalensis*, *Lamellidens marginalis*, *Pila globosa*, *Parreysia*, *Assimineia*, *Brotia*, *Lymnaea*, *Viviparus*, and *Gyraulus*.

### 1. *Bellamya bengalensis*:

*Bellamya bengalensis* in Fig.4(a), also known as Lamarck's pond snail (1822), is a freshwater edible mollusk with a wide distribution across Asia and Africa. Highly valued for its protein-rich flesh, this species holds significance in both ethnomedicine and culinary practices. Its protein content surpasses that of common fish and red meat. *Bellamya bengalensis* plays a crucial ecological role in freshwater ecosystems, primarily inhabiting stagnant water bodies and low saline environments such as rivers, streams, lakes, ponds, wetlands, polluted roadside marshes, ditches, and paddy fields. Identified by its greenish and opaque body color, it features a moderately thin operculum with a deep brownish hue.

### 2. *Lamellidens marginalis*

Freshwater mussel *Lamellidens marginalis* in Fig.4(b), belonging to the order Unionida in the Class Bivalvia of the Phylum Mollusca, thrives in freshwater rivers, lakes, and ponds, among other habitats. These mussels typically inhabit the bottom sediment, where they feed on algae, plankton, and bacteria. India boasts over 50 species of mussels distributed across its freshwater bodies, with the genus *Lamellidens* alone represented by nine species and two subspecies (Rao, 1989). *Lamellidens marginalis*, a prevalent species in India and neighboring countries, including the River Gomti and surrounding water reservoirs in and around Lucknow, Uttar Pradesh, was documented alongside another freshwater mussel variety, *Parreysia favidens* (Benson), by Shukla *et al.* in 2018. *Lamellidens marginalis* maintains a year-round presence in the Gomti River, Lucknow, and contributes to pearl production through culture practices (Rawat and Singh, 2023). The distribution pattern of *Lamellidens marginalis* across different sites along the Gomti River reflects its habitat preferences and

adaptability to diverse environmental conditions, with sites featuring higher water flow and suitable substrates potentially supporting larger and healthier mussel populations.

### 3. *Brotia*

*Brotia* in Fig.4(c), is a genus of freshwater snails native to Southeast Asia, belonging to the taxonomic family Pachychilidae. The genus name, *Brotia*, is believed to honor the Swiss malacologist Auguste Louis Brot (1821-1896). These snails exhibit gonochorism and viviparity, with females retaining developing eggs and young in a specialized brood pouch. Characterized by a high conoid or turreted shell with numerous whorls, the spire typically exceeds the body whorl in length, featuring an asymmetrical apex covered with dark brown or black epidermis and heavy axial ribs. The columellar angle of the aperture tip is slightly forward or round, with a multispiral operculum featuring a central nucleus. *Brotia* snails possess broad and protrusible snouts, along with long and slender tentacles. Their foot is short and slender, and they predominantly exhibit parthenogenesis, although rare instances of males have been recorded by David in 1971. The brood pouch structure in *Brotia* is similar to that found in *Thiara* species

### 3. *Pila globosa*

*Pila globose* in Fig.4(d), commonly known as the apple snail, is a freshwater gastropod belonging to the Ampullariidae family. These snails inhabit ponds, lakes, and streams, and they may venture onto land during the rainy season. Their entire body is contained within the whorls of their characteristic conical shell, which can exhibit colors ranging from reddish to greenish or brown. The body consists of three main parts: the head, visceral mass, and foot. The head features two pairs of tentacles, a pair of eyes, and a ventral slit mouth. The foot, triangular when viewed from below, aids in locomotion. As herbivores, *Pila globosa* feeds on algae, aquatic plants, and organic debris, contributing to nutrient cycling in aquatic ecosystems. Fig.4(d)

### 4. *Parreysia*

*Parreysia corrugata* in Fig.4(e), holds significance as a key component of freshwater fauna in the Indian sub-continent. Widely distributed across various states including Punjab, Bihar, Madhya Pradesh, Uttar Pradesh, Maharashtra, Orissa, and Karnataka, this species plays a vital role in the ecosystem. *P. corrugata* has been recognized as an essential species for pearl culture operations in India, as highlighted by Janakiram in 1989. Characterized by a sub-rhomboidal shell with a rounded anterior end and a pointed posterior end, *P. favidens* utilizes its inhalant siphon, foot, labial palps, mouth, and lips in prey capture and ingestion.

