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Dr. K. VENKATARAMAN

Director

Zoological Survey of India

AN APPEAL

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Dr. K. VENKATARAMAN
Director
Zoological Survey of India



DENSITY AND DISTRIBUTION OF MEIOFAUNA OF TAMILNADU COAST

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INTRODUCTION

The meiofauna inhabiting the different sediment habitat of Tamilnadu was studied. A brief description of the density, sediment characters, total organic carbon, and vertical distribution in different sediment habitats, diversity and cluster analysis is given. All the typical meiofauna groups are present. A quantitative estimate of the diverse taxonomic groups encountered is given. The density of total meiofauna individuals in these intertidal sediments ranged from 26 animals/100 cm³ to 1440 animals/100 cm³. A list of 101 spp. collected from Tamilnadu is given. Several genera and species regarded as widespread and cosmopolitan were recorded. The evidence that several meiofauna species are widely distributed and any future

investigations of the unexplored areas are likely to indicate a closer meiofaunal relationship is supported. The distribution of meiofauna is discussed in relation to the nature of the substratum.

ENVIRONMENTAL VARIABLES

SEDIMENT CHARACTERISTICS

The median particle size at all stations ranged between 2 ϕ (0.250 mm) and 3 ϕ (0.125 mm) thereby indicating that it contained median sand (Table 1a, b). The median particle size of sandy sediment fluctuated between 2.25 and 2.5 Md ϕ , muddy sediment between 2.3 and 2.75 Md ϕ , muddy sediment with seagrass bed between 2.7 and 2.75 Md ϕ and sandy sediment with rocky environment between 2.0 and 2.25 Md ϕ (Table 1a, b).

Table 1a. Percentage composition of sediment texture (%) and mean densities of meiofauna (n/10 cm²) of Tamil Nadu coast during 2006.

Sediment types and Fauna	Stations											
	1	2	3	4	5	6	7	8	9	10	11	12
Sediment types												
Sand (%)	96.4	92.2	91.1	86.9	81.7	84.6	83.0	88.0	87.2	89.8	90.1	97.2
Silt & clay (%)	3.6	7.8	8.9	13.1	18.4	15.4	17.0	12.0	12.8	10.2	9.9	2.8
Md ϕ	2.3	2.3	2.5	2.65	2.75	2.7	2.7	2.5	2.55	2.6	2.4	2.0
Fauna												
Nematodes	244	326	304	580	269	708	824	217	502	536	210	238
Harpacticoids	109	238	223	166	110	298	212	78	201	193	116	120
Foraminiferans	116	152	144	107	92	124	160	67	135	146	119	85
Polychaetes	49	45	77	47	29	24	32	48	45	56	51	36

Oligochaetes	190	80	45	-	70	314	340	50	-	-	-	12
Ostracods	26	40	30	12	20	20	22	24	24	16	30	42
Gastrotrichs	-	4	15	-	-	-	-	-	-	-	4	8
Turbellarians	-	15	45	-	-	-	-	-	-	-	-	25
Isopods	-	116	122	-	-	-	15	-	-	-	-	22
Total	734	1016	1005	912	590	1488	1605	484	907	947	530	588

The Mdø values showed a greater fluctuation in sandy sediments than in muddy sediments. It was also observed that the sediment in stations 4-8, 10-11 had finer sediments than in stations 1-3, 9 and 12 (Table 1a, b).

All stations of sandy environment had little silt and clay content (3.6-8.9%), except station 9

(Mandapam), where high silt and clay content (12.8-13.1%) was observed (Table 1a, b).

Areas with muddy (9.1-18.4%) and muddy with seagrass bed (15.4-18.0%) cover had a higher silt and clay content compared to sandy environment (Table 1a, b). Station 12 which was sandy with rocky environment had very less silt and clay content.

Table 1b. Percentage composition of sediment texture (%) and mean densities of meiofauna (n/10 cm²) of Tamil Nadu coast during 2007.

Sediment types and Fauna	Stations											
	1	2	3	4	5	6	7	8	9	10	11	12
Sediment types												
Sand (%)	95.7	92.8	91.5	87.3	89.2	83.4	82.0	88.1	86.9	90.4	90.9	97.9
Silt & clay (%)	4.3	7.2	8.5	12.7	10.8	16.6	18.0	11.9	13.1	9.6	9.1	2.1
Md ø	2.25	2.3	2.45	2.6	2.6	2.7	2.75	2.45	2.6	2.3	2.4	2.25
Fauna												
Nematodes	260	422	434	410	150	1008	800	245	675	575	280	298
Harpacticoids	109	138	250	155	45	540	355	55	240	230	125	134
Foraminiferans	87	132	120	120	32	234	275	45	120	150	108	98
Polychaetes	55	40	55	67	58	78	55	70	25	68	75	45
Oligochaetes	240	246	34	15	90	145	120	90	15	25	45	34
Ostracods	15	25	45	42	20	42	95	8	32	20	24	32
Gastrotrichs	-	12	15	-	-	-	-	-	-	-	-	-
Turbellarians	-	-	6	-	-	-	-	-	-	-	-	4
Isopods	-	95	155	20	-	5	125	-	12	15	4	12
Total	766	1110	1114	829	395	2052	1825	513	1119	1083	661	657

The composition of meiofauna in Tamil Nadu coast is mostly related to grain size. The sediment characteristic of muddy sediments with seagrass bed cover had a high silt and clay content with a corresponding higher density of meiofauna. Sediment with higher silt and clay content is mainly inhabited by burrowers such as nematodes and oligochaetes (Table 1a, b).

TOTAL ORGANIC CARBON CONTENT

The variation in the sediment organic carbon values in the present study, showed considerable similarity at stations 4 to 8, 10 and 11, which had a muddy sediment (Fig. 1), while stations 1 to 3, 9 and 12 (sandy environment) differed from muddy (stations 4 to 8 and 10 to 11) environment (Fig. 1).

The minimum sediment organic carbon content (5.02-7.42 mg C/g) was observed at sandy sediments and maximum (5.21-9.73 mg C/g) in muddy sediments (Fig. 1).

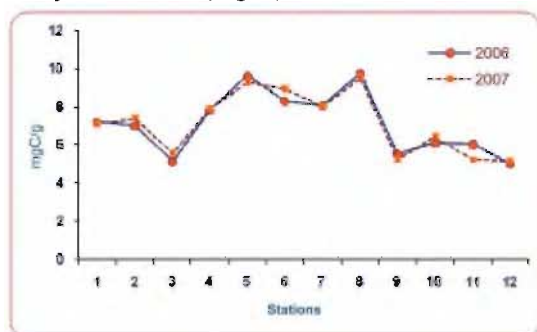


Fig. 1. Variations in total organic carbon content of Tamil Nadu coast during 2006 and 2007.

The highest value of organic content (9.73 mg C/g and 9.51 mg C/g during 2006 and 2007 respectively)

was recorded at station 8 in Tuticorin Port (Fig. 1). In general, the total organic carbon content increased with increasing silt and clay content.

MEIOFAUNAL TAXA

TOTAL DENSITY OF MEIOFAUNA

Nine major meiofaunal taxa were identified, namely nematodes, harpacticoid copepods, foraminiferans, polychaetes, oligochaetes, ostracods, gastrotrichs, turbellarians and isopods from intertidal areas of Tamil Nadu coasts. Among the twelve stations studied, minimum (155 individuals/10 cm²) meiofaunal density was observed at station 4 (Appendix II, Table 5) and maximum (3128 individuals/10 cm²) at station 6. The values are an average of five replicates in each station (Appendix II, Tables 2 to 13).

Appendix II

Table 2. Density of meiofauna communities (individuals/10 cm²) at Station 1 during 2006 and 2007.

2006

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Nematodes	220	145	225	450	180	1220	244	119.66
2	Harpacticoid copepods	120	145	90	85	105	545	109	24.34
3	Foraminiferans	24	105	56	285	110	580	116	100.97
4	Polychaetes	139	25	45	4	32	245	49	52.45
5	Oligochaetes	259	90	178	345	78	950	190	113.44
6	Ostracods	12	50	64	-	4	130	26	29.05
	Total	774	560	658	1169	509	3670	734	263.39

2007

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Nematodes	360	130	470	250	90	1300	260	158.11
2	Harpacticoid copepods	60	80	215	85	105	545	109	61.38
3	Foraminiferans	24	105	45	151	110	435	87	51.68
4	Polychaetes	139	25	75	4	32	275	55	53.59
5	Oligochaetes	310	110	462	240	78	1200	240	155.99
6	Ostracods	12	-	59	-	4	75	15	25.08
	Total	905	450	1326	730	419	3830	766	372.32

Table 3. Density of meiofauna communities (individuals/10 cm⁻²) at Station 2 during 2006 and 2007.

2006

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Nematodes	425	199	135	326	545	1630	326	166.11
2	Harpacticoid copepods	310	157	98	228	397	1190	238	119.09
3	Foraminiferans	150	72	98	220	220	760	152	68.13
4	Polychaetes	19	45	59	12	90	225	45	31.57
5	Oligochaetes	170	23	16	140	51	400	80	70.51
6	Ostracods	64	20	10	32	74	200	40	27.82
7	Gastrotriches	12	8	-	-	-	20	4	5.66
8	Turbellarians	45	24	-	2	4	75	15	19.34
9	Isopods	130	20	48	180	202	580	116	79.89
	Total	1325	568	464	1140	1583	5080	1016	484.19

2007

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Nematodes	650	750	210	175	325	2110	422	262.17
2	Harpacticoid copepods	120	190	96	45	239	690	138	76.88
3	Foraminiferans	175	160	95	120	110	660	132	34.02
4	Polychaetes	68	12	45	-	75	200	40	33.23
5	Oligochaetes	475	385	150	45	175	1230	246	177.78
6	Ostracods	40	-	32	12	41	125	25	18.19
7	Gastrotriches	12	43	-	5	-	60	12	18.01
8	Isopods	45	175	120	-	135	475	95	70.98
	Total	1585	1715	748	402	1100	5550	1110	553.19

Table 4. Density of meiofauna communities (individuals/10 cm⁻²) at Station 3 during 2006 and 2007.**2006**

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Nematodes	605	245	95	125	450	1520	304	218.59
2	Harpacticoid copepods	475	180	80	120	260	1115	223	156.35
3	Foraminiferans	340	110	65	90	115	720	144	111.32
4	Polychaetes	165	20	40	55	105	385	77	58.37
5	Oligochaetes	75	45	-	45	60	225	45	28.06
6	Ostracods	63	45	-	8	34	150	30	26.05
7	Gastrotriches	4	12	-	34	25	75	15	14.28
8	Turbellarians	72	33	-	-	120	225	45	51.35
9	Isopods	220	145	45	55	145	610	122	72.59
	Total	2019	835	325	532	1314	5025	1005	677.99

2007

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Nematodes	120	440	850	175	585	2170	434	300.65
2	Harpacticoid copepods	105	220	520	120	285	1250	250	168.04
3	Foraminiferans	87	180	168	45	120	600	120	56.16
4	Polychaetes	25	40	130	-	80	275	55	50.99
5	Oligochaetes	28	35	75	-	32	170	34	26.82
6	Ostracods	50	55	90	10	20	225	45	31.62
7	Gastrotriches	4	8	63	-	-	75	15	27.04
8	Turbellarians	-	20	6	-	4	30	6	8.25
9	Isopods	40	75	420	45	195	775	155	160.90
	Total	459	1073	2322	395	1321	5570	1114	782.59

Table 5. Density of meiofauna communities (individuals/10 cm⁻²) at Station 4 during 2006 and 2007.

2006

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Nematodes	1200	175	585	90	850	2900	580	464.07
2	Harpacticoid copepods	285	90	190	45	220	830	166	97.56
3	Foraminiferans	210	55	115	20	135	535	107	73.71
4	Polychaetes	90	12	23	-	110	235	47	49.57
5	Ostracods	28	-	12	-	20	60	12	12.33
	Total	1813	332	925	155	1335	4560	912	689.27

2007

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Nematodes	210	330	210	450	850	2050	410	265.33
2	Harpacticoid copepods	105	120	70	170	310	775	155	93.81
3	Foraminiferans	80	65	50	75	330	600	120	117.95
4	Polychaetes	70	90	-	55	120	335	67	44.67
5	Oligochaetes	40	25	-	-	10	75	15	17.32
6	Ostracods	40	35	20	30	85	210	42	25.15
7	Isopods	-	20	-	20	60	100	20	24.49
	Total	545	685	350	800	1765	4145	829	549.49

Table 6. Density of meiofauna communities (individuals/10 cm⁻²) at Station 5 during 2006 and 2007.

2006

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Nematodes	120	145	445	545	90	1345	269	210.22
2	Harpacticoid copepods	80	90	155	180	45	550	110	55.79
3	Foraminiferans	40	60	210	110	40	460	92	71.90
4	Polychaetes	25	30	-	90	-	145	29	36.81
5	Oligochaetes	55	20	10	250	15	350	70	102.16
6	Ostracods	10	10	20	60	-	100	20	23.45
	Total	330	355	840	1235	190	2950	590	436.28

2007

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Nematodes	110	120	90	310	120	750	150	90.28
2	Harpacticoid copepods	20	80	10	90	25	225	45	37.08
3	Foraminiferans	35	20	5	90	10	160	32	34.39
4	Polychaetes	60	55	40	90	45	290	58	19.56
5	Oligochaetes	45	50	60	220	75	450	90	73.57
6	Ostracods	5	30	-	50	15	100	20	20.31
	Total	275	355	205	850	290	1975	395	259.88

Table 7. Density of meiofauna communities (individuals/10 cm⁻²) at Station 6 during 2006 and 2007.

2006

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Nematodes	450	650	445	870	1125	3540	708	291.22
2	Harpacticoid copepods	320	175	210	255	530	1490	298	140.56
3	Foraminiferans	90	110	120	110	190	620	124	38.47
4	Polychaetes	-	50	10	20	40	120	24	20.74
5	Oligochaetes	390	280	410	370	120	1570	314	119.29
6	Ostracods	23	17	10	10	40	100	20	12.43
	Total	1273	1282	1205	1635	2045	7440	1488	353.77

2007

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Nematodes	1200	850	1450	1005	535	5040	1008	346.75
2	Harpacticoid copepods	735	345	950	440	230	2700	540	295.91
3	Foraminiferans	275	120	395	300	80	1170	234	131.02
4	Polychaetes	40	120	125	90	15	390	78	48.81
5	Oligochaetes	40	120	90	155	320	725	145	106.54
6	Ostracods	35	40	93	32	10	210	42	30.73
7	Isopods	-	-	25	-	-	25	5	11.18
	Total	2325	1595	3128	2022	1190	10260	2052	739.10

Table 8. Density of meiofauna communities (individuals/10 cm⁻²) at Station 7 during 2006 and 2007.**2006**

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Nematodes	1125	1200	794	445	556	4120	824	334.79
2	Harpacticoid copepods	320	145	230	120	245	1060	212	80.67
3	Foraminiferans	210	120	235	145	90	800	160	60.93
4	Polychaetes	-	10	40	75	35	160	32	29.28
5	Oligochaetes	50	40	540	420	650	1700	340	281.34
6	Ostracods	40	55	15	-	-	110	22	24.65
7	Isopods	50	25	-	-	-	75	15	22.36
	Total	1795	1595	1854	1205	1576	8025	1605	254.48

2007

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Nematodes	770	850	1100	410	870	4000	800	250.20
2	Harpacticoid copepods	290	440	680	150	215	1775	355	211.36
3	Foraminiferans	250	320	495	120	190	1375	275	143.44
4	Polychaetes	50	20	75	110	20	275	55	38.41
5	Oligochaetes	90	140	50	280	40	600	120	97.72
6	Ostracods	180	40	100	35	120	475	95	60.21
7	Isopods	50	150	225	-	200	625	125	96.82
	Total	1680	1960	2725	1105	1655	9125	1825	590.88

Table 9. Density of meiofauna communities (individuals/10 cm⁻²) at Station 8 during 2006 and 2007.**2006**

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Nematodes	340	75	245	175	250	1085	217	98.65
2	Harpacticoid copepods	120	25	90	70	85	390	78	34.75
3	Foraminiferans	140	15	105	40	35	335	67	52.99
4	Polychaetes	40	60	40	40	60	240	48	10.95
5	Oligochaetes	50	90	30	35	45	250	50	23.72
6	Ostracods	30	-	40	-	50	120	24	23.02
	Total	720	265	550	360	525	2420	484	176.83

2007

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Nematodes	195	440	170	330	90	1225	245	139.10
2	Harpacticoid copepods	45	90	50	70	20	275	55	26.46
3	Foraminiferans	40	20	50	45	70	225	45	18.03
4	Polychaetes	90	30	70	50	110	350	70	31.62
5	Oligochaetes	140	80	125	30	75	450	90	43.73
6	Ostracods	-	20	-	20	-	40	8	10.95
	Total	510	680	465	545	365	2565	513	115.25

Table 10. Density of meiofauna communities (individuals/10 cm⁻²) at Station 9 during 2006 and 2007.

2006

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Nematodes	515	425	600	450	520	2510	502	68.43
2	Harpacticoid copepods	205	235	195	215	155	1005	201	29.66
3	Foraminiferans	125	110	130	160	150	675	135	20.00
4	Polychaetes	45	40	40	80	20	225	45	21.79
5	Ostracods	60	20	10	10	20	120	24	20.74
	Total	950	830	975	915	865	4535	907	59.64

2007

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Nematodes	700	645	550	790	690	3375	675	87.46
2	Harpacticoid copepods	220	180	265	330	205	1200	240	59.06
3	Foraminiferans	105	90	110	140	155	600	120	26.69
4	Polychaetes	10	15	45	35	20	125	25	14.58
5	Oligochaetes	30	10	15	-	20	75	15	11.18
6	Ostracods	40	40	20	20	40	160	32	10.95
7	Isopods	40	10	-	10	-	60	12	16.43
	Total	1145	990	1005	1325	1130	5595	1119	134.97

Table 11. Density of meiofauna communities (individuals/10 cm⁻²) at Station 10 during 2006 and 2007.

