



FRESHWATER OSTRACODS FROM THE SIWALIK (CHURIA) GROUP OF NEPAL

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ABSTRACT

Nineteen ostracod species are recorded from the Siwalik (Churia) Group of Nepal from two sections: (i) Surai Khola Road Traverse southeast of Dang District; (ii) the upper part of the Binai Khola middle Member at the confluence of the Jhumsa Khola and the Tinau Khola. Of these, three species – *Cypris whatleyi*, *Zonocypris curvicostata* and *Potamocypris nepalensis* – are new, twelve species - *Hemicypris megalops* Sars, *H. pyxidata* (Moniez), *Strandesia hartmanni* Mannikeri and Vaidya, *Potamocypris* sp. cf. *P. islagrandensis nicaraguensis* Hartmann, *Candonia lactea* Baird, *C. marengoensis* Klie, *Cypria ophthalmica* (Jurine), *Candonopsis* sp. cf. *C. dorsorecta* Rome, *C. kingsleyi* Brady and Robertson, *Ilyocypris gibba* (Ramdohr), *Darwinula* sp. cf. *D. cuneata* Klie, *Limnocythere* sp. cf. *L. xinanensis* Zhao - are assigned to previously known taxa and 4 species - *Herpetocypris* sp., *Pelocypris* sp., *Darwinula* sp., and Genus A sp. – are left in open nomenclature. The overall evidence furnished by the ostracod assemblage suggest that no form is inconsistent with the Upper Siwalik age for the upper part of the Binai Khola middle Member assigned by Tokuoka *et al.* (1990) and the upper part of Surai Khola and Dobatta formations assigned by Corvinus and Rimal (2001). The upper part of the Chor Khola Formation (sample no. S/9) has yielded *Z. curvicostata*, *P. nepalensis*, *I. gibba*, and *L. sp. cf. L. xinanensis* which suggest that lower age limit for these species might be extending down to Middle Siwaliks.

Keywords: Freshwater, ostracods, Siwalik, Surai Khola, Jhumsa Khola, Tinau Khola, Nepal

INTRODUCTION

In Nepal, the Siwalik Group (also designated as the Churia Group) is developed in the east-west trending Sub-Himalayas/Churia Range all along its southern territory. In the north, it is separated from the Lesser Himalayas by the Main Boundary Fault (M.B.T.) and in the south from the Gangetic Alluvium Plain by the Himalayan Frontal Thrust (H.F.T.). During the last over 50 years considerable work has been done on the Siwalik (Churia) Group of Nepal. Important contributions to the stratigraphy, including magnetostratigraphy, have been made by Tokuoka *et al.* (1986, 1988, 1990), Corvinus (1988, 1990, 1993, 1994), Appel *et al.* (1991), Appel and Roesler (1994), Corvinus and Nanda (1994), Gautam and Appel (1994), Dhittal *et al.* (1995), Roesler *et al.*, (1997), and Corvinus and Rimal (2001); the vertebrate fauna by West *et al.* (1978, 1991), Munthe *et al.* (1983), Nanda and Corvinus (1992, 2000), Corvinus and Nanda (1994), Corvinus and Schleich (1994), Kotlia and Mathur (1997), and Paudyal (2013); Molluscs by West *et al.* (1975), Tokuoka *et al.* (1986, 1988, 1990), Takayasu (1992), Gurung (1998), and Corvinus and Rimal (2001); Plant megafossils by Awasthi and Prasad (1990), Prasad (1994a, 1994b), Prasad and Awasthi (1996), Konomatsu and Awasthi (1999), Prasad *et al.* (1999), Prasad and Pandey (2008), and Prasad and Dwivedi (2008); Pollens by Mathur (1972), and Sarkar (1990).

In so far as ostracod microfauna is concerned, it has not received much attention from the micropaleontologists since its first reporting from the Siwalik Group of Central and Western Nepal by the Chinese Petroleum Investigation Team (1973). Thereafter, Khosla *et al.* (1995) recorded occurrence of 6 species – *Candonia lactea* Baird, *Cypria ophthalmica* (Jurine), *Cyprinotus* sp., *Ilyocypris gibba* (Ramdohr), *Limnocythere* sp.

and *Potamocypris* sp. – from the Siwaliks of Surai Khola Road Traverse in West Nepal. The ostracod fauna from the Siwalik Group from western Himalayas of adjoining India are, however, better known. It has been described and / or recorded by Bhatia and Khosla (1967), Mathur (1972, 1976, 1977), Bhatia (1995, 1996), Bhatia *et al.* (2001), and Bhandari and Kundal (2008). Two of these studies pertain to records from Jammu region and remaining from Himachal Pradesh and areas in vicinity of Chandigarh. Here, we record 19 species from the Siwalik Group of Nepal from two sections: (i) Surai Khola Road Traverse southeast of Dang District, West Nepal; (ii) the upper part of the Binai Khola middle Member at the confluence of the Jhumsa Khola and the Tinau Khola, west Central Nepal. Of the nineteen ostracod species recorded, three species – *Cypris whatleyi*, *Zonocypris curvicostata* and *Potamocypris nepalensis* – are new. Twelve species - *Hemicypris megalops* Sars, *H. pyxidata* (Moniez), *Strandesia hartmanni* Mannikeri and Vaidya, *Potamocypris* sp. cf. *P. islagrandensis nicaraguensis* Hartmann, *Candonia lactea* Baird, *C. marengoensis* Klie, *Cypria ophthalmica* (Jurine), *Candonopsis* sp. cf. *C. dorsorecta* Rome, *C. kingsleyi* Brady and Robertson, *Ilyocypris gibba* (Ramdohr), *Darwinula* sp. cf. *D. cuneata* Klie, *Limnocythere* sp. cf. *L. xinanensis* Zhao - are assigned to previously known taxa and 4 species - *Herpetocypris* sp., *Pelocypris* sp., *Darwinula* sp., and Genus A sp. – are left in open nomenclature.

STRATIGRAPHY OF THE SURAI KHOLA ROAD TRAVERSE, WEST NEPAL

A continuous sequence of the Siwalik Group in the Surai Khola (Khola meaning a small stream in Nepali) Area in

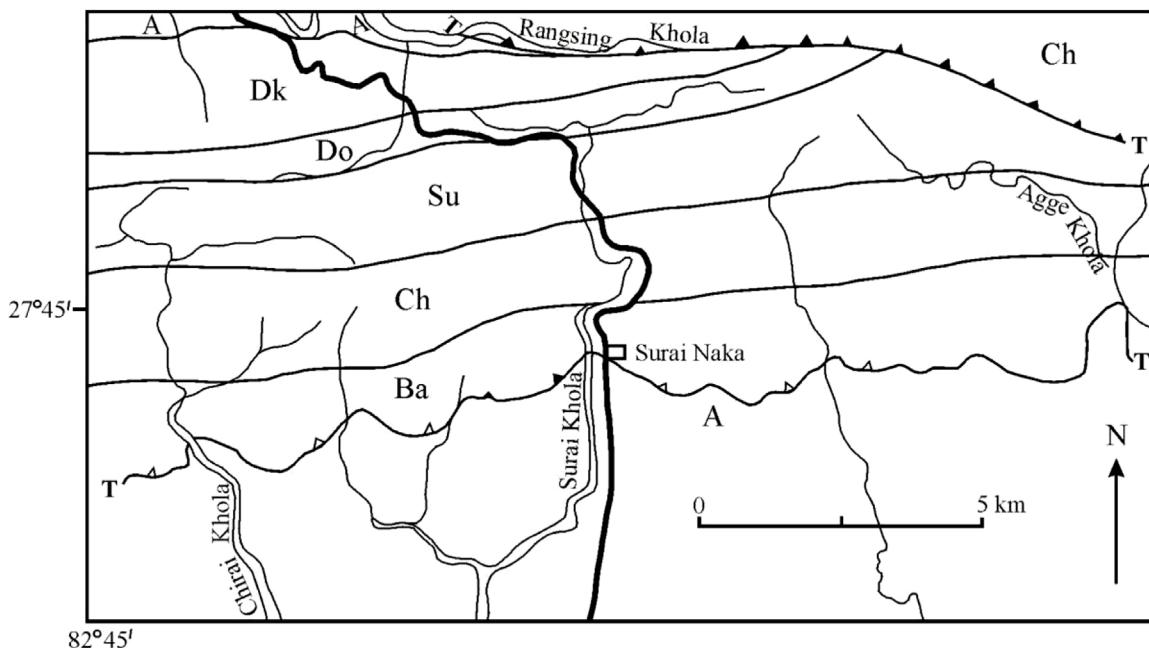
Western Nepal includes the upper part of the Lower Siwaliks, the Middle and the Upper Siwaliks. It comprises (i) tectonically much disturbed northern belt and (ii) an undisturbed southern belt. The two belts are separated by the Rangsing Thrust. We are concerned with southern belt in our present study, which is over 5000 m thick.

The Siwalik Group in Surai Khola area has been extensively worked by Corvinus (1988 *et seq.*). It has been divided into five lithostratigraphic units *viz.* in ascending order Bankas, Chor Khola, Surai Khola, Dobatta and Dhan Khola formations. They exhibit a gradual coarsening-up of sediments from predominantly fine-grained clasts of claystones and siltstones in the Bankas Formation through alternations of mudstones and sandstones in the Chor Khola Formation, massive multistoried sandstones in the Surai Khola Formation to predominantly conglomeratic deposits in the Dhan Khola Formation. A short period of aggradations of soft mudstones, claystones and sandstones of the Dobatta Formation, laid during a time of quieter river regime in between the conglomerates of the Dhan Khola Formation. On the basis of magnetostratigraphic studies, Appel and Roesler (1994) dated the entire sequence of the Siwalik (Churia) Group of the Surai Khola Area from 13 to 1 ma. We collected in all 39 samples from the Bankas Formation to the basal part of the Dhan Khola Formation. The ostracods were recovered from the upper part of the Chor Khola Formation, the Surai Khola and

the Dobatta formations. A simplified geological map of the area studied and the stratigraphic column are given in Figs 1 and 2, and distribution of ostracods in Table 1.