### 5. *Assiminea*

*Assiminea* in Fig.4(f), is a genus comprising minute, salt-tolerant snails with opercula, belonging to the family Assimineidae. These aquatic gastropod mollusks, also known as micro mollusks, are distributed worldwide. They predominantly inhabit brackish water and salt marshes in tropical and temperate regions, commonly found along beaches and in both aquatic and terrestrial environments. Characterized by reduced tentacles forming short lobes housing eyes, *Assiminea* species possess central teeth with or without basal denticles, with a characteristic accessory plate situated between the lateral and first marginal teeth. While some species are

oviparous, others may exhibit viviparity or parthenogenesis. These snails primarily feed on algae, bacteria, and decaying organic matter, occasionally ingesting small invertebrates while grazing on algae and detritus, as observed by the US Fish and Wildlife Service in 2010.

## 7. *Lymnaea*

*Lymnaea stagnalis* in Fig.4(g), commonly known as the great pond snail, is a species of large air-breathing freshwater snail, classified as an aquatic pulmonate gastropod mollusk within the family Lymnaeidae. *Limnaea stagnalis* var. *baltica* Lindström, 1868, is considered synonymous with *Lymnaea stagnalis* (Linnaeus, 1758). The shells of these snails exhibit a range of colors, from light brown to dark brown, with adult shells typically measuring between 45 to 60 millimeters in height, although specimens with shells up to 70 mm are occasionally encountered. The width of an adult shell typically falls within the range of 20 to 30 mm. *Lymnaea stagnalis* snails are easily maintained in freshwater aquariums at room temperature and can be nourished with a variety of vegetables, salad greens, cabbage, and dandelion leaves.

## 8. *Viviparus*

*Viviparus viviparus* in Fig.4(i), a species of large freshwater snail possessing both gills and an operculum, belongs to the family Viviparidae, commonly known as river snails. The shell of this species typically measures between 25 to 35 mm in height and 20 to 26 mm in width, with males generally slightly smaller than females of the same age. The shell displays a dark greenish-brown or greyish-yellow coloration adorned with three reddish-brown spiral bands and is characterized by striations rather than a hammer pattern, with a blunt apex (though more pointed compared to other *Viviparus* species). *Viviparus viviparus* is primarily found in major, slow-moving, lowland rivers and lakes, exhibiting a preference for calcareous (base-rich) waters. Featuring a radula in its mouth and a respiratory siphon opening on the right side of the head, this species feeds on plankton and organic micro debris suspended in the water, utilizing its siphon to breathe while simultaneously filtering the water. Two short tentacles with eyes situated externally on each tentacle assist in sensory perception and navigation.

## 9. *Gyraulus*

*Gyraulus* in Fig.4(h), is freshwater snail which can be found in Varanasi, Uttar Pradesh, and in West Bengal, particularly Kolkata, Hugli, and 24 Paraganas (North). It is also reported elsewhere, including Tibet. Commonly inhabiting ponds, ditches, and drains, these snails are typically found attached to leaves and roots of aquatic vegetation. The shell, measuring up to 7 mm in diameter, is disc-like, thin, and greatly depressed, with flatly rounded whorls that may be angular or carinate, ranging from 3 to 5 in number and increasing rapidly. The shell is often pale translucent or transparent and may or may not exhibit hair-like projections on the periostracum. Some specimens may have a peripheral keel, while others do not. The body whorl features a slightly deflected aperture, which is oblique, with a simple lip. The radula is characterized by a bicuspid central tooth, lateral tri- or bicuspid teeth, and several teeth with sharp cusps on the marginal. Pseudobranch possesses a lamella on its dorsal surface, while the penis has a sub-terminal opening and a dagger-like stylet.

Despite being a pulmonate gastropod, this minute species absorbs oxygen through its mantle cavity filled with water, rather than using air for respiration.