2006

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Nematodes	450	345	475	670	740	2680	536	163.68
2	Harpacticoid copepods	125	140	170	225	305	965	193	73.37
3	Foraminiferans	90	130	90	180	240	730	146	64.27
4	Polychaetes	30	90	60	78	22	280	56	29.53
5	Ostracods	20	20	10	-	30	80	16	11.40
	Total	715	725	805	1153	1337	4735	947	281.87

2007

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Nematodes	745	225	550	370	985	2875	575	300.89
2	Harpacticoid copepods	160	120	220	270	380	1150	230	101.49
3	Foraminiferans	110	90	110	150	290	750	150	81.24
4	Polychaetes	20	130	40	110	40	340	68	48.68
5	Oligochaetes	-	80	-	45	-	125	25	36.40
6	Ostracods	10	20	20	10	40	100	20	12.25
7	Isopods	35	-	40	-	-	75	15	20.62
	Total	1080	665	980	955	1735	5415	1083	395.86

Table 12. Density of meiofauna communities (individuals/10 cm⁻²) at Station 11 during 2006 and 2007.

2006

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Nematodes	225	110	340	270	105	1050	210	102.16
2	Harpacticoid copepods	120	80	230	110	40	580	116	70.92
3	Foraminiferans	110	85	190	90	120	595	119	42.19
4	Polychaetes	40	75	20	40	80	255	51	25.59
5	Ostracods	20	-	80	50	-	150	30	34.64
6	Gastrotriches	-	-	10	10	-	20	4	5.48
	Total	515	350	870	570	345	2650	530	214.51

2007

S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Nematodes	120	230	420	120	510	1400	280	177.62
2	Harpacticoid copepods	60	105	155	60	245	625	125	77.70
3	Foraminiferans	40	90	110	120	180	540	108	50.70
4	Polychaetes	90	80	55	100	50	375	75	21.79
5	Oligochaetes	78	45	10	80	12	225	45	34.01
6	Ostracods	18	12	40	40	10	120	24	14.90
7	Isopods	-	-	12	-	8	20	4	5.66
	Total	406	562	802	520	1015	3305	661	244.90

Table 13. Density of meiofauna communities (individuals/10 cm⁻²) at Station 12 during 2006 and 2007.

2006

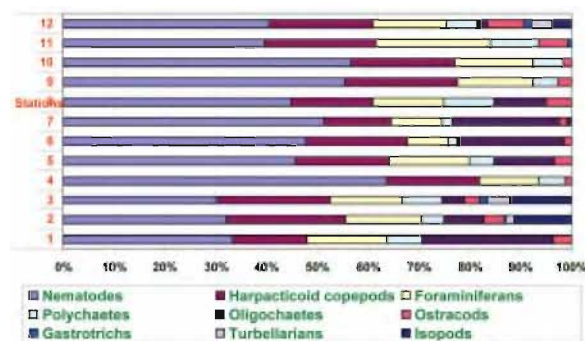
S. No.	Fauna	Samples					Total	Mean	SD (±)
		1	2	3	4	5			
1	Nematodes	125	320	145	205	395	1190	238	116.06
2	Harpacticoid copepods	90	120	95	100	195	600	120	43.45
3	Foraminiferans	50	90	60	75	150	425	85	39.37
4	Polychaetes	75	30	60	-	15	180	36	31.10
5	Oligochaetes	30	-	20	10	-	60	12	13.04
6	Ostracods	30	60	20	60	40	210	42	17.89
7	Gastrotriches	10	5	-	-	25	40	8	10.37
8	Turbellarians	10	60	-	-	55	125	25	30.00
9	Isopods	25	-	25	20	40	110	22	14.40
	Total	445	685	425	470	915	2940	588	210.52

2007

S. No.	Fauna	Samples					Total	Mean	SD ($\pm$)
		1	2	3	4	5			
1	Nematodes	423	345	110	256	356	1490	298	120.73
2	Harpacticoid copepods	180	157	133	75	125	670	134	39.40
3	Foraminiferans	150	72	98	60	110	490	98	35.24
4	Polychaetes	19	45	59	12	90	225	45	31.57
5	Oligochaetes	70	23	16	10	51	170	34	25.52
6	Ostracods	64	20	10	32	34	160	32	20.35
7	Turbellarians	4	12	-	-	4	20	4	4.90
8	Isopods	30	-	12	14	4	60	12	11.58
	Total	940	674	438	459	774	3285	657	212.86

Nematodes were the most dominant group of meiofauna at all the sampling stations of Tamil Nadu coast, constituting from 30.25% to 63.60% of total abundance (Figs. 2 a, b). The next important faunal group was the harpacticoid copepods which contributes 10.72 to 26.32% of the total meiofauna. Nematodes and harpacticoid copepods together comprised about 80% of the meiofauna (Figs. 2 a, b).

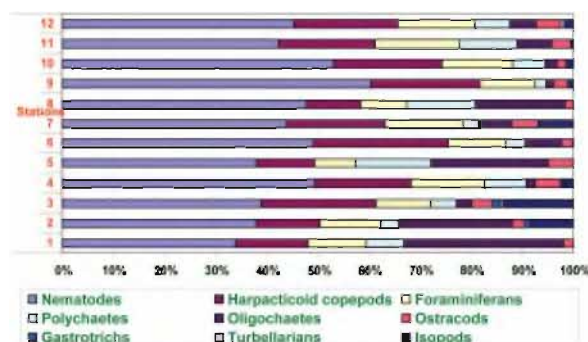
Fig. 2a Mean percentage composition of meiofauna communities from intertidal sediments of Tamil Nadu coast during 2006.



The foraminiferans ranked third, with a percentage contribution of 8.1 to 22.45 % of the total meiofauna. However, at station 11 (Rameswaram) alone they ranked second. Polychaetes formed the fourth largest group, with a percentage occurrence of 1.61 to 14.69% of the total fauna. Oligochaetes were observed at all the stations during 2007; nonetheless, it was totally absent at stations 3, 9-11 during 2006. Their

percentage was high (31.33 % of the total meiofauna) at station 1 (Chennai) during 2007 (Figs. 2 a, b).

Fig. 2b Mean percentage of meiofauna communities from intertidal sediments of Tamil Nadu coast during 2007.



Ostracods were recorded at all the twelve stations, but their population density was considerably low (1.34 % to 7.14 % of the total abundance).

The other taxa found were gastrotrichs, turbellarians and isopods which made up only less than 5 % of the total meiofauna. However, at station 3 (Cuddalore) isopods constituted the maximum percentage (13.91 %) during 2007 (Figs. 2 a, b).

DISTRIBUTION OF MEIOFAUNA

Sandy sediment

The meiofauna density ranged between 509 and 1169 individuals/10 cm⁻² (Appendix II, Table 2),

464 and 1583 individuals/10 cm⁻² (Appendix II, Table 3), 325 and 2019 individuals/10 cm⁻² (Appendix II, Table 4) and 830 and 975 individuals/10 cm⁻² (Appendix II, Table 10) at stations 1, 2, 3 and 9 respectively during 2006.

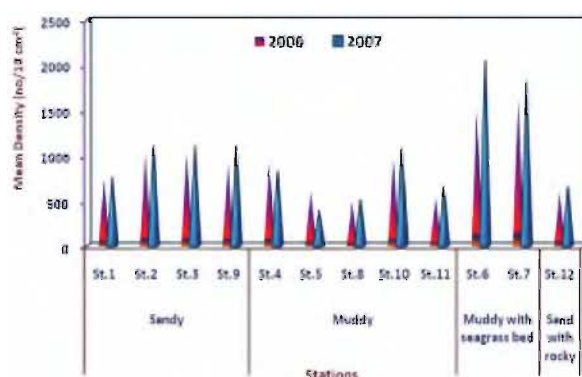
During 2007, ranges of 419 to 1326 individuals/10 cm⁻² (Appendix II, Table 1), 402-1715 individuals/10 cm⁻² (Appendix II, Table 3), 395-2322 individuals/10 cm⁻² (Appendix II, Table 4) and 990-1325 individuals/10 cm⁻² (Appendix II, Table 10) were encountered at stations 1, 2, 3 and 9 respectively.

Muddy sediment

The meiofaunal density ranged from 155 to 1813 individuals/10 cm⁻² (Appendix II, Table 5), 190 to 1235 individuals/10 cm⁻² (Appendix II, Table 6), 265 to 720 individuals/10 cm⁻² (Appendix II, Table 9), 715 to 1337 individuals/10 cm⁻² (Appendix II, Table 11) and 345 to 870 individuals/10 cm⁻² (Appendix II, Table 12) at stations 4, 5, 8, 10 and 11 respectively during 2006.

During 2007, a ranges of 350-1765 individuals/10 cm⁻² (Appendix II, Table 5), 205-850 individuals/10 cm⁻² (Appendix II, Table 6), 365 to 680 individuals/10 cm⁻² (Appendix II, Table 9), 665-1735 individuals/10 cm⁻² (Appendix II, Table 11) and 406-1015 individuals/10 cm⁻² (Appendix II, Table 12) were recorded at stations 4, 5, 8, 10 and 11 respectively.

Fig. 3. Mean total density of meiofauna in relation to substratum from intertidal sediments



Muddy sediment with seagrass bed

The meiofaunal density ranged between 1205 and 2045 individuals/10 cm⁻² (Appendix II, Table 7) and between 1205 and 1854 individuals/10 cm⁻² (Appendix II, Table 8) at stations 6 and 7 respectively during 2006. During 2007, a range of 1190-3128 individuals/10 cm⁻² (Appendix II, Table 7) and 1105-2725 individuals/10 cm⁻² (Appendix II, Table 8) were recorded at stations 6 and 7 respectively.

Sandy sediment with rocky environment

The meiofaunal density varied from 425 to 915 individuals/10 cm⁻² (Appendix II, Table 13) and from 438 to 940 individuals/10 cm⁻² at station 12 during 2006 and 2007 respectively (Appendix II, Table 13). In general, muddy sediments with seagrass bed had relatively higher densities of meiofauna than those with other sediment types (Fig. 3). The gastrotrichs and turbellarians were totally absent in muddy environment.

DIVERSITY INDEX

The diversity indices were lowest at stations 5 (Nagapattinam) and 8 (Tuticorin), which can be considered as indications of the stress at these sites. These sites were very close to the harbor. Station 7, showed higher diversity in addition to a high density of meiofauna. It must be stated that the sediment here was muddy with seagrass (Table 14).

Table 14. Diversity of meiofauna at various stations in Tamil Nadu coast during 2006 and 2007 (*S* = Number of species; *N* = Number of animals; *d* = Margalef Richness; *J'* Evenness; *H* = Shannon - Wiener diversity, *l*- Lambda - Simson richness).

Stations	S	N	d	J'	H'(log2)
1	61	734	9.09296	0.89801	5.32584
2	67	1016	9.53257	0.87700	5.31996
3	64	1005	9.11360	0.88939	5.33635
4	49	912	7.04263	0.91500	5.13748
5	40	590	6.11274	0.91232	4.85530**
6	58	488	7.80267	0.89486	5.24206
7	70	1605	9.34848	0.89436	5.48180*
8	43	484	6.79382	0.84802	4.60156**
9	42	907	6.02043	0.93143	5.02259
10	44	947	6.27435	0.91300	4.98444
11	40	530	6.21724	0.95418	5.07810
12	45	588	6.90009	0.93887	5.15612

(*- higher diversity indices; **- lowest diversity indices)

It could also be seen from the similarity matrix (Fig.4) and the MDS plot (Fig.5) that the muddy and seagrass bed environment, muddy environment and sandy environment harboured distinct populations. Few sites of muddy stations are closer to those in other zones of sandy sediment stations. Nonetheless in some stations of muddy environment no such distinctness could be recognized, probably because of the impact of pollution (stations 5 (NAG), 8 (TUT) and 11 (RAM)).

Fig. 4. Cluster analysis for meiofauna from intertidal sediments of Tamil Nadu coast during 2006 and 2007.

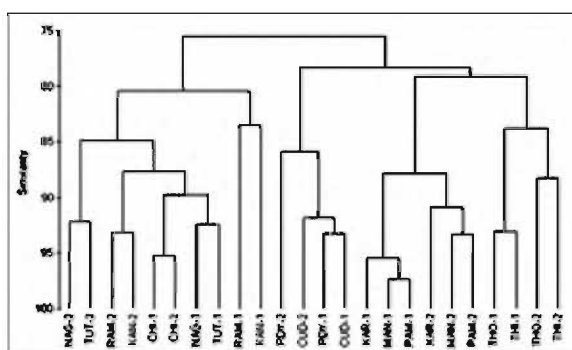


Table 15. ANOVA for meiofauna density within stations.

Factor	SS	Df	Ms	F(cal)	P(F<=F(cal))	F(0.05)
A (Between Groups)	13867.38	11	1260.67	4.895	*** (P<=0.001)	1.90E-07
R(A) (Within Groups)	309048.04	1200	257.54			
AR (Total)	322915.42	1211				

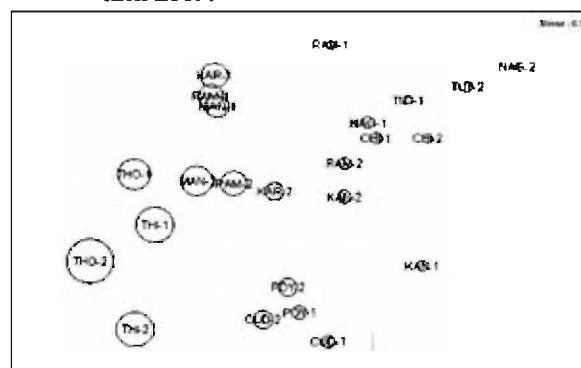
*** (P<=0.001)

VERTICAL DISTRIBUTION OF MEIOFAUNA

The vertical distribution of meiofauna was quite similar in all the twelve stations. Densities were highest near the sediment surface and especially in muddy sediments, where the upper sediment had up 50% of the total fauna (Fig. 6 d, e, h, i, k).

In sandy sediments, total meiofauna fluctuated with depth, and the maximum was found at 2-6 cm. (Fig. 6 a, b, c, l). In muddy sediment with seagrass bed, again, higher densities occurred in the top portion (Fig. 6f, g).

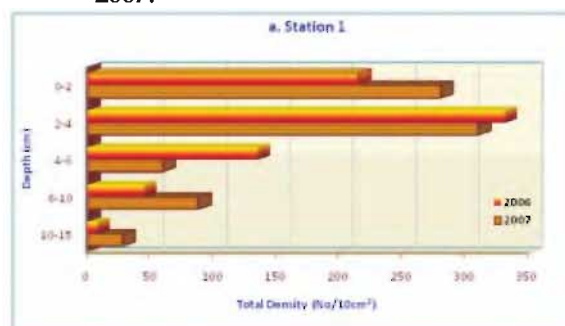
Fig. 5. MDS of meiofauna from intertidal sediments of Tamil Nadu coast during 2006 and 2007.

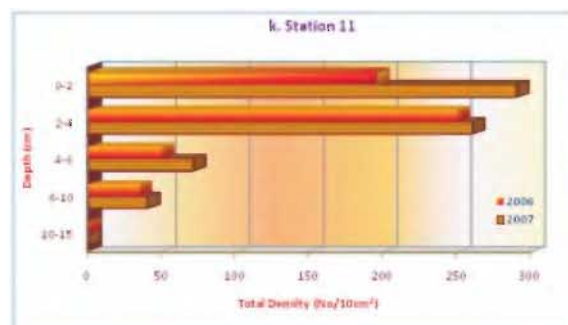
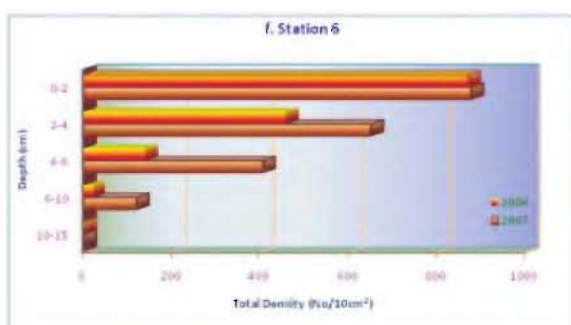
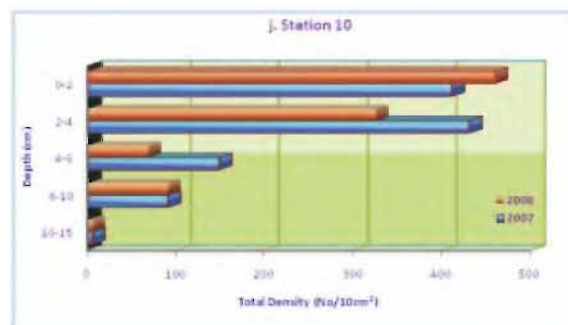
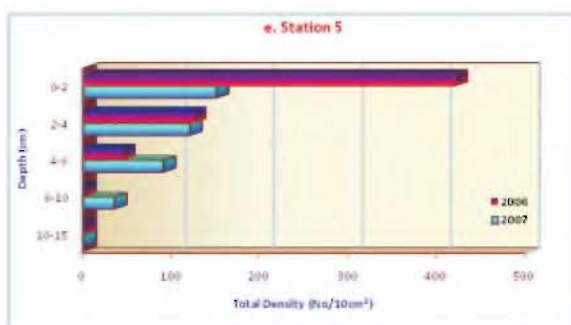
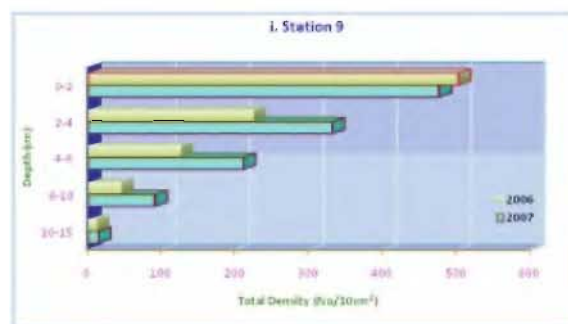
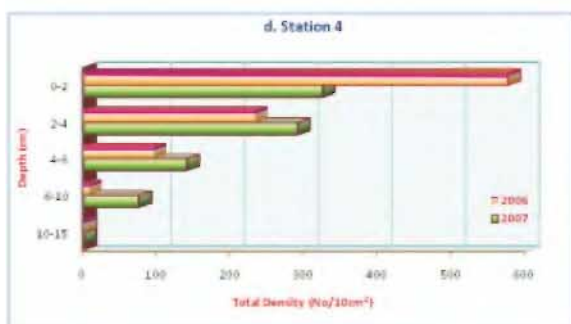
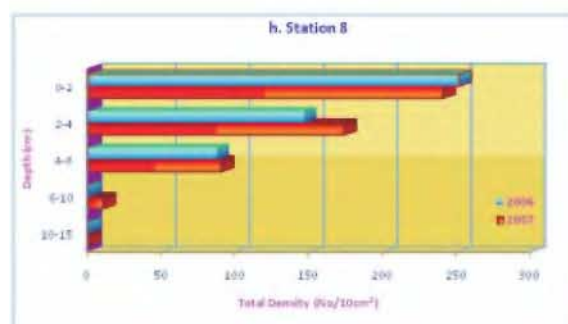
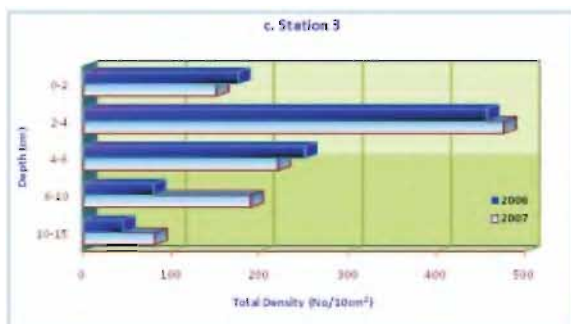
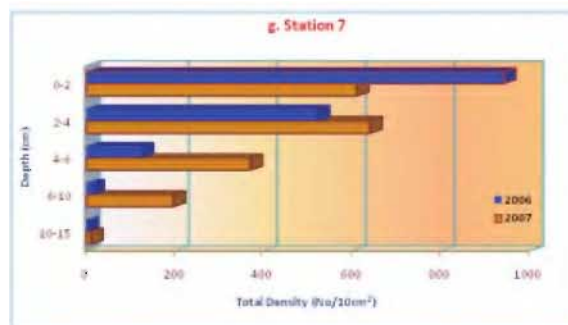
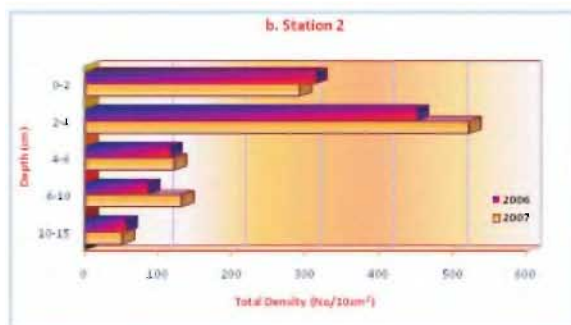