STRATIGRAPHY OF THE TINAU KHOLA-BINAI KHOLA AREA, WEST CENTRAL NEPAL

The Siwalik Group of west Central Nepal has been studied between Arung-Binai-Tinau kholas by Tokuoka *et al.* (1986, 1988, 1990). It is divided lithostratigraphically into the Arung Khola, Binai Khola, Chitwan and Deorali formations in ascending order, that is, in the order of A, B, C and D formations in their capital letters. The A and B formations are subdivided into three members each. These are, in ascending order, the Al, Am, Au, Bl, Bm, Bu members where l, m, u stand for lower, middle, upper members respectively. The group is divided into North and South belts which are separated by the Central Churia Thrust (C.C.T.). In the North Belt, the strata up to the Bl Member are exposed, whereas the strata down to the Am Member are exposed in the south Belt. Here we have studied the ostracods only from the upper part of the Binai Khola middle Member exposed at the confluence of the Jhumsa Khola and the Tinau Khola. Its location and stratigraphic column are given in Figs 3 and 4 and distribution of ostracods in Table 2. The succession is 5 metres thick and consists of very fine to fine grained calcareous



Dk - Dhan Khola Formation; Do - Dobatta Formation; Su - Surai Khola Formation;
Ch - Chor Khola Formation; Ba - Bankas Formation; A - Alluvium; T - Thrust

Fig. 1. Geological map of Surai Khola from Surai Naka to Rangsing Khola (modified after, Corvinus and Rimal, 2001).

EXPLANATION OF PLATE I

- 1-4. *Cypris whatleyi* n. sp. Holotype (SUGDMF 1229), carapace; 1, right valve view, x 43; 2, pits enlarged, x 120; 3, left valve view, x 43; 4, dorsal view, x 43.
 5-7. *Cypris whatleyi* n. sp. (Juvenile?) Paratype (SUGDMF 1230), carapace; 5, right valve view, x 66; 6, dorsal view, x 67; 7, left valve view, x 66. 8-10. *Hemicypris megalops* Sars, 1903, Carapace (SUGDMF 1231); 8, left valve view, x 47; 9, dorsal view, x 48; 10, right valve view, x 47. 11-13. *Hemicypris pyxidata* (Moniez, 1892) 11, carapace (SUGDMF 1232), left valve view, x 55; 12, left valve (SUGDMF 1233), internal view, x 52; 13, right valve (SUGDMF 1234), internal view, x 51. 14-16. *Strandesia hartmanni* Mannikeri and Vaidya, 1990; 14-15, carapace (SUGDMF 1235); 14, right valve view, x 60; 15, left valve view, x 60; 16, carapace (SUGDMF 1236), dorsal view, x 61.

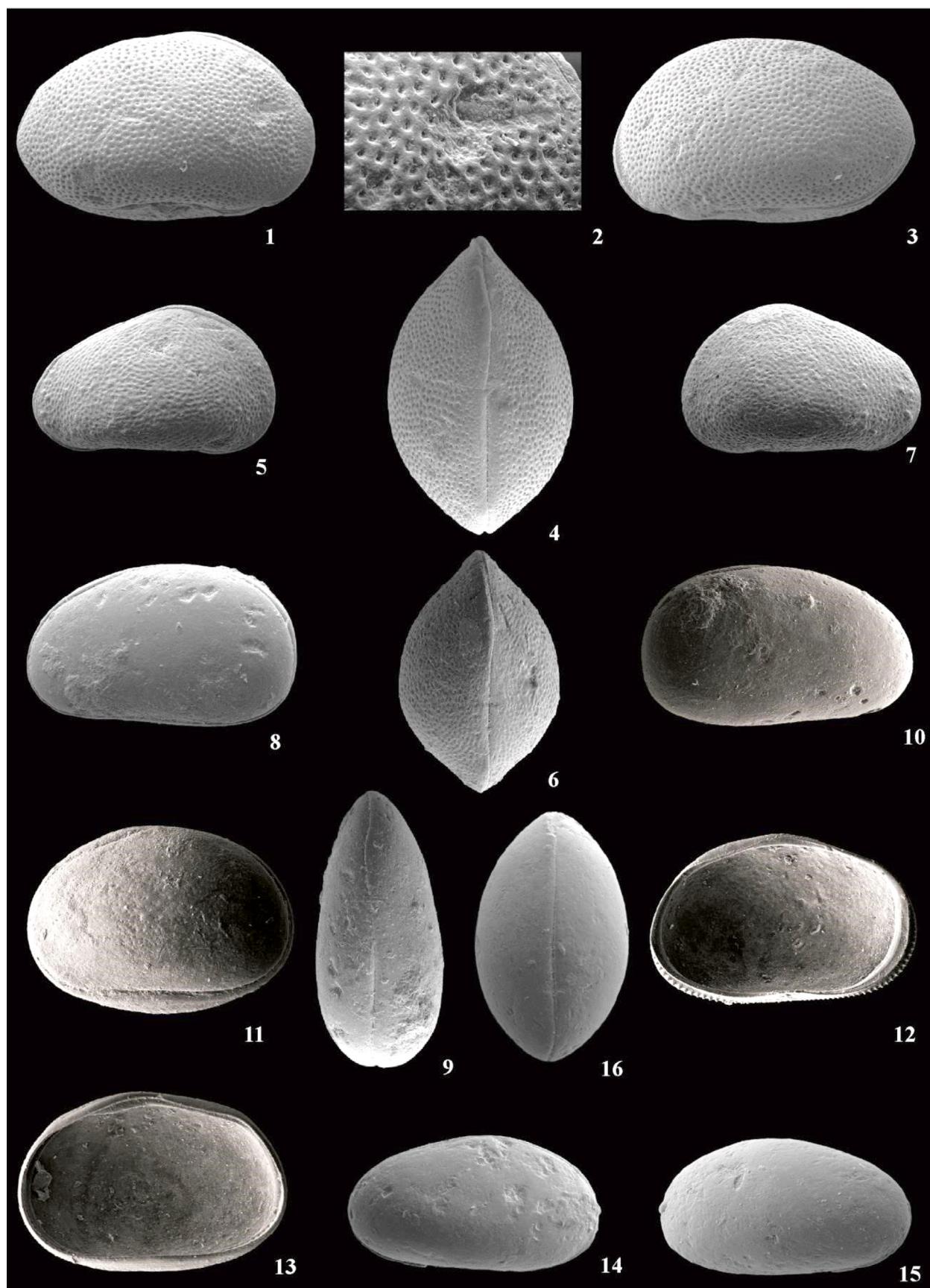


Table 1. Distribution of ostracods in the Siwalik (Churia) Group of Surai Khola Road Traverse, West Nepal.

Formations		Sample Nos.	<i>Hemicypris pyxidata</i> (Moniez)	<i>Zonocypris curvostata</i> n. sp.	<i>Potamocypris nepalensis</i> n. sp.	<i>Candonula lactea</i> Baird	<i>C. marencoensis</i> Kie	<i>Cypria ophthalmica</i> (Jurine)	<i>Ilyocypris gibba</i> (Ramdohr)	<i>Limnocythere</i> sp. cf. <i>L. xinanensis</i> Zhao Yuhong	Genus A sp.	Total Specimens
Dhan Khola												
	Dobatta	S/37 S/36 S/34-35* S/33 S/32 S/31 S/30 S/29* S/28 S/21-27* S/20 S/19* S/18 S/14-17* S/13 S/12* S/11 S/10* S/9 S/6-8* S/2-5* S/1*	27 4 8 2	1 13 5 7 2 1 3 1 1 4 2	1 1 1 7 2 1 3 1 1 4 9 2	20 4 1 1 4 1 3 1 1 4 9 2	38 1 1 4 4 3 5 1 1 7 17	1 1 1 1 1 1 1 1 1 1 1 1	86 11 14 6 20 2 5 1 1 7 17			
Surai Khola	Chor Khola											
	Bankas	Total specimens	10	35	7	26	3	1	41	48	1	172

*Barren of ostracods

sandstone with nodules at the base, successively overlain by the conglomerate bed, cross bedded coarse to very coarse grained sandstone, mudstone at places with rare to abundant gastropod fossils, conglomerate bed and cross bedded coarse to very coarse grained sandstone. In all 8 samples were collected. Abundant ostracod fauna was encountered in sample no. J/5, common in sample no. J/7, and rare in sample no. J/8.

Corvinus and Rimal (2001) have proposed tentative correlation of the Siwaliks of Surai Khola Road Traves and Arung-Binai-Tinau kholas. According to them the Bankas Formation is equivalent to the upper part of the Arung Khola lower Member to the lower part of the Arung Khola middle Member; the Chor Khola Formation is equivalent to the upper part of the Arung Khola middle Member to the Binai Khola lower Member; the Surai Khola Formation is equivalent to the

EXPLANATION OF PLATE II

1-3. *Zonocypris curvostata* n. sp. 1, carapace (SUGDMF 1237), right valve view, x 81; 2, carapace (SUGDMF 1238), dorsal view, x 83; 3, left valve (SUGDMF 1239), internal view, x 80. 4-6. *Potamocypris nepalensis* n. sp. 4, Holotype (SUGDMF 1240), carapace, left valve view, x 83; 5-6, paratype (SUGDMF 1241), carapace; 5, dorsal view, x 81; 6, right valve view, x 84. 7-9. *Potamocypris* sp. cf. *P. islagrandensis nicaraguensis* Hartmann, 1959 Carapace (SUGDMF 1242); 7, right valve view, x 81; 8, dorsal view, x .81; 9, left valve view, x 83. 10-11. *Cypria ophthalmica* (Jurine, 1820) Carapace (SUGDMF 1248); 10, left valve view, x 93; 11, right valve view, x 93. 12-14. *Candonula lactea* Baird; 12-13, carapace (SUGDMF 1243); 12, right valve view, x 89; 13, dorsal view, x 90; 14, carapace (SUGDMF 1244), right valve view, x 81.

