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FIRST RECORD OF PELECYPOD FOSSILS FROM DHOK PATHAN FORMATION, HASSNOT AREA, DISTRICT JHELUM, PAKISTAN

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Author's contribution
A.Y planned this study K.R investigates the samples, M.A.F compiled the data, M.R revised the paper and make submission possible.

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Pelecypod, Dhok Pathan Formation, Siwaliks, Hassnot.

ABSTRACT

Fresh water Pelecypod fossils were collected and identified from the Dhok Pathan Formation in the nearby area of Hassnot Village, District Jhelum, which is the first documentation of Pelecypods from this area. A total of 50 Pelecypod specimens were collected and 17 well preserved specimens were selected for present study. Data was compiled at genus level and arranged systematically. Present study indicates five Pelecypod genera *Solemya* sp., *Nuculana* sp., *Macoma* sp., *Acila* sp. and *Litorhadia* sp. belonging to three orders, two subclasses and four families. Preliminary taxonomic features of these five genera are described.

1. INTRODUCTION

Siwalik Group sequence is broadly shown in the Plateau of Potwar in Pakistan (Shah, 1977), (Khan et al., 2008, 2009, 2010, 2013). The Pelecypod fossils were gathered from the fossiliferous outcrops of Late Miocene Formation is Dhok Pathan exposed near Hassnot village, Jhelum District of Pakistan (Fig. 1). Hassnot town is west of Jhelum city that is about 70 km i.e (Lat. 32.828471 and Long. 73.319407) where fresh water deposits of Middle Siwaliks are exposed (Khan et al., 2013). Complete sequence of Siwalik group exposed in Hassnot area with diverse assemblage of Dhok Pathan Formation having average thickness of the sequence is 180m (Farooq et al., 2007a, b, 2008). In proposed area, the lithologically consist alternation beds of sandstone and claystone. Sandstone is firm, well cemented to very soft and of variegated color gives Buffy and shiny appearance whereas claystones are grey to greenish grey over silty clays (Fig. 2). A total of 50 Pelecypod fossils were collected from the Study area (Fig. 3) and 17 well preserved specimens were selected for the present study. Those specimens have been washed, wiped clean in water, classified and preserved within the repository of the Pakistan Museum of Natural History, Islamabad. Cause of this research paper is to record the new findings of Pelecypod fossils of Dhok Pathan Formation from Hassnot area, District Jhelum. Detailed paleoecological and paleogeographical studies of the newly discovered species are already underway that will be reported later.

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2. MATERIAL AND METHODS

The standard method described by Akhtar [1] was adopted for this study.

3. RESULTS

Taxonomy:
Based on taxonomic studies 17 Pelecypod fossils have been identified up to genus level that are described in the following section.

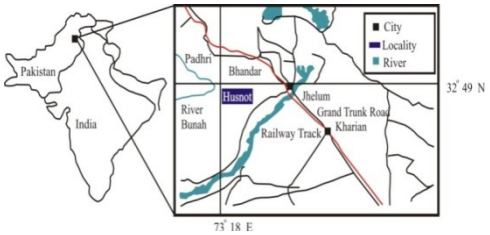

Figure 1- The Study area map. Batool *et.al.,* 2015.

Figure 2- Outcrop of Dhok Pathan Formation, Hassnot area.

Figure 3- Assemblage of Pelecypod fossils in Dhok Pathan Formation, Hassnot area.

a. Genus ***Solemya*** Lamarck, 1818

Solemya Lamarck, 1818, Histoire naturelle des animaux sans vertebras, v. 5, p. 488. (Fig.4)

Description
Phylum: Mollusca
Class: Pelecypoda
Subclass: Protobranchia **Pelseneer, 1889**
Order: Solemyoida **Dall, 1889**
Family: Solemyidae **Gray, 1840**

Umbones are not prominent in this specimen. Both anterior and posterior margins are rounded. The ratio of shell length to height ranges from 1.80 to 2.03.

Geological range: Devonian to Holocene.
Material: five well preserved specimens.

Table 1- Dimensions of Genus *Solemya.*

Specimen No.	Length (mm)	Width (mm)	Ratio
PMNH/ESD/DP/01	74	37	2.0
PMNH/ESD/DP/02	67	35	1.9
PMNH/ESD/DP/03	66	30	2.2
PMNH/ESD/DP/04	55	27	2.03
PMNH/ESD/DP/05	55	30	1.8

Figure 4- Five specimen of the Genus *Solemya*. Numbers corresponds to the Specimen Number given in the Table 1.

b. Genus ***Nuculana*** Link, 1807

Beschreibung der Naturalien-Sammlung der Universität zu Rostock. Rostock, Adlers Erben. 1 Abt. Link, D. H. F. (1807-1808). [Part 1], pp. 1-50; (Fig.5)

Description:
Phylum: Mollusca
Class: Pelecypoda
Subclass: Protobranchia **Pelseneer, 1889**
Order: Nuculoida
Family: Nuculanidae H. and A. **Adams, 1858**

The specimen has Shell small, elongate, convex, thin, umbones anterior, turning slightly toward the posterior end, which is elongated, narrow and truncated. It has an evenly rounded anterior end. It has deep concentric grooves on the shell. The ratio of shell length to height ranges from 1.4 to 2.6.