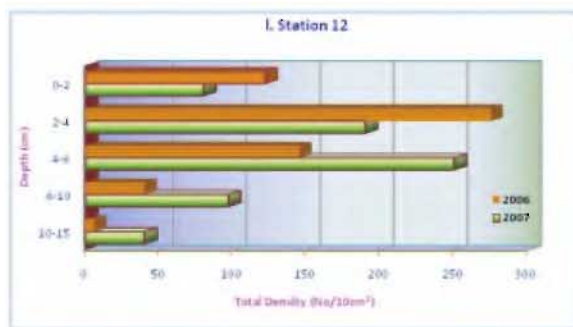
CHI-Chennai; PDY-Puducherry; CUD-Cuddalore; KAR-Karaikal; NAG-Nagapattinam; THO-Thondi; THI-Thiruchendur; TUT-Tuticorin; MAN-Mandabam; PAM-Pamban; RAM-Rameswaram; KAN-Kanyakumari; 1-2006; 2-2007

The densities of meiofauna varied significantly ($F = 4.895$; $P < 0.001$) between the stations (Table 15), probably due to the variation in environmental parameters like nature of sediment.

Fig. 6. Vertical distribution of meiofauna ($n/10\text{cm}^2$) at stations 1-12 during 2006 and 2007.







COMPOSITION OF MEIOFAUNA

A total of 101 species of meiofauna belonging to 63 families were identified, of which 34 species were nematodes, nine were harpacticoid copepods, 38 were foraminiferans, six each were polychaetes, ostracods and oligochates, one was an isopod and one each of unidentified species of gastrotrichs and turbellarians (Table 16).

Table 16. Occurrence and distribution of meiofaunal community in the intertidal region of Tamil Nadu coast during 2006 and 2007.

S. No	Name of the Family & Species	Stations											
		1	2	3	4	5	6	7	8	9	10	11	12
NEMATODES													
Family: Thoracostomopsidae													
1	<i>Enoploides</i> sp.	+	+	+	-	-	+	+	-	+	+	+	+
Family: Anoplostomatidae													
2	<i>Anoplostoma</i> sp.	-	-	-	-	-	+	+	-	-	-	-	-
Family: Ironidae													
3	<i>Trissonchulus oceanus</i>	+	+	+	-	+	-	+	-	+	+	+	+
Family: Oxystominidae													
4	<i>Halalaimus filum</i>	+	-	-	+	-	-	+	-	-	-	-	-
5	<i>Halalaimus gracilis</i>	+	+	+	+	-	+	+	+	+	+	+	-
Family: Oncholaimidae													
6	<i>Viscosia viscosa</i>	+	+	+	+	+	+	+	+	+	+	+	+
7	<i>Adoncholaimus fuscus</i>	+	+	+	-	-	+	+	-	+	+	-	+
8	<i>Oncholaimus</i> sp.	+	+	+	-	+	+	+	+	+	-	+	+
Family: Enchelidiidae													
9	<i>Polygastrophora septembulba</i>	-	-	-	+	-	+	+	-	-	-	-	-
Family: Tripyloidiidae													
10	<i>Tripyloides gracilis</i>	-	+	+	+	-	+	+	-	-	-	-	-
Family: Chromadoridae													
11	<i>Ptycholaimellus ponticus</i>	-	-	+	-	-	-	+	-	-	-	-	-
Family: Comesomatidae													
12	<i>Hopperia</i> sp.	-	-	-	+	-	+	+	-	+	-	-	-
13	<i>Dorilaimopsis timmi</i>	-	-	-	+	-	+	+	-	-	-	-	-
14	<i>Paracomesoma dubium</i>	-	-	-	+	-	-	+	-	-	-	-	-

15	<i>Sabatieria falcifera</i>	+	-	+	+	+	+	+	-	-	-	-	-
Family: Cyatholaimidae													
16	<i>Paracanthionchus elongatus</i>	+	-	-	+	-	+	+	+	-	-	-	-
Family: Selachnematidae													
17	<i>Halichoanolaimus dolichurus</i>	+	+	+	+	-	+	+	-	+	+	+	+
Family: Desmodoridae													
18	<i>Metachromadora remanei</i>	+	+	+	+	+	+	+	+	+	+	+	+
19	<i>Desmodora (D.) sanguinea</i>	+	-	+	+	-	-	-	-	-	+	-	-
20	<i>Desmodora (D.) tenuispiculum</i>	+	+	+	-	-	+	+	+	-	+	-	+
21	<i>Spirinia (S.) parasitifera</i>	+	+	-	+	+	+	+	-	-	-	-	-
Family: Microlaimidae													
22	<i>Microlaimus sp.</i>	+	+	-	-	-	-	+	-	-	-	-	-
Family: Ceramononematidae													
23	<i>Pselionema sp.</i>	+	+	+	-	+	+	+	+	+	+	+	+
Family: Leptolaimidae													
24	<i>Camacolaimus barbatus</i>	-	-	-	+	-	+	+	-	-	-	-	-
Family: Desmoscolecidae													
25	<i>Desmoscolex falcatus</i>	+	+	+	+	-	+	+	-	-	-	-	-
Family: Xyalidae													
26	<i>Daptonema conicum</i>	+	+	+	+	+	+	+	+	+	+	+	+
27	<i>Daptonema oxycerca</i>	+	+	-	+	+	+	+	+	+	+	+	+
28	<i>Theristus pertenuis</i>	+	+	+	-	+	+	+	+	+	+	+	+
29	<i>Theristus clax</i>	+	+	+	+	+	+	+	-	+	+	+	+
Family: Linhomoeidae													
30	<i>Paralinhomoeus brevibucca</i>	-	-	-	+	-	+	+	-	-	-	-	-
31	<i>Metalinhomoeus typicus</i>	+	-	+	+	-	-	+	-	-	-	-	-
32	<i>Terschellingia longicauda</i>	-	-	-	+	-	+	+	-	-	-	-	-
Family: Axonolaimidae													
33	<i>Paradontophora breviseta</i>	-	-	-	+	-	+	+	-	-	-	-	-
Family: Diplopeltidae													
34	<i>Araeolaimus longicauda</i>	-	-	-	+	-	+	-	-	-	-	-	-
HARPACTICOID COPEPODS													
Family: Canuallidae													
35	<i>Canuella sp.</i>	-	+	+	-	-	-	-	-	+	-	+	-

[illegible]

78	<i>T. candiana</i>	-	-	-	-	-	-	-	-	-	-	-	+
79	<i>T. agglutinans</i>	-	+	-	+	-	-	-	+	-	+	-	+
Family: Miliolidae													
80	<i>Triloculina</i> sp.	+	+	+	+	+	+	+	+	+	+	+	+
POLYCHAETES													
Family: Pisionidae													
81	<i>Pisone</i> sp.	+	+	+	+	-	-	+	-	+	-	+	+
Family: Capitellidae													
82	<i>Capitella</i> sp.	+	+	+	+	+	+	+	+	+	+	+	+
Family: Nephtyidae													
83	<i>Nephtys</i> sp.	+	+	+	+	+	-	-	+	+	+	+	+
Family: Nerillidae													
84	<i>Nerillidium</i>	+	+	+	-	-	-	-	-	-	-	+	+
85	<i>Nerilla</i>	+	+	+	+	-	-	+	-	+	-	-	-
Family: Protodrilidae													
86	<i>Protodrilus</i> sp.	-	+	+	+	-	-	+	-	+	+	-	-
OLIGOCHAETES													
Family: Tubificidae													
87	<i>Limnodriloides</i> sp.	+	+	+	-	+	+	+	-	-	-	-	-
88	<i>Akteredrilus</i> sp.	+	+	+	-	+	+	+	+	-	-	-	-
89	<i>Heterodrilus</i> sp.	-	+	-	-	+	+	+	-	-	-	-	-
90	<i>Olavius</i> sp.	+	-	-	-	+	+	+	-	-	-	-	-
91	<i>Phallogrilus</i> sp.	+	-	-	-	-	+	+	-	-	-	-	-
Family: Enchytracidae													
92	<i>Grania</i> sp.	+	+	+	-	+	+	+	+	-	-	-	+
OSTRACODS													
Family: Cypridae													
93	<i>Cyprideis</i> sp.	+	+	+	+	-	-	-	+	-	-	-	-
Family: Cytherideidae													
94	<i>Cytheridea</i> sp.	-	-	-	-	+	+	+	-	-	-	-	-
Family: Paracytherideidae													
95	<i>Paracytheridea</i> sp.	-	-	-	-	-	-	-	-	-	-	-	+
Family: Cyprididae													
96	<i>Herpetocypris</i> sp.	+	+	+	-	-	+	+	+	+	+	+	+

Family: Cytheruridae														
97	<i>Cytheromorpha</i> sp.	+	+	+	+	+	+	+	+	+	+	+	+	+
Family: Paracythermidae														
98	<i>Paracythroma</i> sp	-	-	-	-	-	-	-	-	+	-	-	-	-
ISOPODS														
Family: Microcerberidae														
99	<i>Microcerberus</i> sp.	-	+	+	-	-	-	+	-	-	-	-	-	+

+ Presence of nematode distribution

- Absence of nematode distribution

Nine major meiofaunal taxa i.e. nematodes, harpacticoid copepods, foraminiferans, polychaetes, ostracods, oligochaetes, gastrotrichs, turbellarians and isopod were recorded at different sediment nature of Tamil Nadu coast. Nematodes were the most abundant group of meiofauna at all the sampling sites. This is generally the case in marine sediments. The abundance of polychaetes was less, which may be due to predominance of sand fraction in sediments at most of the stations. Oligochaetes were second in abundance to nematodes only at stations 1, 6 and 7 (Chennai, Thondi and Thiruchendur), probably because at station 1, situated near the sewage mixing area and sediment here was very fine. In general, oligochaetes are mainly found in the polluted areas. Among the different sampling sites, areas with seagrass bed cover (stations 6 and 7) sediment contained highest density of meiofauna and also mainly inhabited by burrowers such as nematodes and oligochaetes. Nematodes were the most dominant group in the

finer sediments. Meiofauna densities in the seagrass bed were significantly related, with a time log, to change in bacterial standing stock, indicating that microbes may be an important resource. The increase of detritus, which provides the main food for the meiofauna, is suggested to be the reason for the high meiofauna densities observed in the seagrass bed. A lowest density of meiofauna was observed in sandy sediments especially at stations 1 (Chennai), 5 (Nagapattinam), 8 (Tuticorin), 11 (Rameswaram) and 12 (Kanyakumari). Probably because at station 1, situated near the sewage mixing area.

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NOTES ON THE ASSOCIATION OF *LISSOCARCINUS POLYBIODES* ADAMS AND WHITE, 1848 (PORTUNIDAE, CAPHYRINAE), WITH SEA STAR *LUIDIA MACULATA* MULLER AND TROSCHEL, 1842.

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INTRODUCTION

A portunid swimmer crab *Lissocarcinus polybiodes* Adams and White, 1848, which is usually free living or associated with hard corals (Stephenson, 1972), is shown to have commensal association with a sea star *Luidia maculata* Muller and Troschel, 1842, is reported for the first time. Significantly, this is the second only report of this species from the Indian waters (Chennai Coast) after Alcock's (1899) description of specimens from Malabar, Orissa, Ganjam, Malabar and Andamans.

SYSTEMATIC ACCOUNT

Family PORTUNIDAE

Subfamily CAPHYRINAE

Lissocarcinus polybiodes Adams
and White, 1848

Materials studied : 1 ♂, Chennai Coast, 12° 45' 50.12" N; 080° 17' 00.14" E, Depth 20 m, 1-vii-2010, coll. K. Venkataraman (Reg. No. D1-1-NZC-MBRC), Fig. 1. c.

Three specimens of sea star obtained from Chennai coast was introduced in the Marine Aquarium of Marine Biology Regional Centre, Chennai and the commensal association observed in one of them was studied. The crab species was observed to be usually attached to central disc of the starfish (Figure 1), though it moved briefly over the arms. The movement however was never to

the distal ends of the arms. At no occasion the crab species was observed to leave the starfish, even when the starfish goes buried under the sand. On experimental detachment by means of forceps, it immediately returned to the starfish.

Among the species of *Lissocarcinus* Adams and White, 1848 – three reported from Indian waters (Alcock, 1899) and one species – *L. arkati* Kemp, 1923 known to occur from Indian waters (Sakai, 1976), *L. orbicularis* and *L. leavis* are known for associations with sessile organisms or organisms with limited mobility (e.g. echinoderms) (Table 1). The crab species reported has been known to inhabit bottoms of the sand, mud or broken shells and usually found at a depth range of 30-100 meters (Sakai, 1976); Stephenson's (1972) is the only account of its association with hard corals. Nonetheless, no association records of this species have been reported with echinoderms from India or elsewhere. The present specimen was retrieved from a depth of 20 m, along with its commensal host. After Alcock (1899), this species has not so far been reported in the studies of the brachyuran fauna from India.

The Aquarium observations prove that the association is of the commensal type. More specimens and further studies are required to show whether it is an epibiotic or an obligative commensal. As described by Low *et al.* (1995) obligative commensals are host specific and determine the health of the host and ecosystem.

Keywords: Association, Portunidae, *Lissocarcinus*, sea star, *Luidia*, India

This report points out that investigations of crab commensal associations are few (James, 1995; Gokul, 2006) and in its preliminary stages in the marine ecosystems of India (Table 1); Commensal associations of tiny swimmer crabs of the family Portunidae, and Xanthidae, with organisms of limited mobility (many of the echinoderms) need to be studied. It is suggested that ecosystem health

assessments also could include indices based on commensal associations, given the ecological significance of these associations.

ACKNOWLEDGEMENT

The authors thank Director, Zoological Survey of India for the facilities provided.

Table-1. Host associations of *Lissocarcinus* Adams and White, 1848.