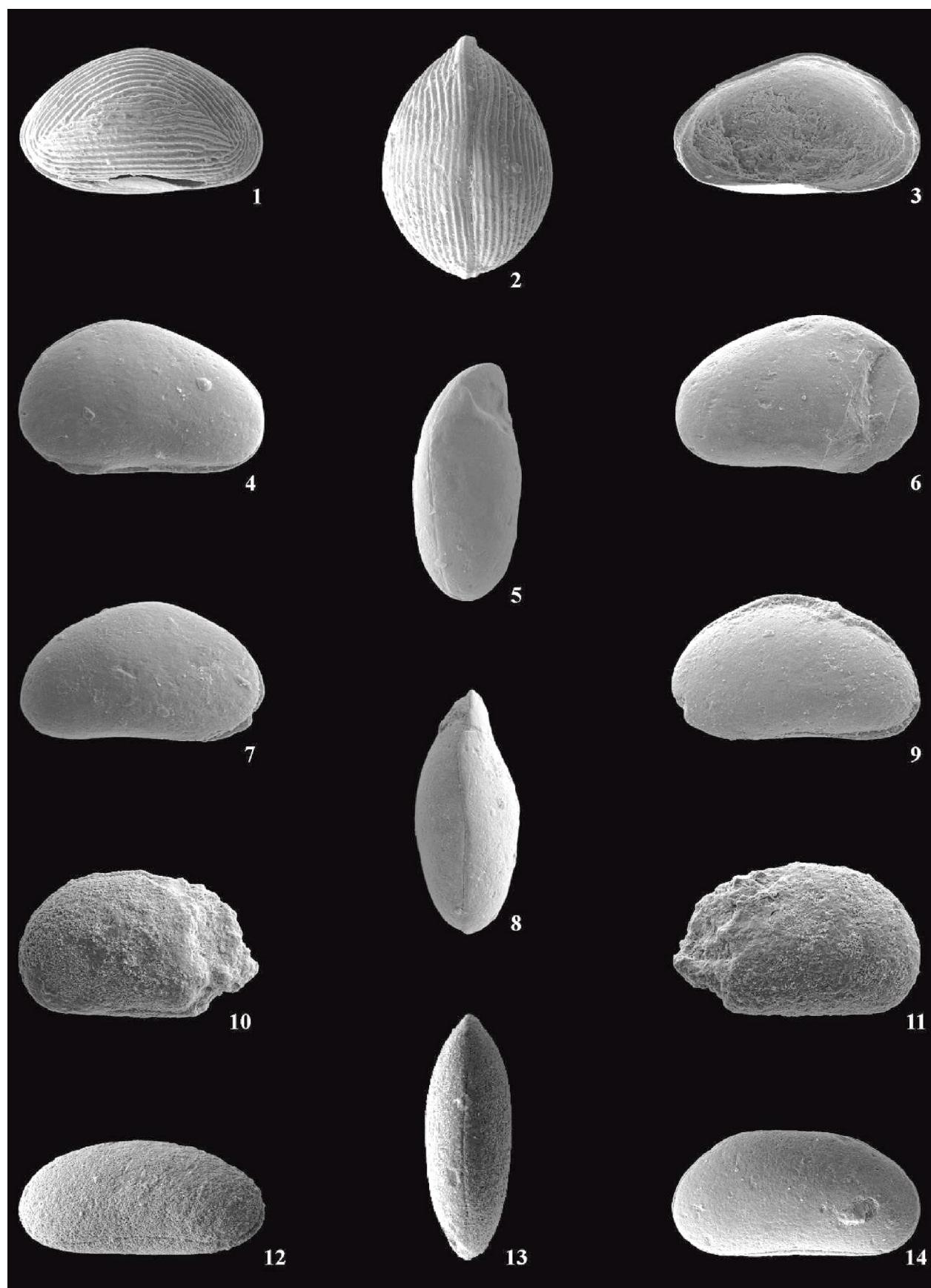


Table 2. Distribution of ostracods in the Upper part of the Binai Khola middle Member at the confluence of the Jhumsa Khola and the Tinau Khola, west Central Nepal.

		Sample Nos.														
		<i>Cypris whatleyi</i> n. sp.														
		<i>Hemicypris megalops</i> Sars														
		<i>Strandesia hartmanni</i> Mannikeri and Vaidya														
		<i>Potamocypris</i> cf. <i>P. islagrandensis nicaraguensis</i> Hartmann														
		<i>P. nepalensis</i> n. sp.														
		<i>Candonia lactea</i> Baird														
		<i>C. marencoensis</i> Klie														
		<i>Herpetocypris</i> sp.														
		<i>Candonopsis</i> sp. cf. <i>C. dorsorecta</i> Rome														
		<i>C. kingsleyi</i> Brady and Robertson														
		<i>Ilyocypris gibba</i> (Ramdohr)														
		<i>Pelocypris</i> sp.														
		<i>Darwinula</i> sp. cf. <i>D. cuneata</i> Klie														
		<i>Darwinula</i> sp.														
		<i>Limnoicythere</i> sp. cf. <i>L. xinanensis</i> Zhao Yuhong														
																Total Specimens
Upper part of the Binai Khola middle Member	J/8 J/7 J/6* J/5 J/1-4*	2 1 1 14 2 4 14 16 32 4 11 7 66 3 53 3 4	15 3 7 30 19 39 6 11 9 87 3 59 3 6	1 7 2 1 11 7 66 3 53 3 4	3 18 2 11 9 87 3 59 3 6	3 18 2 11 9 87 3 59 3 6	1 1 1	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	5 58 233							
Total Specimens		16 1 3 4 30 19 39 6 11 9 87 3 59 3 6														296

*Barren of ostracods

Binai Khola middle and upper members; the Dobatta Formation is equivalent to the greater lower part of the Chitwan Formation; and the Dhan Khola Formation is equivalent to the upper part of the Chitwan Formation and the Deorali Formation.

AGE AND COMPOSITION OF THE OSTRACOD FAUNA

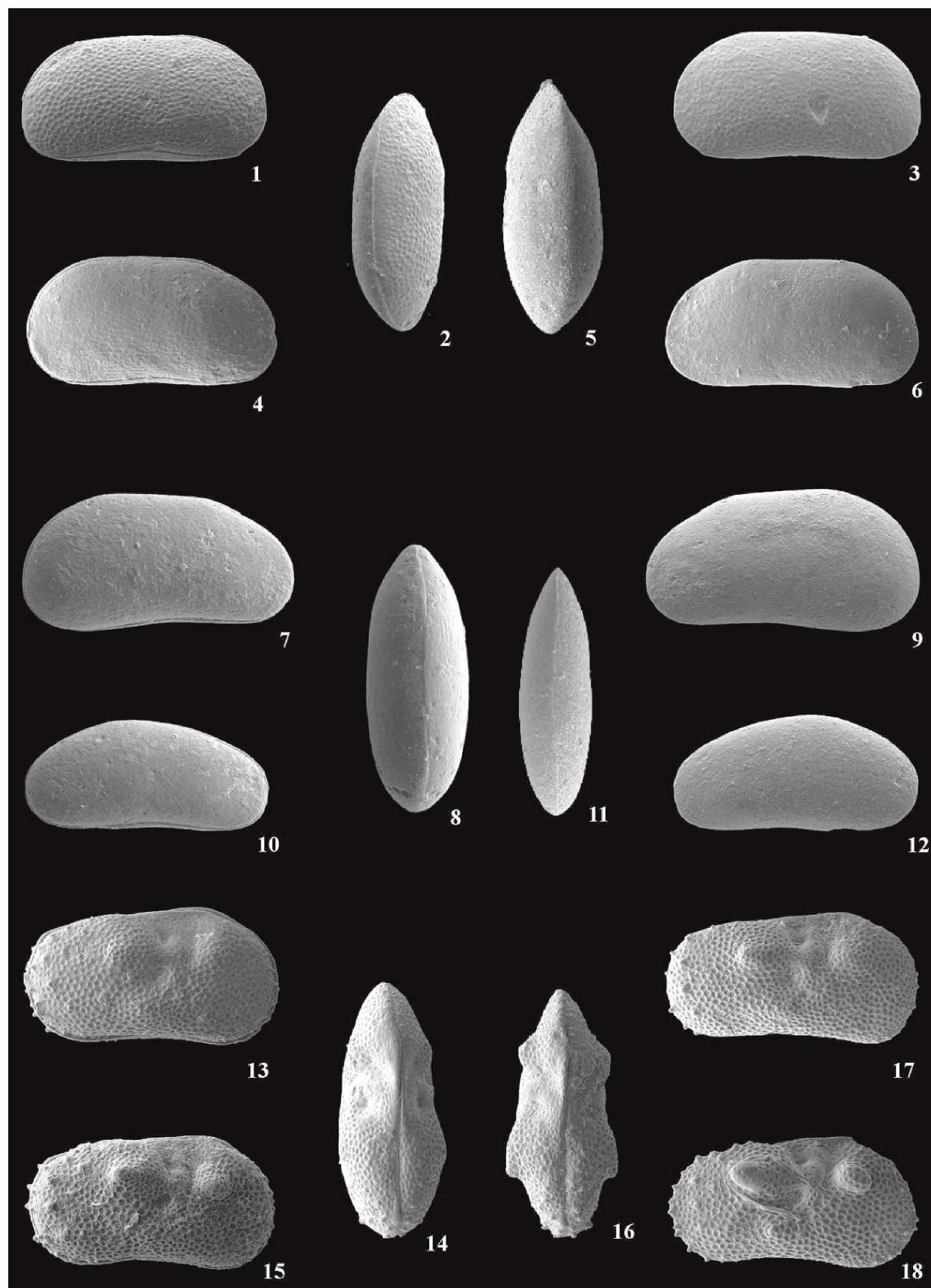
- One species – Genus A sp. – is indeterminate at generic level. It is represented by a single specimen occurring in sample no. S/37 of Dobatta Formation of Surai Khola Section. Two species – *Zonocypris curvicostata* and *Potamocypris nepalensis* – are new. The latter species occurs in both the sections studied but the former species occurs only in the Surai Khola Section, abundantly in the topmost horizon (sample no. S/37) of the Dobatta Formation. These species

are at present of little stratigraphic significance.

- Three species – *Herpetocypris* sp., *Pelocypris* sp., and *Darwinula* sp. – are left in open nomenclature. These species are restricted in the upper part of the Binai Khola middle Member studied and are not of any stratigraphic significance at the present.
- One species – *Cypris whatleyi* – though new, has been previously reported from the Upper Siwaliks, the Karewas and freshwater ponds of India and Sri Lanka. In Nepal, it is being described from the upper part of the Binai Khola middle Member only.
- Five species - *Strandesia hartmanni* Mannikeri and Vaidya, *Potamocypris* sp. cf. *P. islagrandensis nicaraguensis* Hartmann, *Candonopsis* sp. cf. *C. dorsorecta* Rome, *C. kingsleyi* Brady and Norman, and *Darwinula* sp. cf. *D.*

EXPLANATION OF PLATE III

- 1-3. *Candonia marencoensis* Klie, 1931; 1, carapace (SUGDMF 1245), right valve view, x 86; 2-3, carapace (SUGDMF 1246); 2, dorsal view, x 82; 3, left valve view, x 86. 4-6. *Herpetocypris* sp. Carapace (SUGDMF 1247); 4, right valve view, x 60; 5, dorsal view, x 61; 6, left valve view, x 60. 7-9. *Candonopsis* sp. cf. *C. dorsorecta* Rome, 1962; 7, carapace (SUGDMF 1249), right valve view, x 50; 8-9, carapace (SUGDMF 1250); 8, dorsal view, x 53; 9, left valve view, x 53. 10-12. *Candonopsis kingsleyi* Brady and Robertson, 1870; Carapace (SUGDMF 1251); 10, right valve view, x 69; 11, dorsal view, x 69; 12, left valve view, x 69. 13-18. *Ilyocypris gibba* (Ramdohr, 1808); 13-14, carapace (SUGDMF 1252); 13, right valve view, x 60; 14, a dorsal view, X 62; 15-16, carapace (SUGDMF 1253); 15, right valve view, x 57; 16, dorsal view, x 58; 17, right valve (SUGDMF 1254), lateral view, x 62; 18, right valve (SUGDMF 1255), lateral view, x 61.