S.No	Animals Name	Site	Site	Site	Site
		1	2	3	4
1.	<i>Bellamya</i>	+	+	-	+
2.	<i>Lamellidens</i>	+	+	+	+
3.	<i>Pila globosa</i>	+	+	-	+
4.	<i>Parreysia</i>	+	-	-	+
5.	<i>Assimineea</i>	-	+	+	-
6.	<i>Brotia</i>	+	+	+	-
7.	<i>Lymnaea</i>	+	+	+	+
8.	<i>Viviparus</i>	-	-	+	-
9.	<i>Gyraulus</i>	-	-	+	+

**Table.1 Distribution of Molluscan species at different sites of study area.**

S.No	Animals Name	Class	Scientists
1.	<i>Bellamya bengalensis</i>	Gastropoda	Lamarck (1822)
2.	<i>Lamellidens marginalis</i>	Bivalvia	Lamarck (1819)
3.	<i>Pila globosa</i>	Gastropoda	Bolten, Roeding (1798)
4.	<i>Parreysia</i>	Bivalvia	Mueller (1714)
5.	<i>Assimineea</i>	Gastropoda	Wood (1828)
6.	<i>Brotia</i>	Gastropoda	H. Adams (1866)
7.	<i>Lymnaea</i>	Gastropoda	Lamarck (1799)
8.	<i>Viviparus</i>	Gastropoda	Kobelt (1879)
9.	<i>Gyraulus</i>	Gastropoda	Charpentier(1837)

**Table.2 Molluscan diversity found in River Gomti, Lucknow[U.P]**

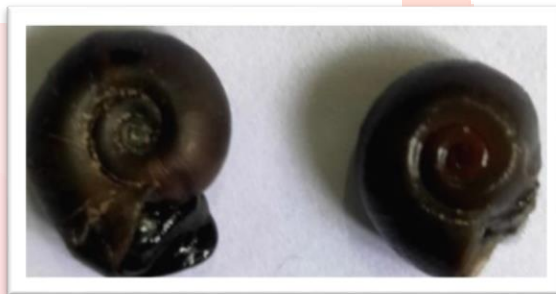
a. *Bellamyia bengalensis*b. *Lamellidens marginalis*c. *Brotia*d. *Pila globosa*e. *Parreysia*f. *Assiminea*g. *Lymnaea*h. *Gyraulus*i. *Viviparus*

Fig.3 Collection of Molluscan species from Gomti River, Lucknow

### Discussion

The current investigation reveals varying species compositions across different sites along the river. The chart presented indicates that not all species were uniformly distributed across all four sites; certain species such as *Lamellidens*, *Parreysia*, and *Lymnaea* were consistently observed at each site, whereas others like *Assiminea*, *Gyraulus*, and *Viviparus* were only detected at select locations. It's important to note that population dynamics of these species can fluctuate depending on factors such as temperature, water quality, and pH, which serve as essential prerequisites for their presence. These environmental variables play a crucial role in shaping the distribution and abundance of freshwater mollusks in the river ecosystem.



## Conclusion

Freshwater molluscs play a crucial role in assessing the ecological health of water bodies, underscoring the significance of studies focusing on their diversity, distribution, and ecology. The findings of the current study illuminate the distribution patterns of molluscan species along the Gomti River, revealing the presence of both Gastropoda and Bivalve communities. Notably, Gastropoda exhibited higher dominance compared to Bivalvia. These molluscan species serve as valuable bioindicators of pollution levels and overall ecosystem well-being. The total abundance and diversity of molluscs are likely influenced by habitat characteristics and soil conditions. Further long-term research is warranted to delve into aspects such as population estimation, habitat preferences, seasonal variations, and potential threats. The insights garnered from this study could aid in the formulation of effective management and conservation strategies for molluscan fauna in the region, providing essential baseline data for future studies on molluscan diversity in the Gomti River, Lucknow, Uttar Pradesh.

**Acknowledgement** - The authors express their gratitude to the Head of the Department of Zoology, BSNV PG College, Lucknow, for their invaluable support and encouragement throughout this research endeavor. Additionally, the authors extend their appreciation to the entire staff of the PG Department of Zoology, BSNV PG College, Lucknow, for their assistance and encouragement, which facilitated the successful completion of this study.

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