Crabs species	Host species.	Type of association	Reference
BRACHYURA			
Family : Portunidae			
Subfamily : Caphyrinae <i>Lissocarcinus laevis</i>	Sea anemones	Symbiotic	Allen, 2000
<i>Lissocarcinus orbicularis</i>	Holothurian : <i>Actinophyga mauritiana</i>	commensal	James, 1995; Bakus, 1973; Eeckhaut <i>et al.</i> , 2004
<i>Lissocarcinus orbicularis</i>	Holothuria atra, and holothurians in general	Symbiotic association	Ng and Jeng, 1999; Lyskin and Britaev, 2005; Jhonson, 1994
<i>Lissocarcinus arkati</i>	Sea urchin (unidentified)	Facultative commensals	Spiridonov, 1999
<i>Lissocarcinus laevis</i>	Anthozoa: <i>Cerianthus</i>	Facultative commensals	Spiridonov, 1999
<i>Lissocarcinus orbicularis</i>	Holothurians and sea urchins	Obligate commensals	Spiridonov, 1999

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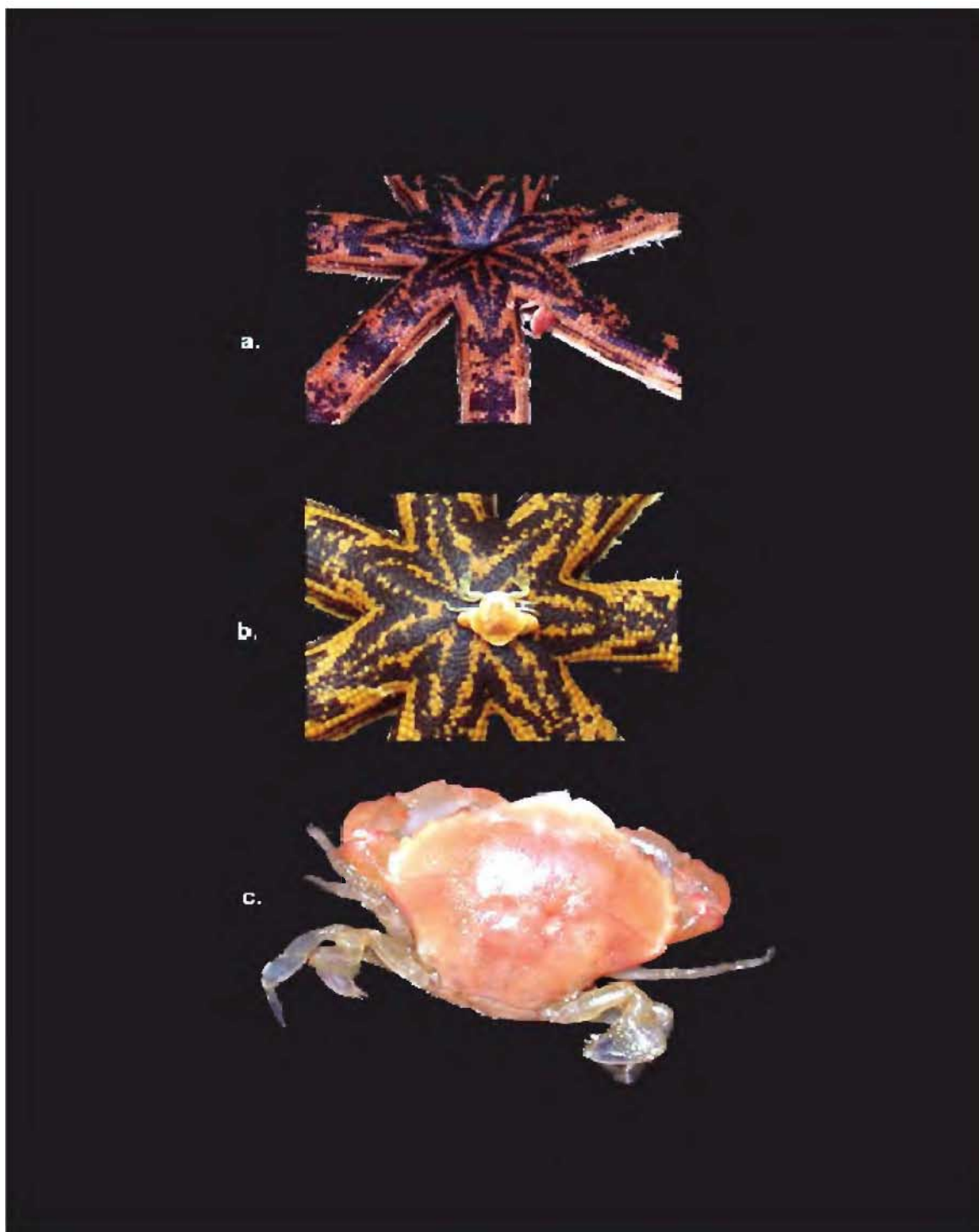
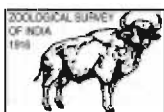


Fig. 1 : *Lissocarcinus polybiodes* Adams and White, 1948 (Portunidae, Caphyrinae); associated with sea star, *Luidia maculata* Mullar and Troschel, 1842 a. and b. Crab showing association; c. Entire crab.

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A NEW AND A KNOWN SPECIES OF TELOTYLENCHINAE (TYLENCHIDA: BELONOLAIMIDAE) FROM WEST BENGAL, INDIA

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INTRODUCTION

A few specimens of *Trophurus clavicaudatus* sp. n. and *Tylenchorhynchus mashhoodi* Siddiqi and Basir, 1959 were collected from soil around the roots of litchi (*Litchi chinensis* Sonn.) at South 24-Parganas district, West Bengal, India. Among 14 valid species of *Trophurus* Loof, 1956, as listed by Siddiqi (2000), only 4 species have been described and reported from India and other 10 species have been reported from Europe, Africa, North and South America. The different species of the genus were described from Maharashtra (Suryawanshi, 1971), Mysore (Khan and Nanjappa, 1971), Punjab (Saha *et al.*, 1973) and from Madhya Pradesh (Ganguly and Khan, 1983) from the soil around the roots of cotton (*Gossypium herbaceum* L.), coconut palm (*Cocos mucifera* L.), apricot (*Prunus armeniaca* L.) and betel vine (*Piper betel* L.) respectively in India. Kleynhans and Cadet (1994) provided a dichotomous key to the species of *Trophurus* Loof, 1956. This is the first report of the genus from West Bengal, India. *Tylenchorhynchus mashhoodi* was described by Siddiqi and Basir (1959) from soil around the roots of sugarcane (*Saccharum officinarum* L.) from Southern India and this was the first record of the genus *Tylenchorhynchus* Cobb, 1913 in India. Baqri and Jairajpuri (1970) reported *T. mashhoodi* from cotton and other plants and from sugarcane from Uttar Pradesh and Andhra Pradesh respectively with a study of intra specific variation. Singh and Khera (1978) reported the species from Narendrapur, Baruiapur block, South 24-Parganas and from Howrah district, West Bengal. Chaturvedi

and Khera (1979) recorded it as a parasite of jute plant from different district of West Bengal. Ahmad and Baqri (1987), Baqri (1991) reported the species from soil around the roots of paddy (*Oryza sativa*) at Burdwan district, West Bengal and from citrus (*Citrus reticulata*) in Skkim respectively. These prove the wide distribution of the species in West Bengal as well as in India.

MATERIALS AND METHODS

The collected soil samples were processed by Cobb's sieving and decantation technique (Cobb, 1918) followed by modified Baermann funnel technique (Christie and Perry, 1951) for extraction of nematodes. The nematode specimens were fixed and preserved in their characteristic body posture in warm FA (formalin-acetic acid 4:1) solution and were mounted in anhydrous glycerin, sealed by paraffin wax. Specimens were observed under an Olympus BX-41 trinocular microscope and were measured and photographed. Figures were drawn with the aid of a drawing tube attached to the microscope.

SYSTEMATIC ACCOUNT

Order TYLENCHIDA Thorne, 1949

Suborder TYLENCHINA Thorne, 1949

Super family TYLENCHOIDEA Örley, 1880

Family BELONOLAIMIDAE Whitehead, 1960

Subfamily TELOTYLENCHINAE Siddiqi, 1960

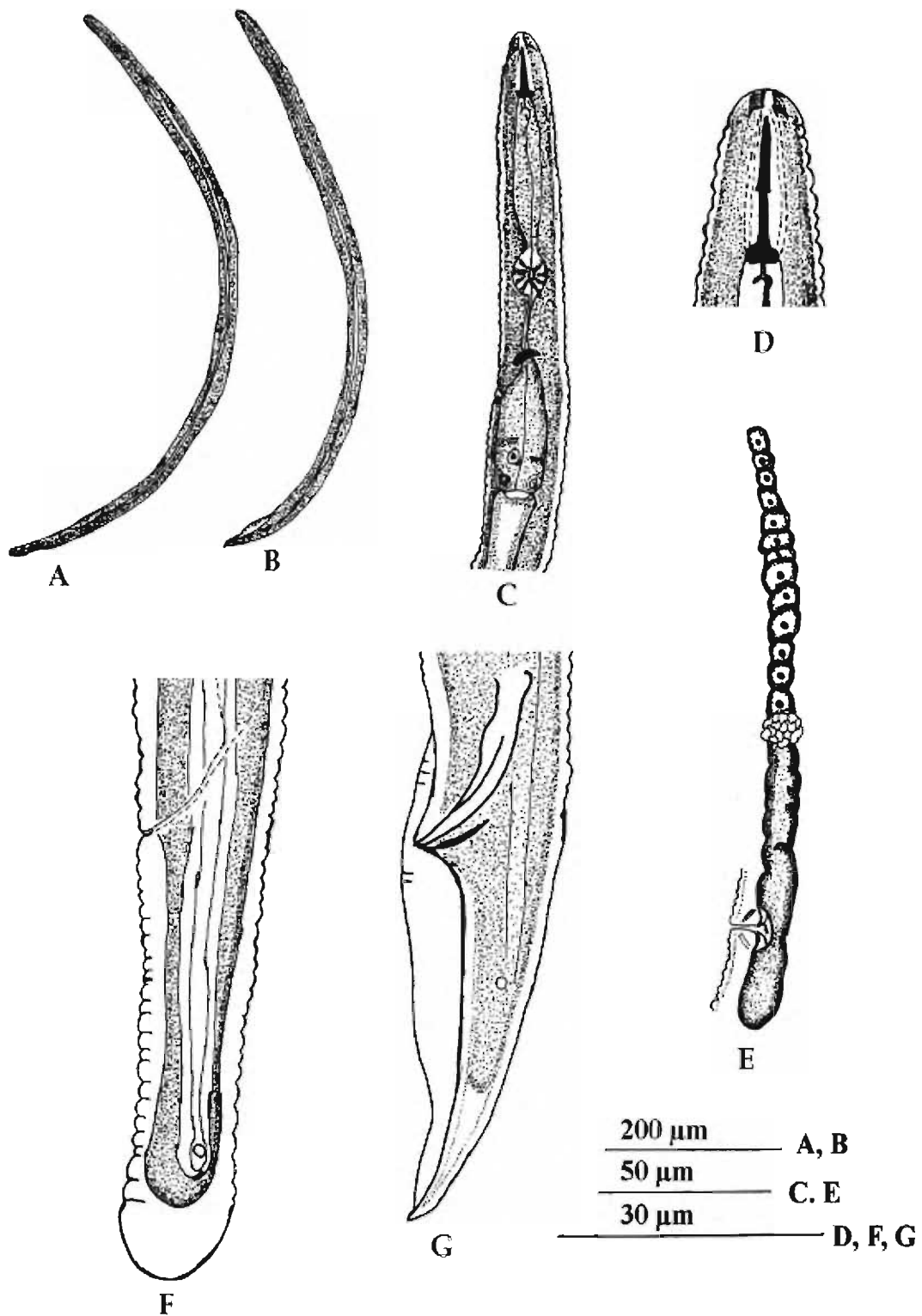


Figure 1. *Trophurus clavicaudatus* sp. n. Female : A. Entire body, C. Anterior portion of body, D. Stomatostylet & cephalic region, E. Mono-prodelphic reproductive system with posterior uterine sac, F. Tail. Male: B. Entire body, G. Posterior end showing spicule, gubernaculum & bursa.

Genus *Trophurus* Loof, 1956

1. *Trophurus clavicaudatus* sp. n.

Genus *Tylenchorhynchus* Cobb, 1913

2. *Tylenchorhynchus mashhoodi* Siddiqi and Basir, 1959

DESCRIPTION

1. *Trophurus clavicaudatus* sp. n.

(Figures 1 and 2)

Measurements : Shown in Table 1. The measurements given hereafter are based on holotype. Minimum-maximum ranges of measurements of paratypes are given in parenthesis.

Females : Body ventrally curved upon fixation. Cuticle finely striated. Lateral fields with four incisures, occupying about one-fourth of body width at mid body. Cephalic region continuous with body, rounded, measuring $3.0\mu\text{m}$ ($2.5 - 3.0\mu\text{m}$) high and $8.0\mu\text{m}$ ($7.0 - 8.0\mu\text{m}$) wide, smooth, lip annules not prominent, labial disc indistinct. Cephalic framework weakly sclerotized. Stomatostylet 2.1 ($2.1 - 2.6$) lip region-widths long, stylet knobs rounded, measuring $5.0\mu\text{m}$ across. Opening of dorsal pharyngeal gland $2.0\mu\text{m}$ behind the stylet base. Median bulb oval with a conspicuous vulvular apparatus, situated slightly posterior to middle of the pharynx. Basal bulb elongate, pyriform. cardia small, broadly rounded. Excretory pore $103.0\mu\text{m}$ ($103.0 - 110.0\mu\text{m}$) from anterior end, 12 annules ($10 - 12$ annules) anterior from the base of basal bulb. Nerve ring $96.0\mu\text{m}$ ($91.0 - 96.0\mu\text{m}$) from anterior end, 3 annules anterior to excretory pore. Hemizonid indistinct. Vulva post-equatorial in position. Vagina extending inward half of the body diameter. Reproductive system mono-prodelphic, anterior branch of gonad functional, anterior ovary outstretched, spermatheca rounded. Posterior gonad in the form of a small post-uterine sac, 1.1 ($1.1 - 1.2$) vulval body-widths long. Phasmids situated at the posterior half of tail, 19 annules ($19 - 22$ annules) posterior to anal opening. Tail sub-clavate with terminal swelling, number of tail annules 24 ($24 - 25$), 3.0 ($3.0 - 3.9$) anal body-diameters long. Cuticle on tail terminus abruptly thick, $8.5\mu\text{m}$ ($7.5 - 8.5\mu\text{m}$) with a prominent hyaline portion. Tail terminus smooth, broadly rounded and clavate.

Males : Similar to females in general morphology except the following. Tail gradually tapering to a pointed terminus in lateral view, $2.4 - 2.9$ anal body-diameters long. Phasmids slightly anterior to the middle of tail. Testes outstretched. Spicules $1.3 - 1.6$ anal body-diameters long. Gubernaculum developed, $1/2.3 - 1/2.8$ of spicule length. Bursa $3.4 - 3.8$ anal body-widths long, completely enveloping tail

Type habitat and locality : Collected from soil around the roots of litchi at South Kalyanpur, Baruipur block, South 24-parganas on 13. 12. 2004.

Type specimens : Holotype registration No. WN 1051 with one female and two male paratypes on same slide. Paratype registration No. WN 1052 (2 ♂). Deposited in National Zoological Collection, Zoological Survey of India, Kolkata, India.

Etymology : The new species has been named after its characteristic tail shape.

Diagnosis and Relationship: *Trophurus clavicaudatus* sp. n. is characterized by its club-shaped tail. It comes close to *T. similis* Khan and Nanjappa, 1971, *T. lomus* Saha, Chawla & Khan, 1973 and *T. impar* Ganguly and Khan, 1983. The new species differs from its all closely resembling species in having a clavate tail. From *T. similis*, the present new species differs in having lesser 'a' and 'c' values, longer spear and tail, more anteriorly located vulva and longer post-uterine sac. The males also differ in having longer spicules (in *T. similis*, $a = 40.0 - 58.0$; $c = 18.0 - 25.0$; spear = $9.0 - 11.0\mu\text{m}$; tail = 36.0m ; $V = 53.0 - 64.0\%$; post-uterine sac = $1/2$ vulval body width in females; spicules = $16.0 - 21.0\mu\text{m}$ in males). From *T. lomus* it differs in having longer tail evident from lesser 'c' value, greater 'c'' value, anteriorly located vulva and longer post-uterine sac. The males differs in having slightly longer spicules (in *T. lomus*, $c = 20.0 - 30.0$; $c' = 1.2 - 1.8$; $V = 53.0 - 60.0\%$; post-uterine sac = $1/2$ vulval body width long; spicules = $20.0 - 22.0\mu\text{m}$). *T. clavicaudatus* sp. n. differs from *T. impar* in having a shorter body, much lesser value of 'a' and 'c', longer tail evident from 'c' value, longer spear and cardia without bifurcation (In *T. impar*, $L = 0.80 - 0.93\text{mm}$; $a = 52.0 - 58.0$; $c' = 1.8 - 2.2$; $c = 30.0 - 40.0$; spear = $12.0 - 14.0\mu\text{m}$ and cardia with bifurcate base).

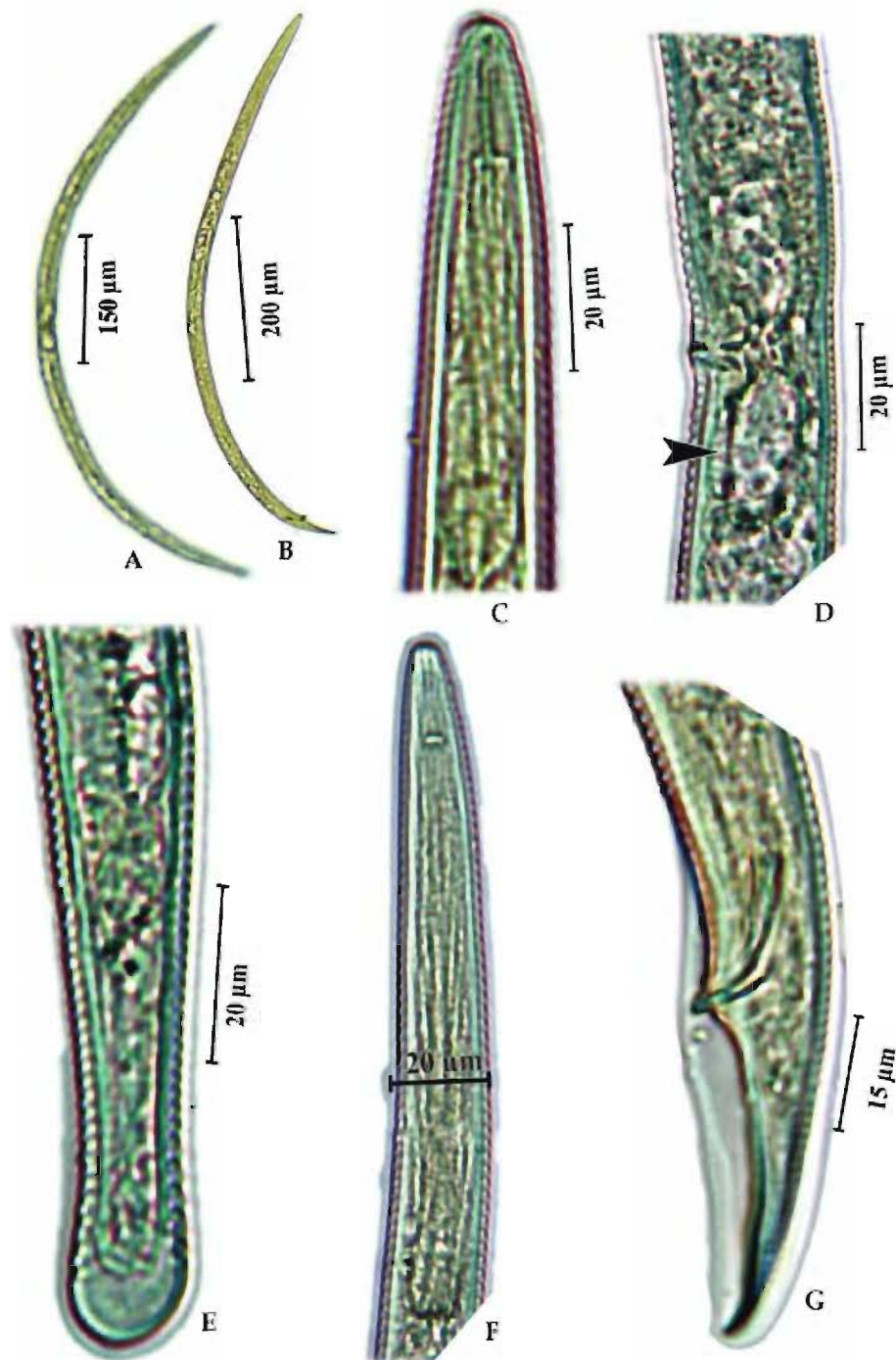


Figure 2. Photomicrographs of *Trophurus clavicaudatus* sp. n. Female: A. Entire body, C. Anterior end, D. Vulva & posterior uterine sac, E. Posterior body end showing tail. Male: B. Entire body, F. Anterior end, G. Posterior end showing spicules & bursa.