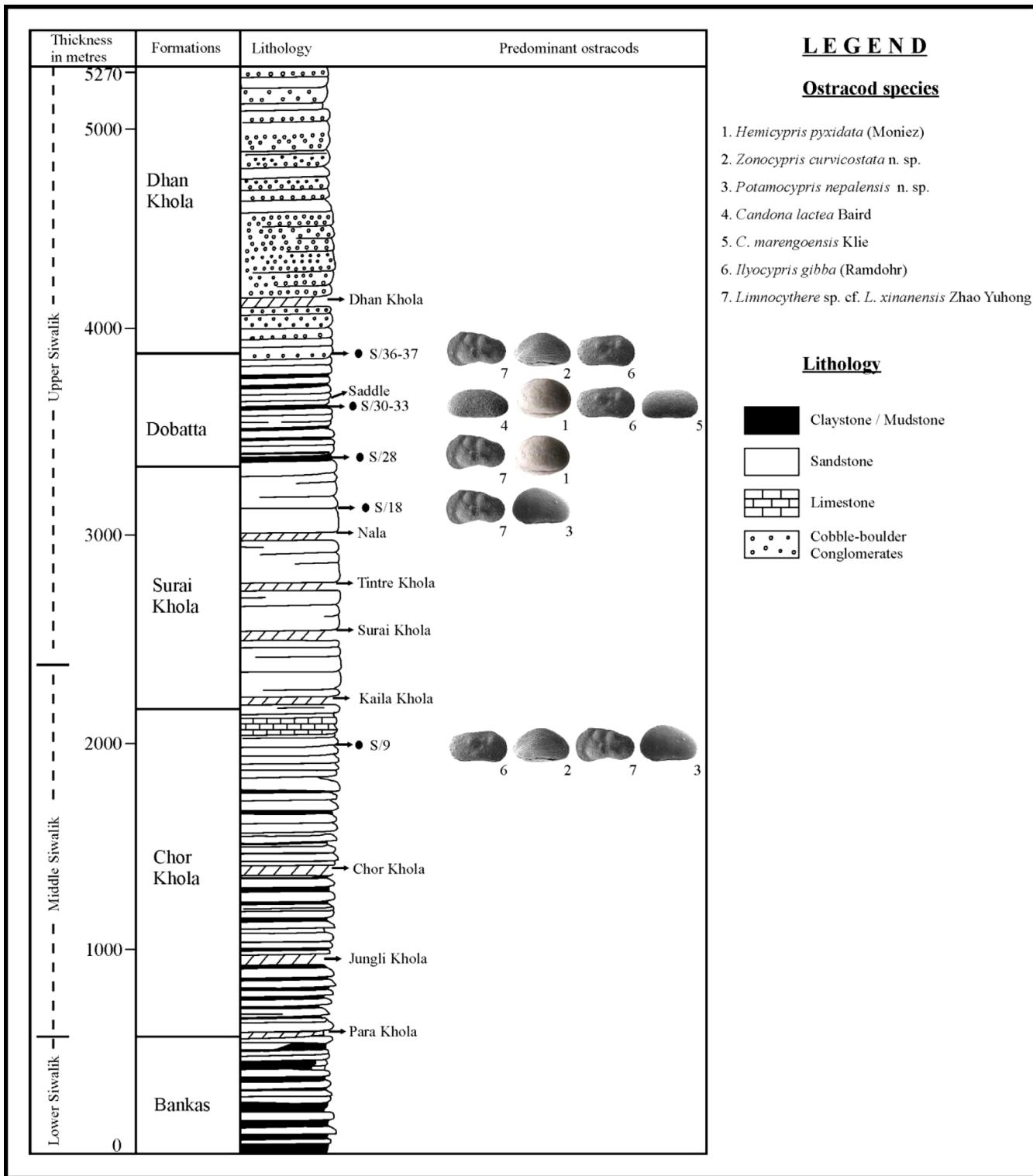
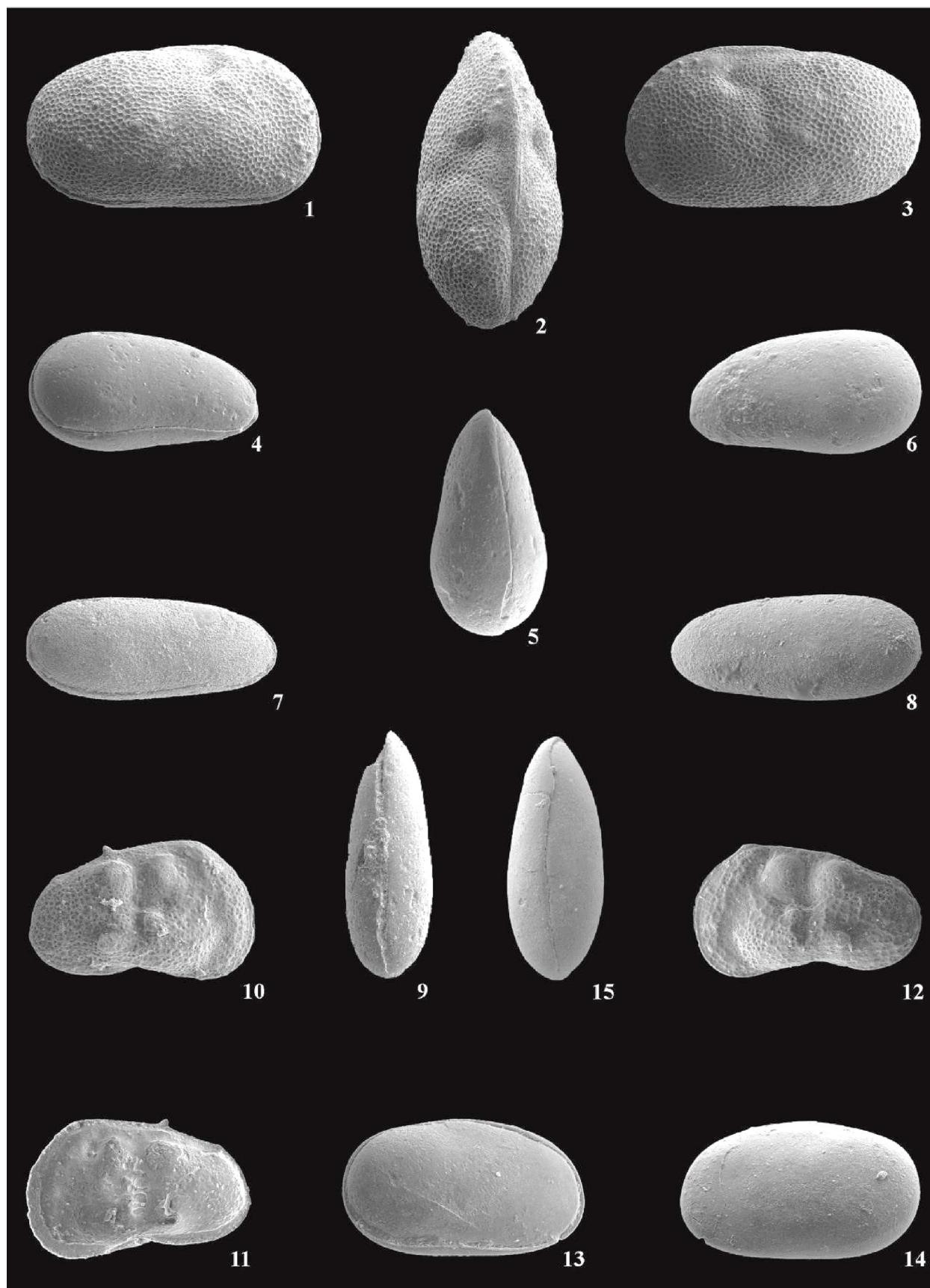
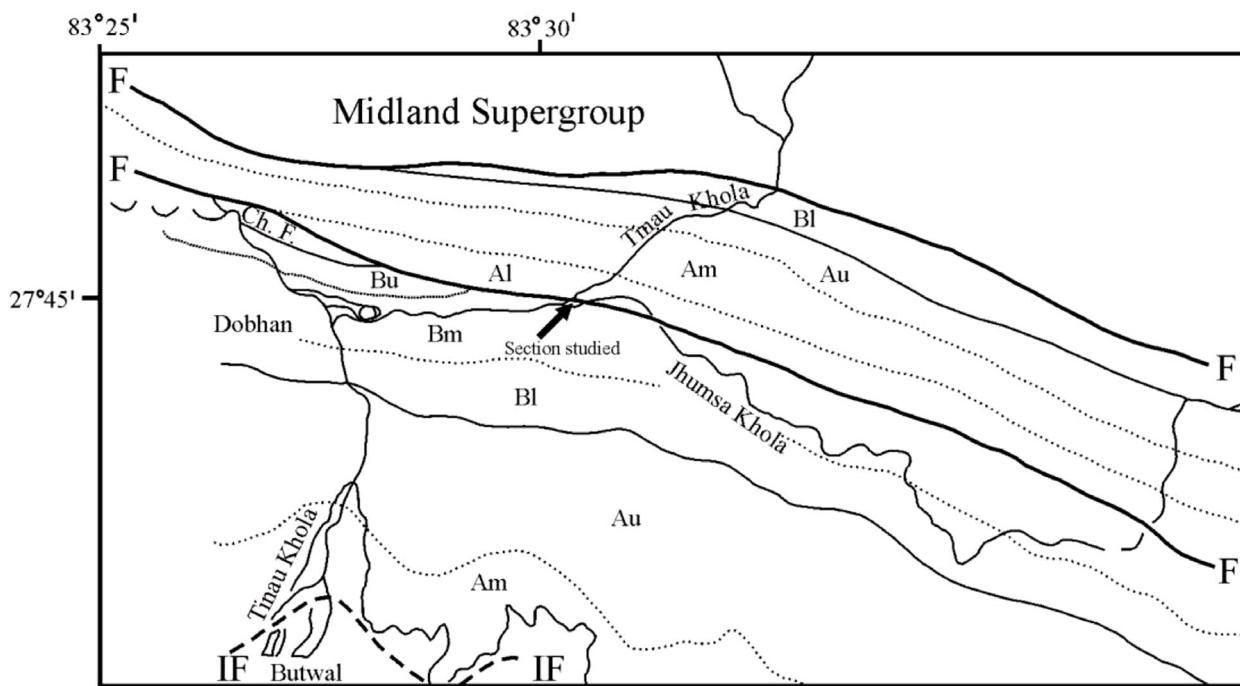


Fig. 2. Stratigraphic sequence of the Siwalik (Churia) Group along Surai Khola Road, Traverse, West Nepal (modified after, Corvinus and Rimal, 2001).