Geological range: Silurian to Recent
Material: four well preserved specimens

Table 2- Dimensions of Genus *Nuculana*

Specimen No.	Length (mm)	Width (mm)	Ratio
PMNH/ESD/DP/01	45	28	1.6
PMNH/ESD/DP/02	35	25	1.4
PMNH/ESD/DP/03	32	21	1.52
PMNH/ESD/DP/04	29	11	2.6

Figure 5- Four specimen of the Genus *Nuculana*. Numbers corresponds to the Specimen Number given in the Table 2.

c. Genus *Macoma* Leach, 1819

Macoma Leach, 1819, in John Ross, A voyage of discovery for the purpose of exploring Buffins Bay and inquiring into the probability of a northwest passage, appendix 11, p. 62. (Fig. 6)

Description
Phylum: Mollusca
Class: Pelecypoda
Subclass: Heterodonta **Neumayr, 1884**
Order: Veneroida **H. and A. Adams, 1856**
Family: Tellinidae **Blainville, 1814**

This specimen is a small thin-shelled subovate, bearing irregularly spaced concentric groove. Ligament is external and long straight. The ratio of shell length to height ranges from 1.18 to 1.26.

Geological range: Oligocene to Recent
Material: four well preserved specimens

Table 3- Dimensions of Genus *Macoma*

Specimen No.	Length (mm)	Width (mm)	Ratio
PMNH/ESD/DP/1	30	25	1.2
PMNH/ESD/DP/2	33	26	1.26
PMNH/ESD/DP/3	29	24	1.2
PMNH/ESD/DP/4	26	22	1.18

Figure 6- Four specimen of the Genus *Macoma*. Numbers corresponds to the Specimen Number given in the Table 3.

d. Genus *Acila* (H. Adams and A. Adams, 1858)
Acila H. and A. Adams, 1858, Genera of Recent Mollusca, v. 2, p. 545. (Fig.7)

Description
Phylum:Mollusca
Class: Pelecypoda
Subclass: Protobranchia **(Pelseneer, 1889)**
Order: Nuculoida
Family: Nuculidae **Gray, 1824**

Shell with rostral sinus from umbo to ventral margin; usually one or more bifurcations of radial ribs in addition to primary one. Concentric ridged filled the surface.

Geological range: Oligocene to Holocene
Material: solitary, well preserved specimen

Table 4- Dimensions of Genus *Acila.*

Specimen No.	Length (mm)	Width (mm)	Ratio
PMNH/ESD/DP/1	22	17	1.29

Figure 7- One specimen of the Genus Acila. Numbers corresponds to the Specimen Number given in the Table 4.

e. Genus **Litorhadia** Stewart, 1930.

Litorhadia Stewart, 1930, Acad. Nat. Sci. Philadelphia Spec. Pub. 3, p. 52-53. (Fig.8)

Description
Phylum: Mollusca
Class: Pelecypoda
Subclass: Protobranchia **Pelseneer, 1889**
Order: Nuculoida
Family: Nuculanidae **H. and A. Adams, 1858**
Litorhadia is a double valved specimen in which valves and hinge are together but not completely closed. Concentric grooves are present on the shell. The ratio of shell length to height ranges from 0.80 to 1.68.

Geological range: Eocene to Miocene
Material: Three well preserved specimen

Table 5- Dimensions of Genus Litorhadia

Specimen No.	Length (mm)	Width (mm)	Ratio
PMNH/ESD/DP/1	42	25	1.68
PMNH/ESD/DP/2	36	22	1.63
PMNH/ESD/DP/3	17	21	0.80

Figure 8- Specimen of the Genus Litorhadia. Numbers corresponds to the Specimen Number given in the Table 5.

4. DISCUSSION

Siwalik Group has been known for rich occurrences of both vertebrate and invertebrate fossils. (Pilgrim 1937-1939, Akhtar 1992 and Waseem et al., 2016). Neogene sedimentary rocks of fresh water origin are widely exposed in the Hassnot area. Most of the fresh water deposits belong to the Dhok Pathan Formation from fresh water fossils has previously been reported. However, the fresh water Pelecypods have not been reported earlier from the Hassnot exposures of Dhok Pathan Formation. Further detailed studies on the basis of these fossils are underway to reconstruct the paleogeography of the area during the deposition of Siwaliks.

5. CONCLUSIONS

The present new record suggests the distribution of Pelecypod fossils in the Late Miocene of the Siwaliks. The presence of Pelecypods along with rich assemblage of vertebrate fossils from Dhok Pathan formation indicates the change in environmental conditions. Taxa identified from the locality are of genus Solemya sp., Nuculana sp., Macoma sp., Acila sp. and Litorhadia sp.

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7. CONFLICT OF INTERESTS

The authors have declared that there is no conflict of interest regarding the publication of this article.

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