Table 1. Morphometric data on *Trophurus clavicaudatus* sp. n. (All measurements are in μm except L and body ratios, L in mm. As only one paratype female was available, minimum-maximum range, mean, SD & SE calculated on the basis of male paratypes. Number of paratypes examined given in the parenthesis)

Characters	Holotype female	Female Paratype(1)	Male paratypes (4)				
			Min	Max	Mean	$\pm$ SD	SE
L	0.79	0.74	0.66	0.72	0.7	0.02	0.01
<i>a</i>	32.6	33.6	27.3	32.9	30.4	2.85	1.42
<i>b</i>	5.9	5.5	5.2	5.7	5.5	0.19	0.09
<i>c</i>	15.5	12.5	14.4	16.7	15.5	1.15	0.57
<i>c'</i>	3.0	3.9	2.5	2.9	2.7	0.2	0.1
V % ♀ / T % ♂	51.5	55.3	31.4	36.3	33.5	2.04	1.02
G1%	20.5	20.5	--	--	--	--	--
G2 %	3.0	3.6	--	--	--	--	--
Lip region height	3.0	3.0	2.0	4.0	3.0	0.93	0.47
Lip region width	7.5	6.5	5.5	6.0	5.7	0	0
Length of stomatostylet	17.0	17.5	14.5	15.5	15.0	0.49	0.24
Stylet knobs (across)	5.0	5.0	3.0	4.0	3.5	0.49	0.24
Length of conus	8.0	8.5	6.5	7.0	6.7	0.2	0.1
m %	47.0	50.0	46.6	47.6	47.0	0.49	0.24
Stylet base to opening of dorsal gland	2.0	2.0	--	--	--	--	--
O %	11.7	11.3	--	--	--	--	--
Maximum body width	24.5	22.0	22.0	24.5	23.0	1.44	0.72
Body width at vulva	22.0	22.0	--	--	--	--	--
Length of vagina	11.5	11.0	--	--	--	--	--
Pharyngeal length	135.0	135.0	117.5	137.0	128.0	8.71	4.36
Anterior end to nerve ring	96.0	91.0	71.5	90.0	82.0	9.6	5.54
Anterior end to excretory pore	103.0	110.0	98.0	100.5	99.6	1.44	0.83
Length of anterior gonad	164.0	149.5	--	--	--	--	--
Length of posterior uterine sac	24.5	27.0	--	--	--	--	--
Anterior end to vulva	412.0	409.0	--	--	--	--	--
Tail length	51.5	59.0	42.0	49.0	45.0	3.03	1.51
Anal body width	17.0	15.0	15.0	17.0	16.5	1	0.5
Length of hyaline portion on tail	8.5	7.0	--	--	--	--	--
Number of tail annules	24	25	--	--	--	--	--
Testis length	--	--	220.5	255.0	235.9	15.67	7.83
Length of Spicules	--	--	22.5	24.5	23.5	0.82	0.4
Length of bursa	--	--	58.0	65.5	61.0	3.57	1.78
Length of gubernaculum	--	--	7.5	10	8.8	0.8	0.4

Apart from these, *T. clavicaudatus* sp. n. shows remarkable resemblance with *T. minnesotensis* (Caveness, 1958) Caveness, 1958 in different body measurements and ratios. Even of those similarities, the new species differs from *T. minnesotensis* in having significantly lesser 'c' value in both female and male, clavate tail in female, anteriorly placed vulva, longer post-uterine sac and spear (in *T. minnesotensis*, *c* = 18 in female and 35 in male; tail broadly rounded in female; *V* = 58%; post-uterine sac 2 or 3 rudimentary terminal cells and spear = 14.0µm).

2. *Tylenchorhynchus mashhoodi* Siddiqi
and Basir, 1959
(Figure 3)

Measurements:

Females (n = 3): L = 0.55 – 0.56mm; *a* = 28.1 – 28.5; *b* = 4.6–4.7; *c* = 12.8–13.0; *c'* = 3.9; *V* = 57.1 – 57.7%; *G*₁ = 15.0–23.5%; *G*₂ = 13–21%; stylet length = 19.5–20.5µm; *m* = 52.0–55.0%; *O* = 14.0–22.5%; anterior end to centre of median bulb = 60.5–61.5µm, MB = 50.8–52.0%; maximum body width = 19.5µm, length of pharynx = 118.5–119.5µm; body width at vulva = 15.5–17.5µm; distance of vulva from anterior end = 315.5–323.5µm; length of vagina = 6.5–8.0µm; length of anterior branch of gonad = 83.0–132.0µm; length of posterior branch of gonad = 71.5–116.5µm; tail length = 43.0µm; anal body diameter = 10.5µm.

Males (n = 2): L = 0.58–0.66mm; *a* = 28.0–29.6; *b* = 4.6–4.9; *c* = 15.7–17.4; *c'* = 2.3; *T* = 25.5–55.4%; stylet length = 19.5–18.5µm; *m* = 50.0–52.6%; *O* = 15.7–17.5%; anterior end to centre of median bulb = 64.5–76.5µm; MB = 51.0–56.5%; maximum body width = 21.0–22.5µm, length of pharynx = 127.0–135.0µm; tail length = 37.0–38.0µm; anal body diameter = 15.5–16.5µm.; length of testis = 309.0–369.5µm; spicule length = 20.5–23.5µm; gubernaculum = 9.5–10.5µm; length of bursa = 57.0–64.0µm.

DESCRIPTION

Females : Body ventrally curved on fixation. Body striae coarse, cuticle marked with distinct transverse striations, 1.0–2.5µm apart. Lateral field one-third of body width, with four incisures.

Lip region continuous with body, rounded, bearing 3–4 fine and distinct annules, measuring 3.0–4.0µm high and 5.5–6.5µm wide. Cephalic frame

work lightly sclerotized. Stomatostylet 2.8–3.4 lip region widths long, stylet knobs small, closely packed together, rounded or directed downward slightly, measuring 3.0µm across. Opening of dorsal pharyngeal gland 3.0–4.5µm behind the stylet base. Median oesophageal bulb muscular, set off from precorpus with vulvular apparatus, round to oval in shape. Centre of median bulb 60.5–62.0µm from anterior end. Basal oesophageal bulb pyriform, 23.5–24.5µm long, with basal portion slightly overlapping the anterior most end of intestine. Cardia small, rounded. Nerve ring at 70.5–84.0µm from anterior end. Excretory pore slightly posterior to nerve ring, 80.0–97.0µm from anterior end or 6–13 annules from the end of median bulb. Hemizonid indistinct. Vulva a transverse slit, post equatorial in position. Length of vagina about one-third of the vulval body-diameter. Reproductive system amphidelphic, ovaries out stretched, oocytes arranged in a single row. Tail cylindrical, slightly ventrally arcuate, regularly tapering, marked with 16–21 annules ventrally, 3.9 anal body-diameters long. Tail terminus rounded and smooth. Phasmids in the anterior half of tail, 5–7 annules apart from anal opening or at 22.5–34.0% of tail from anus.

Males : Similar to females in general morphology except the following. Tail conoid with acute terminus in lateral view, 2.2–2.3 anal body-diameters long. Testis single, outstretched. Spicules cephalated, 1.3–1.4 anal body-widths long. Gubernaculum short, about half of the spicule length. Copulatory bursa large with crenate margins, completely enveloping tail.

Remarks : The present specimens conform well to the type specimens and all other reported specimens of *Tylenchorhynchus mashhoodi* Siddiqi and Basir, 1959 from different parts of India.

Habitat and locality : Collected from soil around the roots of litchi at South Kalyanpur of Baruipur block, South 24-parganas on 13. 12. 2004.

SUMMARY

A few specimens of *Trophurus clavicaudatus* sp. n. and *Tylenchorhynchus mashhoodi* Siddiqi and Basir, 1959 were collected from soil around the roots of litchi at South 24-Parganas district, West Bengal, India. The new species has been characterized by its club-shaped tail and can be differentiated from other species of the genus. It comes closer to *T. similis* Khan and Nanjappa, 1971,

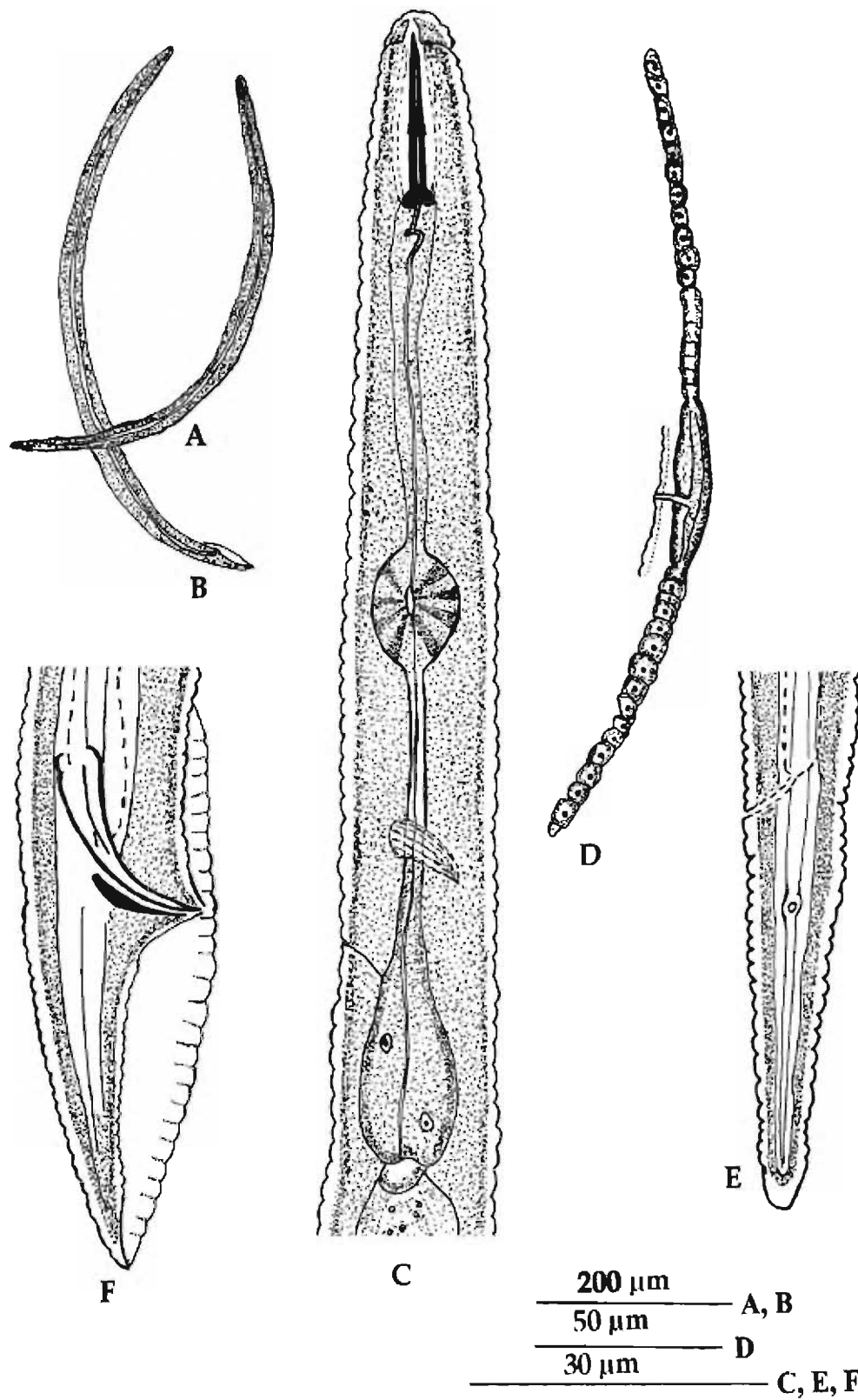


Figure 3. *Tylenchorhynchus mashhoodi*. Female: A. Entire body, C. Anterior portion of body, D. Reproductive system, E. Posterior end showing phasmid & tail. Male: B. Entire body, F. Posterior end showing spicule, bursa, gubernaculum & tail.

T. lomus Saha, Chawla & Khan, 1973 and *T. impar* Ganguly and Khan, 1983 among the species described from India. Apart from these, *T. clavicaudatus* sp. n. also shows remarkable resemblance with *T. minnesotensis* (Caveness, 1958) Caveness, 1958 described from outside India having clear differences in body ratios and measurements. This is the first report of the genus *Trophurus* from

the West Bengal, India. The present specimens of *Tylenchorhynchus mashhoodi* conform well to the earlier reports. *T. mashhoodi* is widely distributed in West Bengal as well as in India.

ACKNOWLEDGEMENT

The authors are grateful to the Director, Zoological Survey of India, Kolkata, India.

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A NEW SPECIES OF THE GENUS *OXYOPES* LATRIELLE (ARANEAE: OXYOPIDAE) FROM SAHYADRI RANGES OF WESTERN GHATS

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INTRODUCTION

Thorell established the family Oxyopidae in 1870 consisting of the type genus *Oxyopes* which was established by Latrielle in 1804. Walckenaer for the first time recorded the genus from Indian sub-continent in 1805. Remarkable works in India on the family Oxyopidae were done by Thorell (1887), Tikader (1965), Gajbe (1999, 2000, and 2008), Biswas and Roy (2005). While examining the collections from plateau region of Satara Dist (Maharashtra), we found an *Oxyopes* species that is new to science. We diagnosed it and describe, illustrate here as sp.nov. in the present study under the name *Oxyopes sataricus*.

The study area i.e. Satara Lat 17°42' N and Lon 74°02' E lies in the western part of Maharashtra State and the climate here is tropical wet and dry.

The specimen was collected from Udtare village (Dist: Satara) (see map) in a Banana plantation (*Musa indica*) and preserved in 70% ethanol. Observations were done using the dissecting microscope; the genitalia was dissected and kept in clove oil for 24hrs. The genitalia was observed and drawn. All measurements are in millimetres.

Family OXYOPIDAE Thorell 1870

Type-genus: *Oxyopes* Latrielle 1804

Distribution: All tropical and sub-tropical regions of world.

General : Type-material ♀ holo-type specimen is deposited in the National Zoological Collections vide Ar/425 at Zoological Survey Of India, Pune.

Type-locality : India, Maharashtra, Satara, Pachwad village, NH4 road; Coll. A.S. Shewale, Sidharth Kulkarni on 10 Oct 2011.

Other material : 2 ♀, Satara, Kurneshwar Garden, 1 running along the branch of Jasmine tree (*Hibiscus rosa sinensis*) and other underside of the leaf on the same plant. 1 ♀, Satara, Ajinkyatara fort, near South gate, on underside of leaf of Pala Indigo (*Wrightia tinctoria*). Coll. Sidharth Kulkarni.

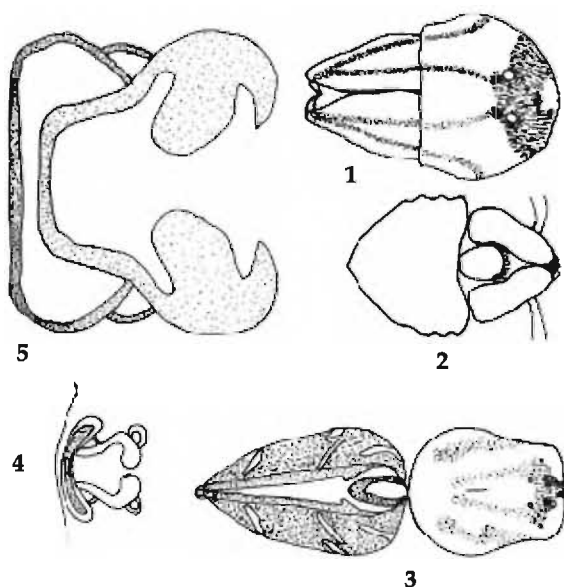
Distribution : India, Maharashtra, Satara.

General : Cephalothorax and legs brownish-yellow. Abdomen brown. Total length: 9.8 mm. Carapace 4.8 mm long and 3.7 mm wide; abdomen: 5 mm long and 3.5 mm wide.

Cephalothorax : Longer than wide; widest just at fovea and narrower in front. Anterior row strongly recurved, posterior row broadly procurved. Top of eyes covered encircled with orange patches. Ocular quad covered with dirty white pubescence extending till posterior laterals continuing as two narrow lines ending up at base of fovea. Clypeus high. Small tooth-like projection or spur present just behind the boss [Fig.1]. Sternum heart-shaped and pointing towards the posterior side, sparsely covered with pubescence. Labium longer than wide. Maxillae slightly oval in shape; slant in position and bear two distinct spines on the posterior-lateral sides [Fig.2]. All legs two-clawed. Greenish longitudinal lines present on femora of all legs. All legs sparsely covered with pubescence. No spines present on ventral side of femur II, III, IV. Micro-setae present on dorsal side of femur of all legs. Long spines on tibia and meta-tarsus of all legs.