EXPLANATION OF PLATE IV

1-3. *Pelocypris?* sp. Carapace (SUGDMF 1256); 1, right valve view, x 44; 2, dorsal view, x 45; 3, left valve view, x 44. 4-6. *Darwinula* sp. cf. *D. cuneata* Klie, 1939; 4, carapace (SUGDMF 1257), right valve view, x 89; 5-6, carapace (SUGDMF 1258); 5, dorsal view, x 85; 6, left valve view, x 87. 7-9. *Darwinula* sp. 7-8, carapace (SUGDMF 1259); 7, right valve view, x 67; 8, left valve view, x 67; 9, carapace (SUGDMF 1260), dorsal view, x 64. 10-12. *Limnocythere* sp. cf. *L. xinanensis* Zhao; 10-11, right valve (SUGDMF 1261); 10, lateral view, x 93; 11, internal view, x 93; 12, left valve (SUGDMF 1262), lateral view, x 95. 13-15. Genus A sp. Carapace (SUGDMF 1263); 13, right valve view, x 75; 14, left valve view, x 75; 15, dorsal view, x 75.





Ch. F. = Chitwan Formation; Bu = Binai Khola upper Member; Bm = Binai Khola middle Member; Bl = Binai Khola lower Member; Au = Arung Khola upper Member; Am = Arung Khola middle Member; Al = Arung Khola lower Member.

F = Fault; IF = Inferred Fault

Fig. 3. Location of the section studied at the confluence of the Jhumsa Khola and the Tinal Khola (modified after, Tokuoka *et al.*, 1990).

cuneata Klie – have so far been recorded from the Recent sediments and occur only in the upper part of the Binai Khola middle Member.

5. One species – *Limnocythere* sp. cf. *L. xinanensis* Zhao – previously described from the Pleistocene to Recent sediments from Guizhou Yunnan Province, China occurs in both the Siwalik sections studied, more abundantly in the topmost horizon (sample no. S/37) of the Dobatta Formation of Surai Khola Section.
6. Six species – *Hemicypris megalops* Sars, *H. pyxidata* (Moniez), *Candonia lactea* Baird, *C. marencoensis* Klie, *Cypria ophthalmica* (Jurine), and *Ilyocypris gibba* (Ramdohr) – previously recorded widely from the Upper Siwaliks, the Pleistocene Karewas, the Subrecent and the Recent sediments of India occur in the Siwaliks of Surai Khola and the upper part of the Binai Khola middle Member studied.

The overall evidence furnished by the ostracod assemblage suggests that no form is inconsistent with the Upper Siwalik age for the upper part of the Binai Khola middle Member assigned by Tokuoka *et al.* (1990) and the upper part of the Surai Khola and the Dobatta formations assigned by Corvinus and Rimal (2001). The upper part of the Chor Khola Formation (sample no. S/9) has yielded *Z. curvicostata*, *P. nepalensis*, *I. gibba*, and *L. sp. cf. L. xinanensis* which suggest that lower age limit for these species might be extending down to Middle Siwaliks.

SYSTEMATIC PALAEONTOLOGY

The authors have followed the classification of Ostracoda as adopted in Moore and Pitrat (1961). Both diagnosis and descriptions are given in new species. Only brief descriptions are given in species compared with previously known forms, and species left in open nomenclature. Routine descriptions of already well known species have been omitted for sake of brevity. However, brief morphological comments have been given under the heading “Remarks”.

Synonyms are limited to original citation or where taxonomic changes have been made. The specimens illustrated in the paper have been deposited in the Micropalaeontology Laboratory, Mohanlal Sukhadia University, Udaipur, Rajasthan and reference to them are designated in text and plate explanations by SUGDMF 1229-1263. All dimensions are given in mm.

Subclass Ostracoda Latreille, 1806
Order Podocopida Müller, 1894
Suborder Podocopina Sars, 1866
Superfamily Cypridoidea Baird, 1845
Family Cyprididae Baird, 1845
Subfamily Cypridinae Baird, 1845
Genus Cypris Müller, 1776

Cypris whatleyi n. sp.
(Pl. I, figs. 1-7)

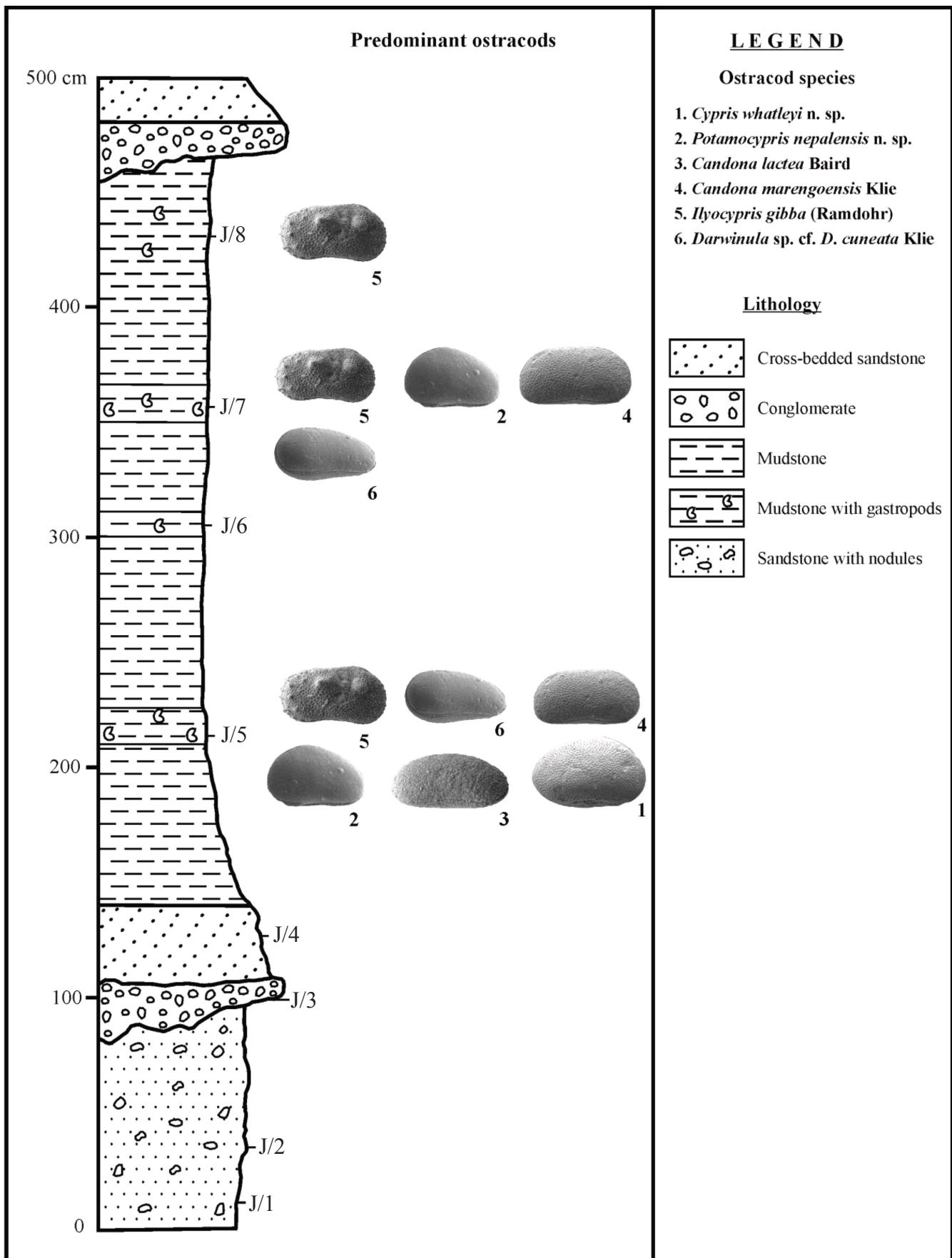


Fig. 4. Columnar section of the upper part of the Binai Khola middle Member at the confluence of the Jhumsa Khola and the Tinau Khola.

Cypris subglobosa Sowerby. - Baird 1859, p. 232, pl. 63, fig. 2.

non Cypris subglobosa Sowerby, in Malcolmson, 1840, pl. 47, fig. 3 (description in plate explanation).

non Paracyprætta subglobosa (Sowerby). Whatley *et al.*, 2003, pp. 1288-1290, pl. 1, figs. 1-19; pl. 2, figs. 1-2, 4; text-fig. 2A-C.

Material: Sixteen specimens from the upper part of the Binai Khola middle Member, at the confluence of the Jhumsa Khola and the Tinau Khola.

Derivation of name: The species is named in memory of the late Professor R. C. Whatley, Micropalaeontology Research Group, Aberystwyth University, Aberystwyth, Cardiganshire, U.K. in recognition of his valuable contributions to our knowledge of the Upper Cretaceous and Palaeocene non-marine Ostracoda of the Peninsular India.

Diagnosis: Carapace very large, elongate-subovate in lateral view, inflated in the dorsal; posterior margin subangulate at mid-height; valve surface densely pitted, pits arranged in concentric pattern.

Holotype: Carapace, SUGDMF 1229 (Pl. I, figs. 1-4).

Description: Carapace very large, elongate-subovate in lateral view, with greatest height about 3/5 of length anterior to middle. Left valve larger than the right, distinctly overlapping it along anterodorsal and mid-ventral margins. Dorsal margin asymmetrically arched sloping down posteriorly; ventral margin concave anteriorly in right valve and straight in the left; anterior margin broad and obliquely rounded; posterior margin narrow, subangulate at mid-height. In dorsal view carapace inflated, with greatest width, exceeding half of length and exceeding height, slightly posterior to middle, anterior end compressed and pointed, posterior end somewhat rounded. Valve surface densely pitted, pits arranged in concentric pattern without striations. Internal characters not known.