Abdomen : Longer than wide. Oval, narrowing behind. An orange longitudinal band present mid-dorsally, extending till the posterior end. Lateral sides brown with three pairs of white bands. [Fig.3]

Brownish black long band present mid-ventrally extending from posterior of epigastric furrow till the spinnerets. Epigyne as in Fig. 4. Internal genitalia containing bulged and internally bent genitalia and distinguishable fertilisation duct. [Fig.5]



Figures 1-5 : *Oxyopes sataricus* sp. nov; 1. Face frontal view; 2. Sternum and labium; 3. Female body view; 4. Epigyne; 5. Internal genitalia. Kulkarni and Deshpande

DISCUSSIONS

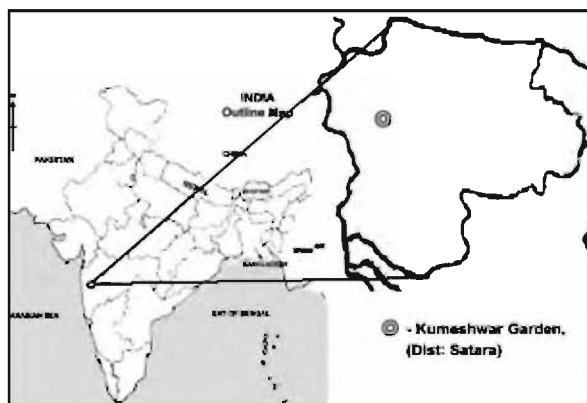
This species shows resemblance with *Oxyopes pankaji* Gajbe & Gajbe 2000 but it differs in following characters compared with those given by Gajbe (2008):

1. Cephalothorax, legs and abdomen reddish-green in *O. pankaji* but in *O. sataricus* Cephalothorax, legs yellowish-brown and abdomen brown.
2. Base of each eye encircled with black patch in *O. pankaji* but top of each eye encircled with orange patch in *O. sataricus*
3. Ocular quad covered with dirty white patch in *O. sataricus* but absent in *O. pankaji*
4. Femora of all legs provided with longitudinal black lines in *O. pankaji* but present only on femora III and IV in *O. sataricus*.
5. Pair of ducts broad in *O. pankaji*, much thin in *O. sataricus* spermatheca much bent inwards than in *O. sataricus*.
6. Fertilisation duct bent in *O. pankaji*, but raised in *O. sataricus*

Etymology : The species is named after the locality Satara.

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Map of India showing the study area



O. staricus female; sternum, maxillae and labium



Oxyopes sataricus female dorsal face view

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IDENTIFICATION OF DORSAL GUARD HAIRS OF NINE SPECIES OF THE FAMILY BOVIDAE (ARTIODACTYLA: MAMMALIA)

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INTRODUCTION

Tricho-taxonomic study of hair is very much significant in the study of mammalian taxonomy along with food habit, ecology, behaviour and even in the control of illegal trade of wildlife and its derivatives. Importance of hair analysis have been focused by a number of workers (Adorjan & Kolenosky 1969, Mathiak 1938, Williams 1938, Mayer 1952, Hausman 1920, Moore *et al.*, 1974, Koppikar & Sabnis 1976, 1977, Terrink 1991, Wallis 1993, De & Chakraborty 1995, 1998, 2002, 2006, Chakraborty & De 2001, 2002, 2005, Chakraborty *et al.*, 1996, 1999, Toth 2002). But meager information is available on the hair structure of the species of the family Bovidae (Order: Artiodactyla).

Out of nineteen Bovid species in India, only nine species are dealt in the present paper. Among the nine species five have been included in Schedule I and rest in the Schedule II or III in the Indian Wildlife (Protection) Act, 1972 amended in 2006 and five in CITES also (Table II). There is a standard identifying key (Pocock, 1941) by which a scientist can identify the species, if full specimen or the total skin is available. But this identifying key is not sufficient to identify the skin or products in part. It is expected that present study will help in identification of mammalia species from hair samples and also help in enforcement of wildlife Acts to check illegal trades.

MATERIALS AND METHODS

10-15 tufts of dorsal guard hairs were collected from the mid-dorsal region of three dry specimens of each species present in the Zoological Survey of India, Kolkata. The materials were processed for study following the method of Chakraborty *et al.*

(1996). Physical characteristics viz., diameter, total length were measured by the dial calipers and millimeter scale respectively and profile, banding pattern, colour were studied under WILD binocular. Nomenclature of colour is followed after Ridgway (1886). Other characteristics such as surface structure, medullary configuration, scale pattern and cross-sectional details were studied after Chakraborty *et al.*, (1996) and Brunner & Coman (1974). Structural nomenclature in respect of surface structure and medullary configuration is followed by Moore *et al.* (1974), Bruner and Coman (1974) and Teerink (1991).

OBSERVATIONS

Detailed results are shown in the table no. I and table no. II

1. *Budrocas taxicolor* Hodgson, 1850, Takin

Status : CITES: App. II

A. Physical Characters

- (i) Profile : Curly
- (ii) Colour : Tip-Claret Brown, Base-Orchraceous Rufous
- (iii) No. of bands: 2
- (iv) Length (mm): 44-99 (52.18 ± 3.55)
- (v) Diameter (μ): 80-120 (105 ± 5.80)

B. Surface Structure (Plate I, Fig. 3)

- (i) Scale margin distance: Close
- (ii) Scale margin: Smooth
- (iii) Scale count per mm length of hair : 225-415 (320 ± 20.15)
- (iv) Scale pattern: Irregular

- (v) Side to side scale length (SS): 22-42 (28 ± 3.2)
- (vi) Proximo-distal scale length (PD): 10-15 (12.2 ± 1.25)

C. Medulla (Plate I, Fig. 2)

- (i) Medullary configuration: Wide Medulla lattice
- (ii) Medullary Index: 0.478-0.629 (0.48 ± 0.002)

D. Transverse Section: Circular (Plate I, Fig. 1)

2. *Boselophus tragocamelus* (Pallas, 1766) ., Blue Bull

Status: IWPA: Sch. III

A. Physical Characters

- (i) Profile : Straight
- (ii) Colour : Black
- (iii) No. of bands : none
- (iv) Length (mm) : 55-94 (74.83 ± 9.59)
- (v) Diameter (μ) : 100-150 (120 ± 9.45)

B. Surface Structure (Plate I, Fig. 6)

- (i) Scale margin distance : Distant
- (ii) Scale margin : Smooth
- (iii) Scale count per mm length of hair : 200-260 (225 ± 15.64)
- (iv) Scale pattern : Regular wave
- (v) Side to side scale length(SS) : 30-36 (32 ± 1.5)
- (vi) Proximo-distal scale length(PD) : 6-13 (9.2 ± 2.51)

C. Medulla (Plate I, Fig. 5)

- (i) Medullary configuration : Multiserial ladder
- (ii) Medullary Index: 0.812-0.888 (0.84 ± 0.025)

D. Transverse Section: Circular (Plate I, Fig. 4)

3. *Antelope cervicapra* (Linnaeus, 1758) ., Black Buck

Status: IWPA: Sch. I, Pt. I; CITES: App. III

A. Physical Characters

- (i) Profile : Straight
- (ii) Colour : Hair Brown
- (iii) No. of bands: none
- (iv) Length (mm) : 14-19 (16.76 ± 1.27)

- (v) Diameter (μ) : 40-60 (55 ± 3.75)

B. Surface Structure : (Plate II, Fig. 2)

- (i) Scale margin distance : Distant
- (ii) Scale margin : Smooth
- (iii) Scale count per mm length of hair : 152-220 (195 ± 14.02)
- (iv) Scale pattern : Regular wave
- (v) Side to side scale length(SS) : 28-62 (35 ± 4.25)
- (vi) Proximo-distal scale length(PD) : 13-26 (15.45 ± 1.73)

C. Medulla : (Plate II, Fig. 3)

- (i) Medullary configuration : Reversed Cloisone
- (ii) Medullary Index: 0.916-0.925 (0.92 ± 0.003)

D. Transverse Section : Concave (Plate II, Fig. 1)

4. *Hemitragus jemlahicus* (Smith, 1826) ., Himalayan Tahr

Status: IWPA : Sch. I, Pt. I

A. Physical Characters

- (i) Profile : Straight
- (ii) Colour: Tip-Clove Brown, Base-Hair Brown
- (iii) No. of bands: 2
- (iv) Length (mm): 65-86 (76.33 ± 5.14)
- (v) Diameter (μ): 60-100 (75 ± 10.75)

B. Surface Structure (Plate II, Fig. 6)

- (i) Scale margin distance: Close
- (ii) Scale margin: Crenate
- (iii) Scale count per mm length of hair: 280-420 (375 ± 18.70)
- (iv) Scale pattern: Irregular wave
- (v) Side to side scale length(SS): 24-42 (32 ± 3.95)
- (vi) Proximo-distal scale length(PD): 11-17 (12.25 ± 1.10)

C. Medulla (Plate II, Fig. 5)

- (i) Medullary configuration: Narrow medulla lattice
- (ii) Medullary Index: 0.602-0.619 (0.61 ± 0.005)

D. Transverse Section : Hexagonal
(Plate II, Fig. 4)

5. *Naemorhedus goral* (Hardwicke, 1825) ., Goral

Status: CITES: App. I

A. Physical Characters

- (i) Profile: Straight
- (ii) Colour: Tip-Clove Brown, 2nd band-Broccoli Brown, 3rd band-Prout's Brown, 4th band-Mars Brown
- (iii) No. of bands: 4
- (iv) Length (mm): 48-58 (52±3.51)
- (v) Diameter (μ): 40-90 (65±5.95)

B. Surface Structure (Plate III, Fig. 4)

- (i) Scale margin distance: Distant
- (ii) Scale margin: Smooth
- (iii) Scale count per mm length of hair: 210-275 (245±16.05)
- (iv) Scale pattern: Regular wave
- (v) Side to side scale length(SS): 32-40 (35±2.75)
- (vi) Proximo-distal scale length(PD): 9-14 (10.25±1.21)

C. Medulla (Plate III, Fig. 2)

- (i) Medullary configuration: Globular
- (ii) Medullary Index: 0.611-0.615 (0.612±0.001)

D. Transverse Section : Circular
(Plate III, Fig. 1)

6. *Ovis ammon* (Linnaeus, 1758) ., Argali

Status: IWPA: Sch I, pt. I; CITES: App. I

A. Physical Characters

- (i) Profile: Curly
- (ii) Colour: Sepia
- (iii) No. of bands: none
- (iv) Length (mm): 47-56 (49.91±2.56)
- (v) Diameter (μ): 40-100 (75±15.50)

B. Surface Structure (Plate III, Fig. 6)

- (i) Scale margin distance: Near

- (ii) Scale margin: Rippled

- (iii) Scale count per mm length of hair: 288-425 (360±10.24)

- (iv) Scale pattern: Irregular wave

- (v) Side to side scale length(SS): 36-48 (38±1.05)

- (vi) Proximo-distal scale length(PD): 11-15 (12.30±1.22)

C. Medulla (Plate III, Fig. 5)

- (i) Medullary configuration: Narrow medulla lattice

- (ii) Medullary Index: 0.645-0.656 (0.65±0.002)

D. Transverse Section : Spindle type
(Plate III, Fig. 3)

7. *Gazella bennetti* (Sykes, 1831) ., Chinkara

Status: IWPA: Sch II, pt. II

A. Physical Characters

- (i) Profile: Straight
- (ii) Colour: Gray
- (iii) No. of bands: none
- (iv) Length (mm): 18-27 (21.09±2.60)
- (v) Diameter (μ): 30-50 (45±3.45)

B. Surface Structure (Plate IV, Fig. 3)

- (i) Scale margin distance: Near
- (ii) Scale margin: Smooth
- (iii) Scale count per mm length of hair: 175-210 (190±10)
- (iv) Scale pattern: Regular wave
- (v) Side to side scale length(SS): 28-32 (30±1.5)
- (vi) Proximo-distal scale length(PD): 12-18 (14.50±2.25)

C. Medulla (Plate IV, Fig. 2)

- (i) Medullary configuration: Narrow medulla lattice

- (ii) Medullary Index: 0.925-0.944 (0.93±0.003)

D. Transverse Section: Oval (Plate IV, Fig. 1)

8. *Pseudois nayaur* (Hodgson, 1833) ., Blue sheep

Status: IWPA: Sch I, pt. I

A. Physical Characters

- (i) Profile: Straight
- (ii) Colour: Cream Buff
- (iii) No. of bands: none
- (iv) Length (mm): 41-60 (50.36 ± 6.05)
- (v) Diameter (μ): 40-110 (85 ± 7.65)

B. Surface Structure (Plate IV, Fig. 5)

- (i) Scale margin distance: Distant
- (ii) Scale margin: Smooth
- (iii) Scale count per mm length of hair: 310-335 (290 ± 25)
- (iv) Scale pattern: Regular wave
- (v) Side to side scale length(SS): 32-40 (35 ± 2.75)
- (vi) Proximo-distal scale length(PD): 9-14 (10.25 ± 1.21)

C. Medulla (Plate IV, Fig. 4)

- (i) Medullary configuration: Filled
- (ii) Medullary Index: 0.932-0.951 (0.94 ± 0.005)

D. Transverse Section : Circular (Plate IV, Fig. 6)**9. Naemorhedus sumatraensis** (Bechstein, 1799), Serow

Status: IOWA: Sch I, pt. I; CITES: App. I

A. Physical Characters

- (i) Profile: Straight
- (ii) Colour: Black
- (iii) No. of bands: none
- (iv) Length (mm): 31-45 (38.8 ± 4.62)
- (v) Diameter (μ): 100-150 (125 ± 1.5)

B. Surface Structure (Plate V, Fig. 3)

- (i) Scale margin distance: Distant
- (ii) Scale margin: Smooth
- (iii) Scale count per mm length of hair: 360-450 (400 ± 15.25)
- (iv) Scale pattern: Regular wave
- (v) Side to side scale length(SS): 30-41 (33 ± 2.60)
- (vi) Proximo-distal scale length(PD): 17-22 (19 ± 1.95)

C. Medulla (Plate V, Fig. 2)

- (i) Medullary configuration: Simple
- (ii) Medullary Index: 0.595-0.658 (0.62 ± 0.105)

D. Transverse Section: Circular (Plate V, Fig. 1)**DISCUSSION**

Coat colour of the species belonging to the family Bovidae possess different shades of brown colour. The colour of dorsal guard hairs of *C. sumatraensis* and *B. taxicolor* is more blackish than the other species studied. *N. goral* is having different shades of brown, arranged in bands, starting from tip it is Clove Brown, Broccoli Brown, Prout's Brown and Mars Brown. In case of *H. jemlahicus* it is Clove Brown at tip and Hair Brown at the base. Coat colour of *O. amon* and *P. nayaur* is Sepia and Cream Buff respectively. Hairs of *G. bennetti* is generally black to Grey but almost White at proximal end and gradually turns to black at distal region with various shades of Brown in *B. tragocamelus*. According to Koppikar & Sabnis (1976) coat colour of *A. cervicapra* is Black at terminal and Grey at proximal end, but in the present study it was observed that female *A. cervicapra* is having Brown coat colour with shades of White & Black. As such, coat colour of mammalian species varies according to sex, age, habitat and season. It is observed that dorsal guard hairs of *B. taxicolor*, *H. jemlahicus* and *N. goral* are banded and others are devoid of any band. Only two species i.e. *B. taxicolor* and *O. amon* have curly dorsal hairs and profile of the rest species is straight (Table I).

The average minimum hair length was observed as (16.76 ± 1.27) in *A. cervicapra* and the maximum was observed in *H. jemlahicus* as (76.33 ± 5.14) (Table I). In the present study, the range of hair length in *G. bennetti* was observed (18-27 mm with an average of (21.09 ± 2.60)). Koppikar & Sabnis (1976) observed 18 to 22 mm hair length in the same species. Hair length of *B. tragocamelus* observed in the present study as 55-94 mm (Table I) but Koppikar & Sabnis (1976) reported the same 23-27 mm. In fact the length of dorsal guard hairs in the Bovid species varies a lot not only in between the species but in the same species also. The lowest diameter observed in *G. bennetti* as (45 ± 3.45) μ and highest as (125 ± 1.5) μ (Table I). Koppikar & Sabnis (1976) reported the

diameter of hair of *G. bennetti* as $54\ \mu$ which differs very little from the present study. The average diameter of *B. tragocamelus* was observed in the present study as $(120\pm 9.45)\ \mu$ and the same was reported by Koppikar & Sabnis (1976) as $140\ \mu$ which differs not much from the present study. Hair stem of Bovid species is very fragile and breaks easily and the same type of observation was noted by Koppikar & Sabnis (1976). Though observation of Koppikar & Sabnis (1976) in respect of average length and diameter of hairs of *A. cervicapra* and *G. bennetti* is in conformity with the present study yet. Hausman (1920) observed maximum hair diameter $105.40\ \mu$ in case of Thompson's Gazelle (*G. thompsoni nasalis*). Chakraborty *et al.* (1996) opined that difference in the length of hair within the same species may be attributed due to geographical and ecological factors. But according to Short (1978), diameter of hair is not specific, it varies from root to tip. Same type of observation has been made by Chakraborty & De (2005) in the study of hairs of species belonging to the family Viverridae. Hausman (1920) inferred that only a meagre amount of significance should be attached to hair magnitudes, except possibly in large averages, and between large groups, i.e. families or genera. So, from the present study, it may be pointed out that the average length & diameter of hairs may be considered as additional characters along with other characters at the time of identification. Moore *et al.* (1974) opined that the hairs of Artiodactyla species are generally larger than that of the species in other orders. The scale count per millimeter of hair length also differs greatly in the different species of the family Bovidae. It is interesting to note that the average scale count in *N. sumatraensis* is 400 ± 15.25 and that of *G. bennetti* is 190 ± 10 which is maximum and minimum respectively among the species studied (Table I). As this character is not so much variable, so it could not be considered as a distinct character for identification but the same could be taken as an additional character with age group of characters.