Dimensions:

	Length	Height	Width
Holotype, SUGDMF 1229, carapace	1.22	0.72	0.78
Paratype, SUGDMF 1230, carapace (? molt)	0.64	0.42	0.43

Remarks: The specimens recorded herein from the upper part of the Binai Khola middle Member are identical with the forms recorded as *Cypris subglobosa* from the Pleistocene Upper Karewas of Kashmir by Bhatia (1968) and from Jaffna rice-fields, Sri Lanka (Ceylon) by Neale (1976, 1977). Incidentally, this species was originally described by Sowerby (in Malcolmson, 1840) from the Inter-trappean sediments (now considered as Late Cretaceous, Maastrichtian in age) of the Sichel Hills (near Munoor, near Hutnoor and in the Mucklenudy Pass, leading to the Berar Valley), India. Subsequently, Baird (1859) erroneously identified a form collected by Hislop from a freshwater pool in Nagpur as *Cypris subglobosa* extending its stratigraphic age to Recent. Since then, the species has been widely reported from the Recent sediments of tropics/subtropics from the Caribbean through West Africa, the Mediterranean region, Southern ex-USSR, Iran, Afghanistan, India, Ceylon, Indonesia, China and Japan (Martens and Toguebaye, 1985). Whatley *et al.* (2003) during investigation of the type collections in the Natural History Museum, London, made in India during the nineteenth century, rediscovered the syntypes of *Cypris subglobosa* Sowerby, which were earlier reported to have been lost. According to them, this species belongs to the genus

Paracyprætta and confined to the Upper Cretaceous and possibly Palaeocene, non-marine Inter-trappean deposits of the Indian Deccan Volcanic Province. It is very large inflated species with strong laterally compressed anterior margin, minute papillate ornament which is not concentrically orientated nor paralleling the margin, a 'flap' of the LV overlapping the RV in the ocular region and a subtle change in slope in dorsal view between the lateral and anterior surfaces, in dorsal and ventral views, the posterior termination is rather rounded. According to Whatley *et al.* (2003), the Pleistocene and Recent record of this taxon is of a separate species that belongs to the genus *Cypris*. A new specific name *Cypris whatleyi* is proposed here to accommodate the Pleistocene and Recent records of "Cypris subglobosa." Other reported occurrences of the present species from India are: the Karewas of Kashmir (Singh, 1977), the Upper Siwalik of Simla Hills (Mathur, 1972), the Holocene of Bombay-Comorin (Hartmann, 1964), Kutch (Jain, 1979), and the Nagrota Formation, Upper Siwalik Subgroup, Jammu (Bhandari and Kundal, 2008).

Type locality: At the confluence of the Jhumsa Khola and the Tinau Khola.

Type Horizon: Fossiliferous mudstone with gastropod fossils (Sample no. J/7), the upper part of the Binai Khola middle Member.

Genus *Hemicypris* Sars, 1903

Hemicypris megalops Sars, 1903
(Pl. I, figs. 8-10)

Hemicypris megalops Sars, 1903, pp. 27-28, pl. 3, figs. 3, 3a-b.

Material: Single carapace from the upper part of the Binai Khola middle Member (Sample no. J/7), at the confluence of the Jhumsa Khola and the Tinau Khola.

Remarks: The specimen recorded herein from Nepal is assigned to *Hemicypris megalops*. Sars (1903) originally described from northeastern Sumatra. McKenzie (1966) recorded it from northwestern Australia. In India this species has been reported from the Tatrot and the Pinjor formations of Himachal Pradesh and in vicinity of Chandigarh (Bhatia, 1995), dried mud of the Chilka Lake Area (Jain, 1977) and ponds of Punjab (Battish, 1981). It is slightly larger in size than the type specimen. The species is oval in lateral view, with greatest height 3/5 of length near middle; ovate in dorsal view, anterior end more attenuated than the posterior; right valve slightly overlapping the left; dorsal margin evenly arched; ventral margin nearly straight; anterior margin obliquely rounded; posterior margin broader and obtusely truncated; valve surface smooth.

Dimensions:

	Length	Height	Width
Carapace, SUGDMF 1231	1.01	0.58	0.47

Hemicypris pyxidata (Moniez, 1891)
(Pl. I, figs. 11-13)

Cyprinotus pyxidatus Moniez, 1891, p. 134, pl. 10, figs. 23-27.

Material: Ten specimens from the Dobatta Formation, Surai Khola Road Traverse.

Remarks: The present specimens from Nepal are assigned to *Hemicypris pyxidata* (Moniez, 1891). In India the species was first reported from the Pinjor Formation of Siwalik

Group near Chandigarh by Bhatia and Khosla (1967). Thereafter, Bhatia *et al.* (2001) and Bhandari and Kundal (2008) recorded it from the Nagrota Formation, Upper Siwalik Subgroup, Jammu Hills. Recent specimens have been reported from the dried mud of Chilka Lake Area (Jain, 1977), freshwater ponds of Kutch (Jain, 1979), Punjab (Battish, 1981), rice-fields of Sri Lanka (Neale, 1977) and rock pools of Madurai (Victor and Fernando, 1979). The species has following characteristics: carapace large, ovate in lateral view and biconvex in the dorsal; greatest height and width in middle; right valve larger than left valve, overlapping it prominently along anterodorsal, posterior and ventral margins; valve surface pitted; in left valve anteroventral margin fringed with 27 denticles and posteroventral with 17 denticles.

Dimensions:

	Length	Height	Width
Carapace, SUGDMF 1232	0.91	0.66	0.50
Left valve, SUGDMF 1233	0.90	0.56	-
Right valve, SUGDMF 1234	0.91	0.59	-

Genus Strandesia Stuhlmann, 1888

Strandesia hartmanni Mannikeri and Vaidya, 1990
(Pl. I, figs. 14-16)

Strandesia hartmanni Mannikeri and Vaidya, 1990, pp. 19-20, pl. 1, figs. 1a-d.

Material: Three specimens from the upper part of the Binai Khola middle Member at the confluence of the Jhumsa Khola and the Tinau Khola.

Remarks: Carapace large, elongate-ovate in lateral view, and biconvex in the dorsal, ends pointed; greatest height, exceeding half of length, slightly anterior to middle; greatest width, more than height, near middle; left valve slightly larger than the right, overlapping it along dorsal and anterior margins; dorsal margin asymmetrically arched; ventral margin nearly straight; anterior margin broad, obliquely rounded; posterior margin comparatively narrow; valve surface smooth. Except for smaller in size, the specimens recorded herein from the upper part of the Binai Khola middle Member are identical with *Strandesia hartmanni* Mannikeri and Vaidya, 1990 described from Hulkop Pond, 26 km south of Dharwad, north Karnataka. *Strandesia indica* Hartmann, 1964 and *Strandesia elongata* Hartmann, 1964 differs from the present species in having greatest width anterior to middle.

Dimensions:

	Length	Height	Width
Carapace, SUGDMF 1235	0.73	0.42	0.45
Carapace, SUGDMF 1236	0.72	0.40	0.42

Genus Zonocypris Müller, 1898

Zonocypris curvicostata n. sp.
(Pl. II, figs. 1-3)

Material: Thirty-five specimens from the Siwaliks of Surai Khola Road Traverse.

Derivation of name: After the surface ridge pattern.

Diagnosis: Carapace elongate-subtriangular in lateral view and inflated fusiform in the dorsal; valve surface strongly costate; outermost costae concentric, parallel to margin; inner costae convex upwardly in upper half and straight in lower half; both meeting each other anteriorly and posteriorly at acute angles.

Holotype: Carapace, SUGDMF 1237, Pl. II, fig. 1.

Description: Carapace medium, elongate-subtriangular in lateral view, with greatest height exceeding half of length near middle. Left valve slightly larger than the right, overlapping it along anterior margin. Dorsal margin symmetrically arched; ventral margin concave in right valve and straight in the left; anterior margin broadly rounded; posterior margin less so. In dorsal view carapace inflated fusiform, greatest width more than height slightly posterior to middle, anterior end gradually tapering, posterior end rounded. Valve surface strongly costate; outermost 4-5 costae concentric parallel to margin; inner four costae in upper half convex upwardly and in lower half about seven costae straight parallel to ventral margin; both upper and lower inner costae meeting each other anteriorly and posteriorly at acute angles; a few costae bifurcating. Inner lamella wide along anterior and posterior margins. Hinge adont. Other details indistinct.

Dimensions:

	Length	Height	Width
Carapace, SUGDMF 1237	0.53	0.31	0.37
Carapace, SUGDMF 1238	0.52	0.32	0.35
Left valve, SUGDMF 1239	0.54	0.31	-

Remarks: The species closely resembles *Zonocypris madagascarensis* Müller, 1898, described from Majunga, Madagascar in shape and overall surface sculpture. However, unlike the present species, surface costae in *Z. madagascarensis* are by and large arranged in concentric pattern. *Zonocypris barakhetarensis* Bhandari and Kundal, 2008, described from the Nagrota Formation, Upper Siwalik Subgroup, Jammu is also very similar species but like *Z. madagascarensis* it is too ornamented by 13-14 very fine concentrically arranged spiral costae.

Zonocypris cordata Sars, 1924, described from Cape Town, South Africa also resembles present species in outline but differs in having surface coarsely sculptured with numerous closely set knob-like tubercles arranged in concentric rows. Comparison between the present species and *Zonocypris costata* (Vávra) Sars recorded by Bhatia and Khosla (1967) from the Upper Siwaliks near Chandigarh is not possible as the latter species is very poorly illustrated; otherwise the types of *Z. costata* are ornamented by numerous concentrically arranged costae.

Type locality: Surai Khola Road Traverse southeast of Dang District, West Nepal.

Type Horizon: Mudstone towards the top of Dobatta Formation (sample no. S/37).

Subfamily Cypridopsinae Kaufmann, 1900

Genus Potamocypris Brady, 1870

Potamocypris nepalensis n. sp.

(Pl. II, figs. 4-6)

Potamocypris sp. Khosla *et al.*, 1995, fig. 3f.

Material: Thirty specimens from the upper part of the Binai Khola middle Member at the confluence of the Jhumsa Khola and the Tinau Khola and 7 from the Siwaliks of the Surai Khola Road Traverse.

Derivation of name: After Nepal from where the species is being described.

Diagnosis: Carapace subtriangular in lateral view; greatest height 2/3 of length anterior to middle; ventral margin in left valve compressed at anteroventral part extending over right valve; valve surface smooth.

Holotype: Carapace, SUGDMF 1240, Pl. II, fig. 4.

Description: Carapace medium, subtriangular in lateral view, with greatest height 2/3 of length anterior to middle. Right valve larger than the left, overlapping it along anterodorsal and ventral margins. Dorsal margin asymmetrically arched, sloping down posteriorly; ventral margin in left valve compressed at anteroventral part extending over right valve, otherwise slightly concave, in right valve ventral margin straight; anterior margin broad and rounded; posterior much less so. In dorsal view carapace compressed, greatest width less than half of length in middle, anterior end pointed, posterior somewhat rounded. Valve surface smooth.

Dimensions:

	Length	Height	Width
Holotype, carapace, SUGDMF 1240	0.51	0.34	0.21
Paratype, carapace, SUGDMF 1241	0.51	0.33	0.21

Remarks: The species has already been recorded from the Siwalik Group of Surai Khola Section in open nomenclature by Khosla *et al.* (1995). *Potamocypris nepalensis* n. sp. resembles *P. minuta* Staplin, 1963, described from the Pleistocene of Illinois in overall shape and size. *P. minuta*, however, differs from the present species in having finely reticulate valve surface and dorsal margin obtusely angled at the highest point. The species also differs from *Potamocypris minuta patriciae* Bhatia, 1968 described from the Pleistocene Upper Karewas of Kashmir in having less concave ventral margin, more broadly rounded posterior extremity, compressed anteroventral margin in left valve extending over right valve, and lack of any surface reticulation; from *Potamocypris smaragdina* (Vávra) recorded from Leh in India by Malik and Shah (1990) in having anterodorsal and posterodorsal margins steeply sloping down towards respective ends from the angulated highest point on dorsal margin. *Potamocypris* sp. A described by Jain (1977) from the dried mud of Chika Lake Area is very similar to *P. nepalensis* and possibly belongs to it.

Type locality: At the confluence of the Jhumsa Khola and the Tinau Khola.

Type Horizon: Highly fossiliferous mudstone with gastropod fossils (Sample no. J/5), the upper part of the Binai Khola middle Member.

Potamocypris sp. cf. *P. islagrandensis nicaraguensis*

Hartmann, 1959

(Pl. II, figs. 7-9)

Potamocypris islagrandensis Hoff subsp. *nicaraguensis* Hartmann, 1959, pp. 279-281, tf. 4, figs. 16-21.

Material: Four specimens from the upper part of the Binai Khola middle Member at the confluence of the Jhumsa Khola and the Tinau Khola.

Description: Carapace medium, subtriangular in lateral view, and compressed in the dorsal; greatest height about 2/3 of length near middle, width less than half of length slightly anterior to middle; right valve overlapping the left along dorsal and ventral margins but left valve extends beyond right valve along anterior margin; dorsal margin symmetrically arched; ventral margin concave; anterior and posterior margins rounded, anterior extremity pointed, posterior rounded; valve surface smooth.

Dimensions:

	Length	Height	Width
Carapace, SUGDMF 1242	0.53	0.31	0.19

Remarks: The specimens recorded herein are closely comparable with *Potamocypris islagrandensis* Hoff subsp. *nicaraguensis* Hartmann, 1959, described from Lake Nicaragua, south of the city of Granada, Nicaragua in shape and size.

Subfamily Candoninae Dady, 1900

Genus Candona Baird, 1845

Candona lactea Baird, 1850

(Pl. II, figs. 12-14)

Candona lactea Baird, 1850, p. 255, pl. 18, figs. 25-27.

Material: Forty-six specimens from the Siwaliks of Surai Khola Road Traverse and nineteen from the upper part of the Binai Khola middle Member at the confluence of the Jhumsa Khola and the Tinau Khola.

Remarks: The species has already been recorded from the Siwaliks of Surai Khola Road Traverse by Khosla *et al.* (1995). Elsewhere in India it has been reported from the Pinjor Formation, Upper Siwaliks near Chandigarh (Bhatia and Khosla, 1967), the Upper and Lower Karewas of Kashmir (Bhatia, 1968, 1969), Vale of Kashmir (Bhatia and Singh, 1971), the Tatrot Formation near Pinjor (Mathur, 1972), the Sub-Recent Marlstone of Southern Haryana (Bhatia and Khosla, 1977), and the Nagrota Formation, Upper Siwalik Subgroup, Jammu Hills (Bhatia *et al.*, 2001). The carapace small, subreniform outline, the narrow duplicature, and the prominent normal pore canals are characteristic of this species.

Dimensions:

	Length	Height	Width
Carapace, SUGDMF 1243	0.49	0.24	0.18
Carapace, SUGDMF 1244	0.53	0.28	0.18

Candona marengoensis Klie, 1931

(Pl. III, figs. 1-3)

Candona marengoensis Klie, 1931, pp. 337, 341-343, figs. 13-16.

Material: Thirty-nine specimens from the upper part of the Binai Khola middle Member at the confluence of the Jhumsa Khola and the Tinau Khola and the 3 specimens from the Surai Khola Formation, Surai Khola Road Traverse.

Remarks: The specimens recorded herein are identical with *Candona marengoensis* Klie, 1931. The species has following characteristics: Carapace small, subquadrate in lateral view; greatest height posterior to middle; valve surface reticulate. In India the species has previously been recorded from the Lower Karewas of Kashmir (Bhatia, 1969), the Manasbal lake of Kashmir (Bhatia and Singh, 1971), the Late Pleistocene terrace of Nalagarh, Himachal Pradesh (Bhatia and Mathur, 1971), Tatrot Formation near Pinjor (Mathur, 1972), the Sub-Recent Marl bed of Southern Haryana (Bhatia and Khosla, 1977), the Pleistocene Karewas and Recent of Kashmir (Singh, 1977) and the Quaternary lacustrine deposits of Ladakh (Malik and Shah, 1990).

Dimensions:

	Length	Height	Width
Carapace, SUGDMF 1245	0.50	0.26	0.18
Carapace, SUGDMF 1246	0.50	0.26	0.18

Genus Herpetocypris Brady and Norman, 1889

Herpetocypris sp.
(Pl. III, figs. 4-6)

Material: Six specimens from the upper part of the Binai Khola middle Member at the confluence of the Jhumsa Khola and the Tinau Khola.

Description: Carapace large, elongate-ovate in lateral outline, with greatest height slightly exceeding half of length posterior to middle. Left valve larger than right valve, except for the anterior overlapping all along margin. Dorsal margin medially straight, evenly curving down posteriorly, while straight sloping down anteriorly, making a cardinal angle; ventral margin slightly sinuate; anterior margin narrow, obliquely rounded; posterior somewhat truncated, broadly rounded. In dorsal view carapace moderately compressed, greatest width, less than 2/5 of length and about 3/4 of height, posterior to middle, anterior end pointed, posterior subrounded. Valve surface faintly pitted. Inner lamella wide along anterior and posterior ends. Other internal details not known.

Dimensions:

	Length	Height	Width
Carapace, SUGDMF 1247	0.72	0.38	0.27

Remarks: The species closely resembles *Herpetocypris reptans* (Baird, 1835) in overall shape but differs in being much smaller in size. The length of latter species is ± 2 mm, which is only 0.72 mm in the present species. Moreover, anterior and posterior margins in *H. reptans* are more obliquely drawn out ventrally.

Family *Cyclocyprididae* Kaufmann, 1900*Genus Cypria* Zenker, 1854

Cypria ophthalmica (Jurine)
(Pl. II, figs. 10-11)

Monoculus ophthalmicus Jurine, 1820, p. 178, pl. 19, figs. 16-17.

Cypria ophthalmica (Jurine), Müller, 1900, p. 43, pl. 11, figs. 1-6.

Material: Single carapace from the Siwaliks (S/36) of Surai Khola Road Traverse.

Remarks: This species has already been recorded from the Surai Khola Road Traverse, West Nepal. In India the species has been reported from the Upper Karewas (Bhatia, 1968), and Vale of Kashmir (Bhatia and Singh, 1971).

Dimensions:

	Length	Height	Width
Carapace, SUGDMF 1248	0.46	0.29	0.22

Family *Eucandonidae* Swain, 1962*Genus Candonopsis* Vávra, 1891

Candonopsis sp. cf *C. dorsorecta* Rome, 1962
(Pl. III, figs. 7-9)

Candonopsis dorsorecta Rome, 1962, pp. 13, 15, 16, tf. 3, figs. A-I.

Material: Eleven specimens from the upper part of the Binai Khola middle Member (sample no. J/5) at the confluence of the Jhumsa Khola and the Tinau Khola.

Description: Carapace large, oblong reniform in lateral view, with greatest height half of length in posterior 1/3. Left valve larger than the right, overlapping it along anterodorsal, posterior and ventral margins. Dorsal margin medially straight, somewhat ascending posteriorly, then abruptly curving down on its two ends; ventral margin concave; anterior and posterior

margins obliquely rounded, anterior narrowly rounded, posterior more broadly rounded. In dorsal view carapace lanceolate in outline, greatest width less than height near middle, end pointed. Valve surface smooth.

Dimensions:

	Length	Height	Width
Carapace, SUGDMF 1249	0.94	0.45	0.37
Carapace, SUGDMF 1250	0.88	0.44	0.34

Remarks: The specimens recorded from Nepal closely resembles *Candonopsis dorsorecta*, Rome, 1962, a Recent species from Tanzania, in lateral outline and size (length 0.97, height 0.47). The species also resembles *Candonopsis brasiliensis* Sars, 1901, a Recent species from Brazil in lateral outline but it is smaller in size (length 0.78) and very compressed dorsally.

Candonopsis kingsleyi Brady and Robertson, 1870

(Pl. III, figs. 10-12)

Candonia kingsleyi Brady and Robertson, 1870, p. 17, pl. 9, figs. 9-12.

Candonopsis kingsleii (Brady and Robertson). Vávra, 1891, p. 162.

Material: Nine specimens from the upper part of the Binai Khola middle Member at the confluence of the Jhumsa Khola and the Tinau Khola.

Remarks: The species has following characteristics: carapace medium, elongate reniform in lateral view and lensoid in dorsal; greatest height less than half of length posterior to middle; width 2/3 of height near middle; dorsal margin broadly arched, ventral margin sinuate; extremities rounded, posterior broader than anterior. In India the species has previously been reported from the Lower Karewas of Kashmir (Bhatia, 1969), the Vale of Kashmir (Bhatia and Singh, 1971), the Late Pleistocene terrace of Nalagarh, Himachal Pradesh (Bhatia and Mathur, 1971), the Tatrot Formation near Pinjor (Mathur, 1972), the Subrecent Marl Bed of Southern Haryana (Bhatia and Khosla, 1977), the Pleistocene (Karewas) and Recent of Kashmir (Singh, 1977), and the Quaternary lacustrine deposits of Ladakh (Malik and Shah, 1990).