Scale pattern and scale margin are 'regular wave' and 'smooth' in *A. cervicapra*, *N. goral*, *G. bennetti* and *P. nayaur*. The same is 'regular mosaic' with 'smooth' margin in *B. tragocamelus* and *N. sumatraensis*. The dorsal guard hair of *H. jemlahicus*

and *O. ammon* are with 'irregular wave' scale pattern and 'crenate' and 'smooth' scale margin respectively (Table I). Koppikar & Sabnis (1976) also reported imbricate scale with smooth margin in the proximal and medial regions in case of hairs of *A. cervicapra*. The scale margin distance is 'distant' in *B. tragocamelus*, *A. cervicapra*, *N. goral*, *P. nayaur*, *N. sumatraensis*, whereas scale margin distance is 'close' in *B. taxicolor* & *H. jemlahicus* & 'near' in case of hairs of *O. ammon* & *G. bennetti*. So, these scalar characters may be used as identifying character with other characters.

'SS' does not varies much from species to species, which is lowest in *B. taxicolor* (28 ± 3.20) & highest in *O. ammon* & *P. nayaur* i.e. (38 ± 1.05) & (38 ± 3.20) respectively. The 'PD' observed is minimum in *B. tragocamelus* (9.2 ± 2.51), maximum in *N. sumatraensis* (19 ± 1.95) (Table-2). From the observation it may be opined that 'PD' is more or less similar in *B. taxicolor*, *H. jemlahicus*, *O. ammon* where as others vary to a small extent.

The present study shows "narrow medulla lattice" in *H. jemlahicus*, *O. ammon*, *G. bennetti*, whereas Koppikar and Sabnis (1975) reported 'continuous medulla' in *G. bennetti*. Wide medulla lattice' is observed in *B. taxicolor*. Whereas 'multiserial ladder', 'reversed cloisonne', 'glandular', 'filled', & 'Simple' medulla are noted in *B. tragocamelus*, *A. cervicapra*, *N. goral*, *P. nayaur* & *N. sumatraensis* respectively (Table-2). But Koppikar and Sabnis (1975) reported 'continuous medulla' in proximo-distal region of *B. tragocamelus* and 'fragmented' medulla in *A. cervicapra*.

Minimum medullary index (0.48 ± 0.002) is found in *B. taxicolor* and maximum (10.94 ± 0.005) in *P. nayaur*, which is almost similar in *A. cervicapra* (0.92 ± 0.003) and (0.938 ± 0.03) in *G. bennetti* (Table-2). Medullary index (0.64 ± 0.005), (0.65 ± 0.002) are found in *N. sumatraensis* and *O. ammon* respectively. *H. jemlahicus* and *N. goral* have almost same medullary index (0.61 ± 0.005) & (0.612 ± 0.001) respectively. Medullary index in *B. tragocamelus* is reported as (0.84 ± 0.025) only which is between the maximum and minimum (Table-2).

'Circular' transverse section is found in *B. taxicolor*, *B. tragocamelus*, *N. goral*, *P. nayaur* & *N. sumatraensis*. But 'Concave' section is noted in *A. cervicapra* and 'Hexagonal' in *H. jemlahicus*. Where

as *O. ammon* and *G. bennetti* posses 'Simple type' and 'Oval type' T.S. respectively (Table-2).

Based on the above characteristics of the dorsal guard hairs, a key to identify the different species of the Indian Bovid is presented below:

Key to the Indian species of the family Bovidae

1. Medullar index <0.50 2
 - Medullary index >0.50 3
2. Medullary index (0.48 ± 0.002), T.S. circular, medullary configuration 'wide medulla lattice', scale pattern 'irregular wave' with smooth scale margin, scale margin distance is 'close', Scale count/ mm (320 ± 20.15) *B. taxicolor*
3. T. S. circular 4
 - T. S. not circular 5
4. Medullary index (0.84 ± 0.025), medullary configuration 'multiserial ladder', scale pattern 'regular mosaic' with smooth margin, scale margin distance is 'distant', Scale count/ mm (225 ± 15.64) *B. tragocamelus*
 - Medullary index (0.612 ± 0.001), medullary configuration 'globular', scale pattern 'regular wave' with smooth scale margin, scale margin distance is 'distant', Scale count/ mm (245 ± 16.05) *N. goral*
 - Medullary index (0.94 ± 0.005), medullary configuration 'filled', scale pattern 'regular wave' with smooth margin and distance is 'distant', Scale count/ mm (290 ± 25) *P. nayaur*
 - Medullary index (0.62 ± 0.105), medullary configuration "simple", scale pattern 'regular mosaic' with smooth scale margin and scale margin distance is 'distant'; Scale count/ mm (400 ± 15.25) *N. sumatraensis*
5. Medullary configuration "narrow medulla lattice" 6

- Medullary configuration not "narrow medulla lattice" 7
- 6. T.S.' hexagonal', Medullary index (0.61 ± 0.005), scale pattern 'irregular wave' with crenate scale margin, scale margin distance 'close', Scale count/ mm (375 ± 18.70) *H. jemlahicus*
- T. S. 'spindle type', medullary index (0.65 ± 0.002), scale pattern 'irregular wave' with rippled scale margin, scale margin distance 'near', Scale count/ mm, (360 ± 10.24) *O. ammon*
- T.S. Oval, medullary index (0.93 ± 0.003), scale pattern 'regular wave' with 'smooth' scale margin, scale margin distance 'near', Scale count/ mm (190 ± 10) *G. bennetti*
- 7. Medullary configuration 'reversed cloisonné', T.S. concave, scale pattern 'regular wave' with smooth scale margin, scale margin distance 'distant', medullary index (0.92 ± 0.003), Scale count/ mm (195 ± 14.02) *A. cervicapra*

SUMMARY

The dorsal guard hairs of nine species of Indian Bovids viz., *B. taxicolor*, *B. tragocamelus*, *N. goral*, *P. nayaur*, *N. sumatraensis*, *H. jemlahicus*, *O. ammon*, *G. bennetti* and *A. cervicapra* have been studied. Among them only hairs of *B. taxicolor* posses medullary index <0.50 and medullary index of the rest of the species is >0.50 . Both medullary configuration and T.S. are of varied type among these 9 species. An identifying key is prepared on the basis of combination of characters such as transverse section, scale pattern, scale margin, scale margin distance, medullary configuration etc.