Dimensions:

	Length	Height	Width
Carapace, SUGDMF 1251	0.62	0.29	0.19

Family *Ilyocyprididae* Kaufmann, 1900Subfamily *Ilyocypridinae* Kaufmann, 1900*Genus Ilyocypris* Brady and Norman, 1889

Ilyocypris gibba (Ramdohr, 1808)
(Pl. III, figs. 13-18)

Cypris gibba Ramdohr, 1808, pp. 91, 92, pl. 3, figs. 13, 14, 17.

Ilyocypris gibba (Ramdohr). Brady and Norman, 1889, p. 107, pl. 22, figs. 1-5.

Material: Eighty-seven specimens from the upper part of the Binai Khola middle Member at the confluence of the Jhumsa Khola and the Tinau Khola and 41 specimens from Siwaliks of Surai Khola Road Traverse.

Remarks: The species has following characteristics: Carapace large, subquadrate in lateral view, elliptical-subovate in the dorsal; greatest height in anterior one fourth and width posterior to middle, anterior end pointed, posterior rounded; left valve larger than the right; valve surface covered by dense honeycomb reticulation, two sulci, a long anterodorsal and a short

mid-dorsal, two nodes/lobes in anterodorsal and dorsomedian regions, posterior region with two rows of spines, one along posterior extremity varying from 5-8 spines, other somewhat away in mid-posterior region, 3-4 spines, anterior extremity also studded with 8-9 spines.

The species exhibits two variants (i) with low anterodorsal and mid-dorsal nodes, (ii) with prominent nodes, mid-dorsal node drawn into backwardly directed spine. But for these differences in node patterns the two variants are perfectly identical in outline, surface reticulations and marginal spines. Considering the phenotypic nature of nodes both the variants are assigned herein this work to *Ilyocypris gibba* (Ramdohr, 1808). This species has already been recorded from the Siwalik Group of Surai Khola Section (Khosla *et al.*, 1995). In India this has been reported from the Lower Karewas of Kashmir (Bhatia, 1969), the Tatrot Formation near Pinjor (Mathur, 1972), the Recent of Punjab and Union Territory of Chandigarh (Bhatia and Singh, 1977), the Plio-Pleistocene and Recent of Kashmir (Singh, 1977), and the dried mud from Chilka Lake Area (Jain, 1977).

Dimensions:

	Length	Height	Width
Carapace, SUGDMF 1252	0.72	0.38	0.29
Carapace, SUGDMF 1253	0.75	0.38	0.32
Right valve, SUGDMF 1254	0.70	0.37	-
Right valve, SUGDMF 1255	0.70	0.38	-

Genus Pelocypris Klie, 1939

Pelocypris? sp.
(Pl. IV, figs. 1-3)

Material: Three specimens from the upper part of the Binai Khola middle Member at the confluence of the Jhumsa Khola and the Tinau Khola.

Description: Carapace very large, subquadrate in lateral outline, with greatest height at anterior one third, exceeding half of length. Left valve larger than the right, and except for the dorsal, overlapping it all along margin. Dorsal margin weakly arched anteriorly, posterodorsal obscured by valve inflation; ventral margin straight; anterior margin evenly rounded; posterior margin narrow, rounded. In dorsal view carapace moderately inflated, constricted in front of middle, greatest width less than half of length, and also less than height, posterior to middle, anterior end compressed, pointed, posterior rounded. Valve surface densely pitted, with sparsely superimposed small nodes all over the surface; anterodorsal sulcus distinct. Other details not known.

Dimensions:

	Length	Height	Width
Carapace, SUGDMF 1256	1.15	0.64	0.51

Remarks: The species resembles *Pelocypris zilchi* Triebel, 1953 described from the Barrance El Sisimico, northeast of Vulkan San Vicente, El Salvador in overall lateral outline but differs in lack of mid-dorsal sulcus. The species is left in open nomenclature for want of open valves.

Superfamily Darwinuloidea Brady and Norman, 1889

Family Darwinulidae Brady and Norman, 1889
Genus Darwinula Brady and Robertson, 1885

Darwinula sp. cf. *D. cuneata* Klie, 1939
(Pl. IV, figs. 4-6)

Darwinula cuneata Klie, 1939, pp. 149-151, figs. 66-72.

Material: Fifty-nine specimens from the upper part of the Binai Khola middle Member at the confluence of the Jhumsa Khola and the Tinau Khola.

Description: Carapace small, elongate-subovate in lateral view; fusiform, inflated in the dorsal; greatest height half of length, and width in posterior half; left valve larger than the right, overlapping it distinctly along posterior and ventral margins; dorsal margin arched sloping down anteriorly; ventral margin slightly concave; posterior margin broadly rounded; anterior margin much less so; valve surface smooth.

Dimensions:

	Length	Height	Width
Carapace, SUGDMF 1257	0.45	0.23	0.21
Carapace, SUGDMF 1258	0.46	0.23	0.22

Remarks: The specimens recorded herein closely resemble *Darwinula cuneata* Klie, 1939 described from Kenya in shape and size. The species also resembles *Darwinula incae* Delachaux, redescribed by Rossetti *et al.* (1996), in overall shape but is much smaller in size. The latter species is 0.77-0.80 mm long.

Darwinula sp.
(Pl. IV, figs 7-9)

Material: Three specimens from the upper part of the Binai Khola middle Member (Sample no. J/5) at the confluence of the Jhumsa Khola and the Tinau Khola.

Description: Carapace medium, elongate-subcylindrical in lateral view, fusiform in the dorsal, anterior end pointed, posterior rounded; greatest height 2/5 of length, and width in posterior half. Left valve larger than the right, overlapping it all along margin, more prominently along ventral and posterior margins. Dorsal margin weakly arched; ventral margin nearly straight in left valve and slightly concave anteriorly in the right; posterior margin broad, rounded in upper part and sloping down ventrally in lower part; anterior margin narrowly rounded. Valve surface smooth.

Dimensions:

	Length	Height	Width
Carapace, SUGDMF 1259	0.66	0.26	0.21
Carapace, SUGDMF 1260	0.67	0.26	0.21

Remarks: The species resembles *Darwinula incurva* Bate, redescribed by Wakefield (1990) in overall shape and overlap but lacks ventral inflexure anterior to middle. Unlike the present species posterior margin in *D. incurva* is evenly rounded. The type species *Darwinula stevensoni* Brady and Robertson, 1885 (in: Jones, 1885, p. 346) differs from this species in having reverse overlap, i.e. right valve larger than left valve. *Darwinula* sp. differs from *D. sp. cf. D. cuneata* described herein this work in being larger in length and less inflated dorsally.

Superfamily Cytheroidea Baird, 1850
Family Limnocytheridae Klie, 1938
Genus Limnocythere Brady, 1868

Limnocythere sp. cf. *L. xinanensis* Zhao, 1987
(Pl. IV, figs. 10-12)

Limnocythere xinanensis Zhao, 1987, pp. 127-130, pl. 14, 128, figs. 1-2; pl. 14, 130, figs. 1-2.

Material: Forty-eight specimens from the Siwaliks of Surai Khola Road Traverse and 6 specimens from the upper part of the Binai Khola middle Member at the confluence of the Jhumsa Khola and the Tinau Khola.

Description: Carapace small, reniform in lateral view, with greatest height about 3/5 of length at anterior cardinal angle. Left valve slightly larger than the right. Dorsal margin weakly arched or irregular, sloping down posteriorly; ventral margin strongly concave medially; anterior margin broad, obliquely rounded; posterior margin 2/3 of anterior margin and rounded. In dorsal view both ends pointed, tubercles protruding backwardly. Valve surface marked by two sulci, a prominent median vertical one, other an arcuate anterior marginal; two tubercles each on either side of median sulcus; dorsal tubercles large, prominent and at about same level; ventral tubercles much smaller in size; tubercle in front of the sulcus in median region other behind the sulcus at lower level in ventromedian region; rest of the area covered by primary and secondary reticulations. Hinge merodont, in right valve consisting of two terminal teeth connected by median groove. Inner lamella moderately wide. Central muscle scars appear to comprise a vertical row of four adductor scars centrally placed on the ridge which represents the expression of the median sulcus internally, and two frontal scars.

Dimensions:

	Length	Height	Width
Right valve, SUGDMF 1261	0.42	0.27	-
Left valve, SUGDMF 1262	0.42	0.25	-

Remarks: The specimens recorded herein from Nepal compare well with *Limnocythere xinanensis* Zhao, 1987 described from the Pleistocene to Recent sediments from Guizhou Yunnan Province, China in overall shape, size and surface ornamentation. The only minor difference between them and the types of *L. xinanensis* is that the types, besides having the four nodes present in the specimens from Nepal, have an additional small node above the ventral node in front of the median sulcus. This may be because of either due to some chronological or paleoecological differences. *Limnocythere franki* Bhatia, 1968, described from the Pleistocene Upper Karewas of Kashmir resembles this species in surface reticulation and having medially concave ventral margin but differs in having straight dorsal margin, anterior and posterior margins equally rounded, and mid-dorsal lobe and a faint node close to the dorsomedian area, and ventromedian area with a large, blunt posteriorly and somewhat laterally directed hollow spine. Other *Limnocythere* species – *L. bhatiae* Mathur, 1972, *L. bhatiae indica* Mathur, 1977, and *L. jaini* Mathur, 1976 – described from the Siwalik Group of India readily differ from *L. sp. cf. L. xinanensis* in surface ornamentation. Former three species lack two tubercles each on either side of median sulcus present in latter species and instead have, besides other ornamental features, a mid-dorsal lobe and ventral ridge curving from anteroventral region up to mid-posterior, gradually rising narrowing posteriorly. *Limnocythere* sp. recorded from the upper Siwaliks, near Chandigarh by Bhatia and Khosla (1967) belongs to this species.

Genus A
(Pl. IV, figs. 13-15)

Material: Single specimen from the Siwaliks (sample no. S/37) of the Surai Khola Road Traverse.

Remarks: The species is subrectangular in lateral view and biconvex in the dorsal; greatest height more than half of length near middle and greatest width posterior to middle. Left valve larger than the right, overlapping it all along margin. Dorsal margin weakly arched; ventral margin straight; anterior margin

obliquely rounded; posterior evenly rounded. Valve surface smooth. The species resembles *Hemicypris bairdi* Martens and Wouters (1985) in overall lateral and dorsal outlines but differs in having left valve larger than the right. The species resembles *Cyprinotus* species in overlap but differs in having subrectangular lateral outline. The species is left in open nomenclature for want of additional material.

Dimensions.

	Length	Height	Width
Carapace 1263	0.56	0.31	0.22

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