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Plate I

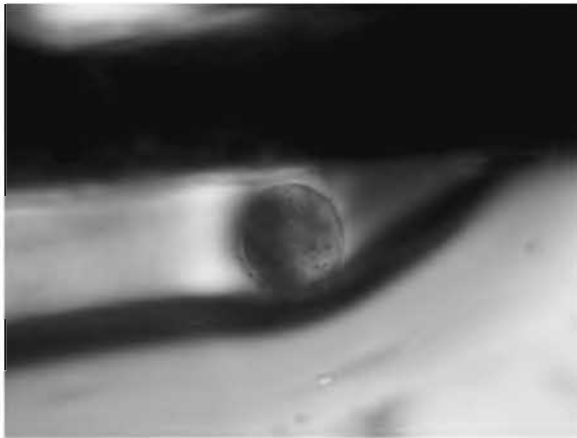


Fig. 1 : T.S. of dorsal guard hair of *B. taxicolor*

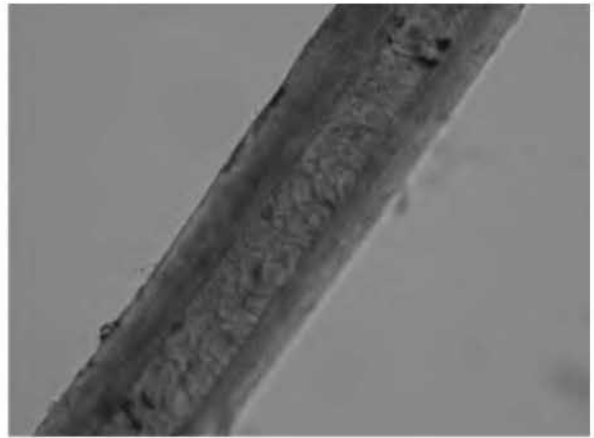


Fig. 2 : Medulla of dorsal guard hair of *B. taxicolor*

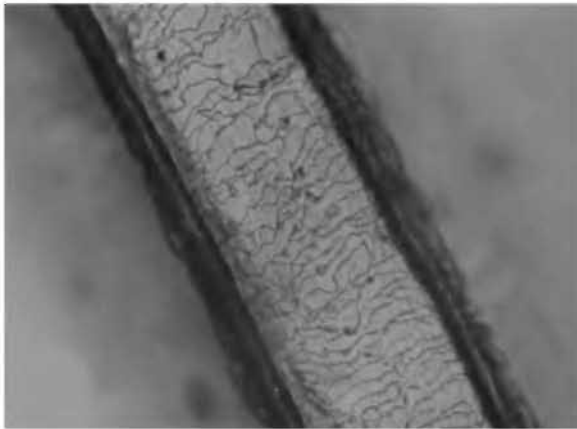


Fig. 3 : Cuticular scales of dorsal guard hair of *B. taxicolor*

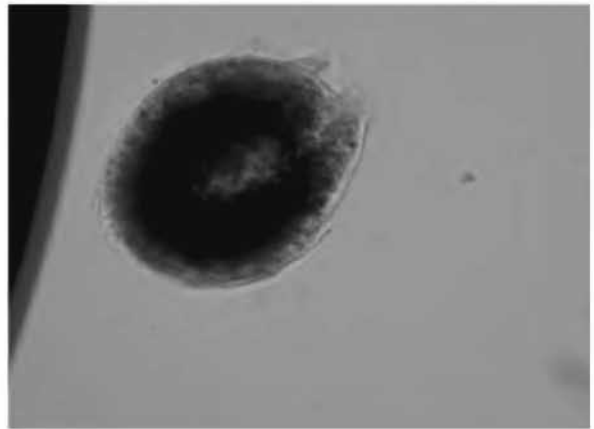


Fig. 4 : T.S of dorsal guard hair of *B. tragocamelus*

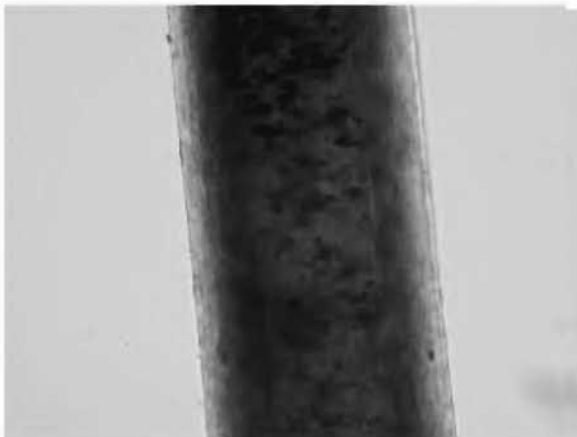


Fig. 5 : Medulla of dorsal guard hair of *B. tragocamelus*

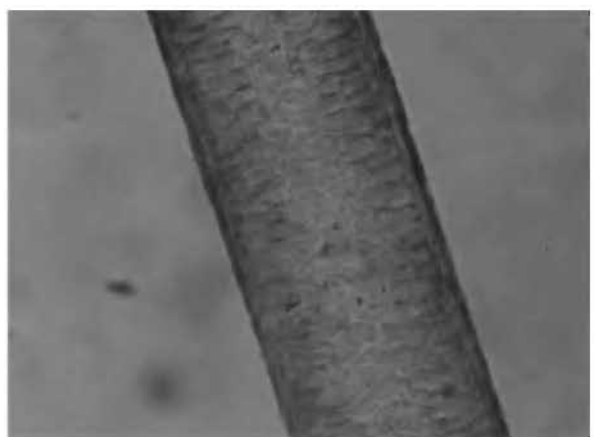


Fig. 6 : Cuticular scales of dorsal guard hair of *B. tragocamelus*

Plate II



Fig. 1 : T.S. of dorsal guard hair of *A. cervicapra*

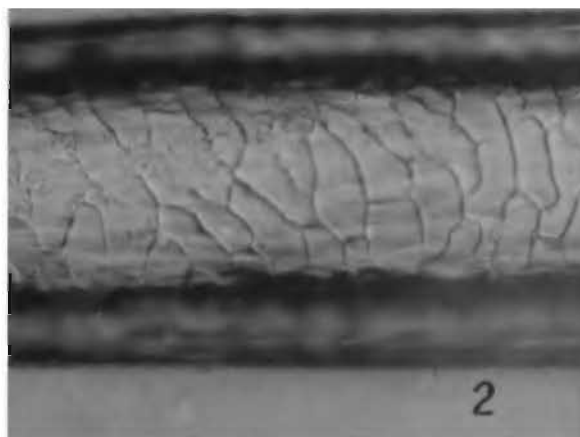


Fig. 2 : Cuticular scales of dorsal guard hair of *A. cervicapra*



Fig. 3 : Medulla of dorsal guard hair of *A. cervicapra*

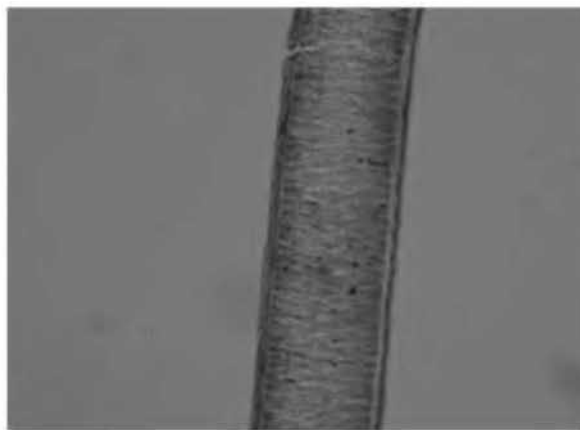


Fig. 4 : T.S. of dorsal guard hair of *H. jemlahicus*

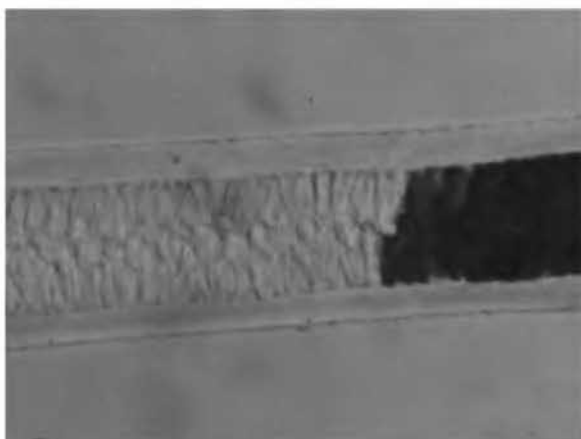


Fig. 5 : T.S. of medulla of dorsal guard hair of *H. jemlahicus*

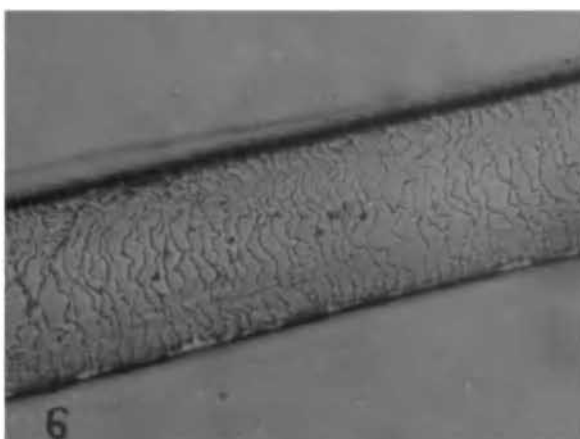


Fig. 6 : Cuticular scales of dorsal guard hair of *H. jemlahicus*

Plate III

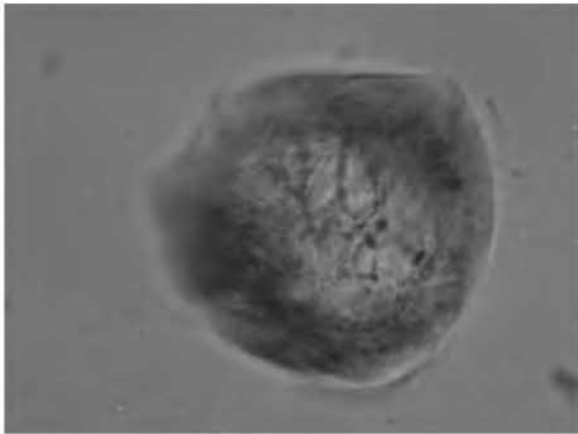


Fig. 1 : T.S. of dorsal guard hair of *N. goral*

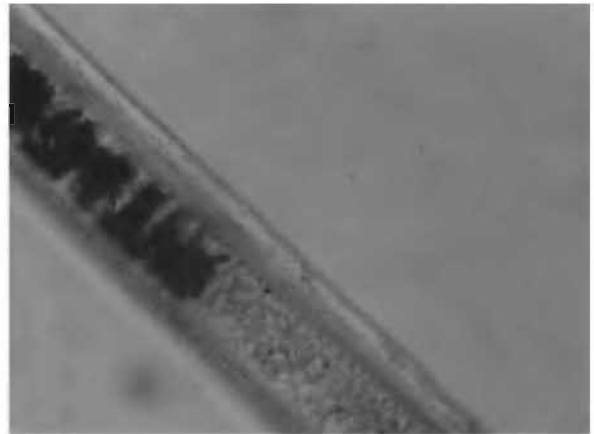


Fig. 2 : Medulla of dorsal guard hair of *N. goral*

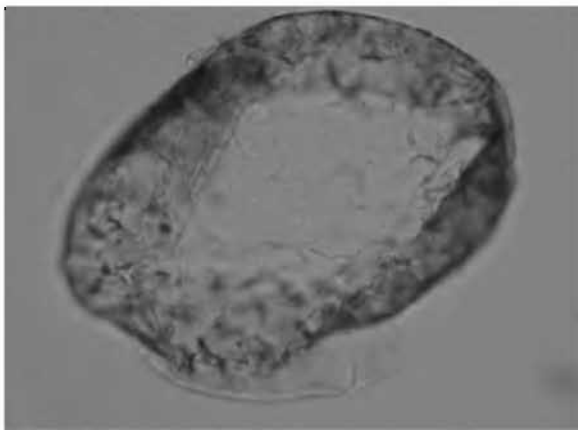


Fig. 3 : T.S. of dorsal guard hair of *O. ammon*

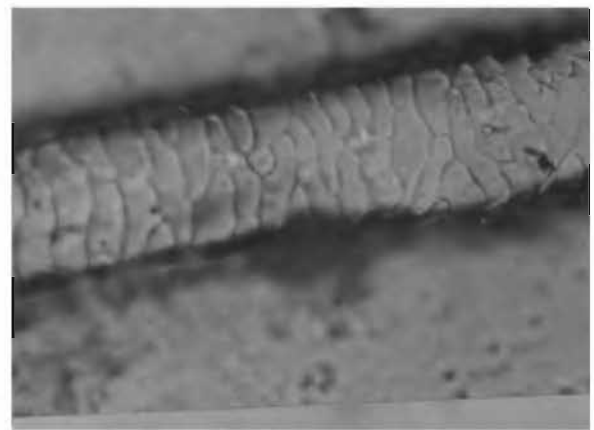


Fig. 4 : Cuticular scales of dorsal guard hair of *N. goral*



Fig. 5 : Medulla of dorsal guard hair of *O. ammon*

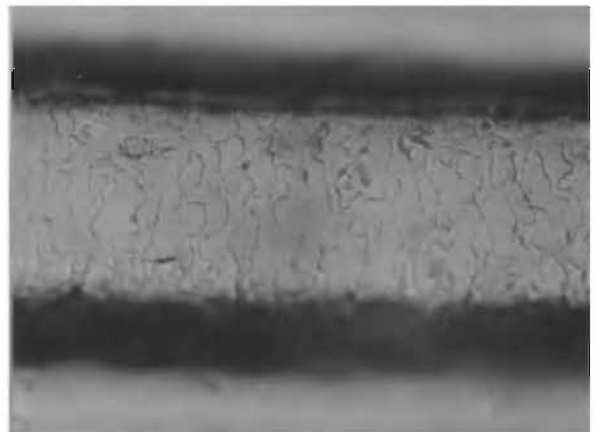


Fig. 6 : Cuticular scales of dorsal guard hair of *O. ammon*

Plate IV

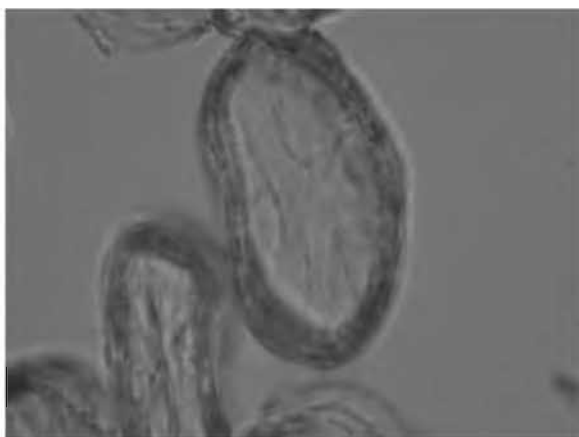


Fig. 1 : T.S. of dorsal guard hair of *G. bennetti*

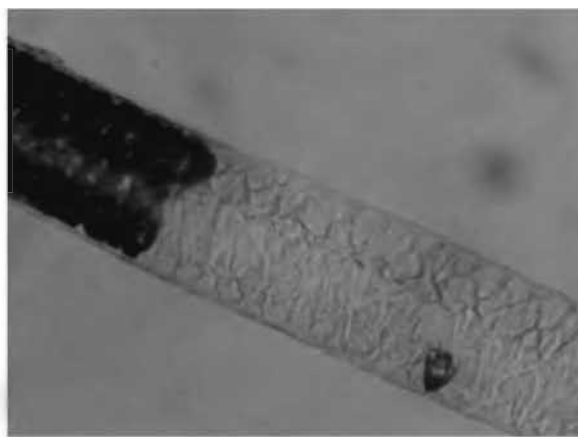


Fig. 2 : Medulla of dorsal guard hair of *G. bennetti*

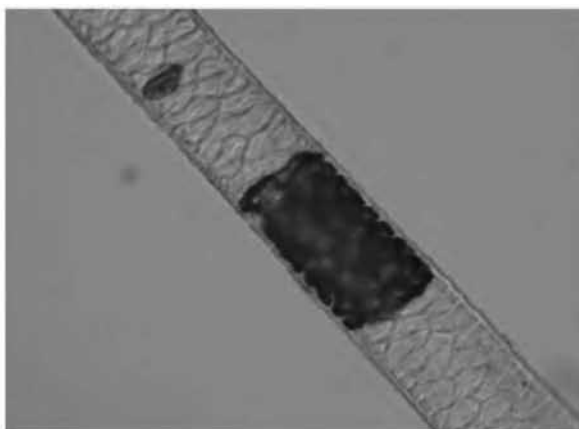


Fig. 3 : Cuticular scales of dorsal guard hair of *G. bennetti*

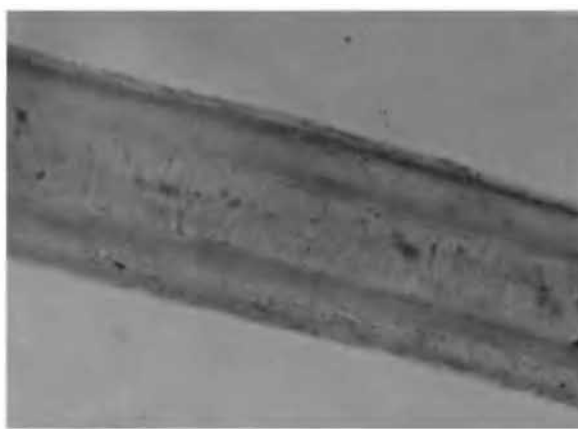


Fig. 4 : Medulla of dorsal guard hair of *P. nayaur*

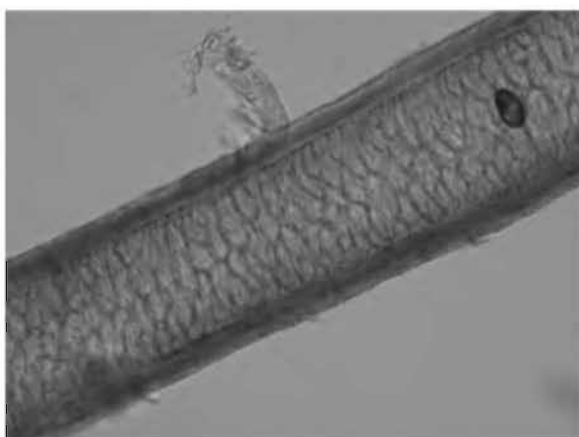


Fig. 5 : Cuticular scales of dorsal guard hair of *P. nayaur*

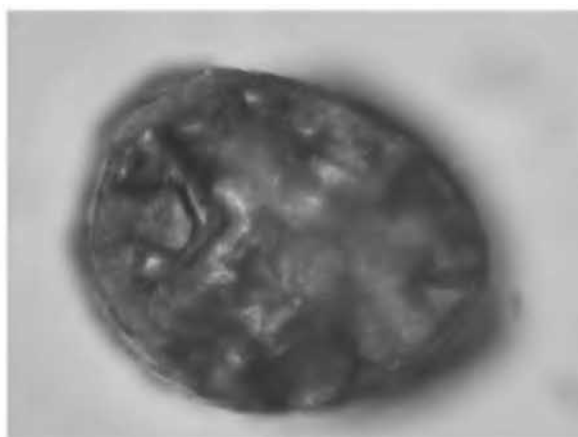


Fig. 6 : T.S. of dorsal guard hair of *P. nayaur*

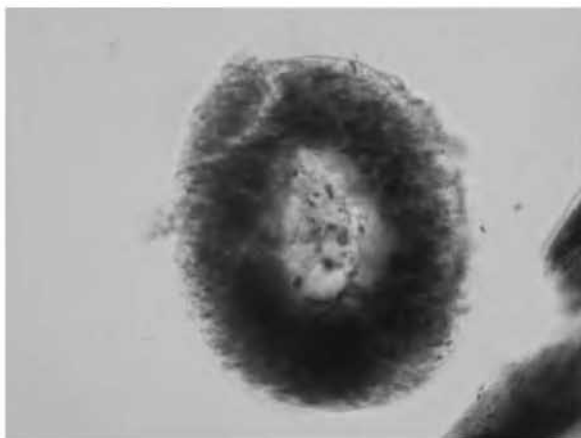
Plate V

Fig. 1: T.S. of dorsal guard hair of *N. sumatraensis*

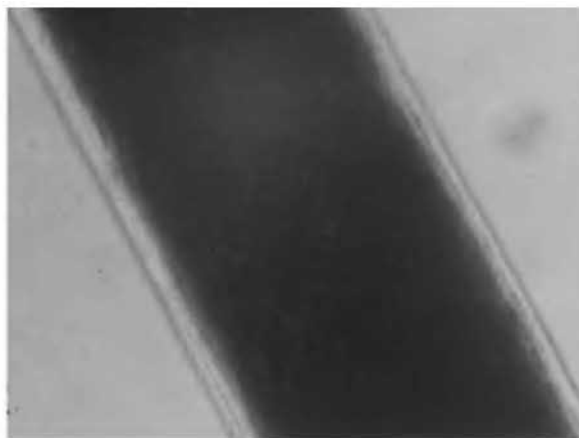


Fig. 2: Medulla of dorsal guard hair of *N. sumatraensis*

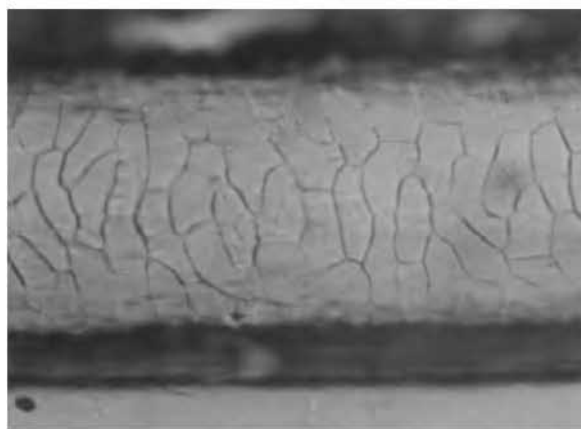


Fig. 3: Cuticular scales of dorsal guard hair of *N. sumatraensis*

Table I : Comparative account of the characteristics of the guard hairs of nine Indian species of the Family Bovidae(Mean and SD given in parenthesis).

Sl. No	Name of the species	Profile	Colour	No.of band	Scale margin Distance	Length (mm)	Diameter (i)	Scale count/ mm hair length	Scale Pattern	Scale Margin
1.	<i>Budrocas taxicolor</i>	Curly	Tip: Claret Brown Base: Orchrac-ceous Rufous	2	Close	44-99 (52.18 ± 3.55)	80-120 (105 ± 5.80)	225-415 (320 ± 20.15)	Irregular wave	Smooth (Pt. I, Fig.3)
2.	<i>Boselophus tragocamelus</i>	Straight	Black	-	Distant	55-94 (74.83 ± 9.59)	100-150 (120 ± 9.45)	200-260 (225 ± 15.64)	Regular mosaic	Smooth (Pt. I, Fig.6)
3.	<i>Antilope cervicapra</i>	Straight	Hair Brown	-	Distant	14-19 (16.76 ± 1.27)	40-60 (55 ± 3.75)	152-220 (195 ± 14.02)	Regular wave	Smooth (Pt.II, Fig.2)
4.	<i>Hemitragus jemlahicus</i>	Straight	Tip: Clove Brown Base: Hair Brown	2	Close	65-86 (76.33 ± 5.14)	60-100 (75 ± 10.75)	280-420 (375 ± 18.70)	Irregular wave	Crenate (Pt.II, Fig.6)
5.	<i>Naemorhaedus goral</i>	Straight	Tip:Clove Brown 2 nd band: Broccoli Brown 3 rd band: Prout's Brown 4 th band:Mars Brown	4	Distant	48-58 (52 ± 3.51)	40-90 (65 ± 5.95)	210-275 (245 ± 16.05)	Regular wave	Smooth (Pt.III, Fig.4)
6.	<i>Ovis ammon</i>	Curly	Sepia	-	Near	47-56 (49.91 ± 2.56)	40-100 (75 ± 15.50)	288-425 (360 ± 10.24)	Irregular wave	Rippled (Pt.III, Fig.6)
7.	<i>Gazella bennetti</i>	Straight	Gray	-	Near	18-27 (21.09 ± 2.60)	30-50 (45 ± 3.45)	175-210 (190 ± 10)	Regular wave	Smooth (PtIV, Fig.6) Fig.3
8.	<i>Pseudois nayaur</i>	Straight	Cream Buff	-	Distant	41-60 (50.36 ± 6.05)	40-110 (85 ± 7.65)	310-335 (290 ± 25)	Regular wave	Smooth (Pt.IV, Fig.5)
9.	<i>Naemorhedus sumatraensis</i>	Straight	Black	-	Distant	31-45 (38.8 ± 4.62)	100-150 (125 ± 1.5)	360-450 (400 ± 15.25)	Regular mosaic	Smooth (Pt. V, Fig.3)

Table 2: Comparative account of the characteristics of the guard hairs of nine Indian species of family Bovidae (Mean and SD given in parenthesis); 'SS' = Side to Side cuticular scale length; 'PD' = Proximo-distal cuticular scale length; T.S = Transverse Section.

Sl. No.	Name of the species	SS (i)	PD(i)	Medullary Configuration	Medullary Index	T.S	Common name/ Status
1.	<i>Budrocas taxicolor</i>	22-42 (28 ± 3.20)	10-15 (12.2 ± 1.25)	Wide Medulla Lattice (Pt. I, Fig.2)	0.478- 0.629 (0.48 ± 0.002)	Circular (Pt. I, Fig.1)	Takin CITES: CITES : Appendix II
2.	<i>Boselophus tragocamelus</i>	30-36 (32 ± 1.5)	6-13 (9.2 ± 2.51)	Multiserial Ladder (Pt. I, Fig.5)	0.812- 0.888 (0.84 ± 0.025)	Circular (Pt. I, Fig.4)	Blue Bull WL (P) Act,'72, Sch III
3.	<i>Antelope cervicapra</i>	28-62 (35 ± 4.25)	13-26 (15.45 ± 1.73)	Reversed Cloisonn'e (Pt. I I, Fig.3)	0.916- 0.925 (0.92 ± 0.003)	Concave (Pt.II, Fig.1)	Black Buck WL (P) Act,'72, Sch I, Part I CITES: Appendix III
4.	<i>Hemitragus jernlahicus</i>	24-42 (32 ± 3.95)	11-17 (12.25 ± 1.10)	Narrow Medulla Lattice (Pt. II, Fig. 5)	0.602- 0.619 (0.61 ± 0.005)	Hexagonal (Pt.II, Fig.4)	Himalayan Tahr WL (P) Act,'72, Sch I, Part I
5.	<i>Naemorhedus goral</i>	32-40 (35 ± 2.75)	9-14 (10.25 ± 1.21)	Globular (Pt.III, Fig.2)	0.611- 0.615 (0.612 ± 0.001)	Circular (Pt.III, Fig.1)	Goral CITES: Appendix I
6.	<i>Ovis ammon</i>	36-48 (38 ± 1.05)	11-15 (12.30 ± 1.22)	Narrow Medulla Lattice (Pt.III, Fig.5)	0.645- 0.656 (0.65 ± 0.002)	Spindle type (Pt.III, Fig.3)	Argali WL (P) Act,'72, Sch I, Part I CITES: Appendix I
7.	<i>Gazella bennetti</i>	28-32 (30 ± 1.5)	12-18 (14.50 ± 2.25)	Narrow Medulla Lattice (Pt.IV, Fig.2)	0.925- 0.9440 (0.93 ± 0.003)	Oval (Pt.IV, Fig.1)	Chinkara WL (P) Act,'72, SchII, Part II
8.	<i>Pseudois nayaur</i>	35-46 (38 ± 3.20)	15-22 (18 ± 2.75)	Filled (Pt.IV, Fig.4)	0.932- 0.951 (0.94 ± 0.005)	Circular (Pt.IV, Fig.6)	Blue Sheep WL (P) Act,'72, Sch I, Part I
9.	<i>Naemorhedus sumatraensis</i>	30-41 (33 ± 2.60)	17-22 (19 ± 1.95)	Simple (Pt.V, Fig.2)	0.595- 0.658 (0.62 ± 0.105)	Circular (Pt. V, Fig.1)	Serow WL (P) Act,'72, Sch I, Part I CITES: Appendix I

ON THE STATUS OF *DEVARIO ASSAMENSIS* BARMAN, 1984 (PISCES : CYPRINIDAE) WITH COMMENTS ON DISTRIBUTION OF *DEVARIO REGINA* FOWLER, 1934

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Past two decades have witnessed sea-change in the systematics of the Danionin fishes (Cypriniformes: Cyprinidae), especially by the discovery of several species in Myanmar region. Many Danionin species have been moved into different genera, in some cases repeatedly; similarly some species have been synonymised with other species and even in some cases later unsynonymised, all of which has caused a lot of confusion. In the same process, *Danio assamensis*, described from Assam by Barman (1984), has been redescribed by Tilak and Jain (1987), but relegated to synonymy of *Danio regina* Fowler by Talwar and Jhingran (1991) without discussion or assigning any reason. Menon (1999) and Jayaram (1999) followed the same synonymy. This resulted in report of *Danio regina* from Assam, India (Kapoor *et al*, 2002) and even record of it from West Bengal (Patra and Datta, 2010). Kullander (2001) considered the former a valid species and now it is placed under genus *Devario* Heckel.

This paper is planned to provide diagnosis of *Devario assamensis* (Barman) and to distinguish it from related species. Further, distribution of *Devario regina* (Fowler) is being discussed.

Devario assamensis (Barman)

1984. *Danio assamensis* Barman, Bull. zool. Surv. India, 6 (1-3): 163 (Streamlets near Tangla, Darrang dist., Assam, India).

2001. *Devario assamensis* : Kullander, Phylogenetic analysis of cyprinid genus *Danio* Hamilton: 17.

Material : FF 1861, 1 ex. (Holotype), 65 mm, streamlet near Tangla, Darrang dist., Assam,

14.xi.1939, Dr. S.L. Hora; FF 1862, 1 ex. (paratype), 60 mm, other details as of Holotype.

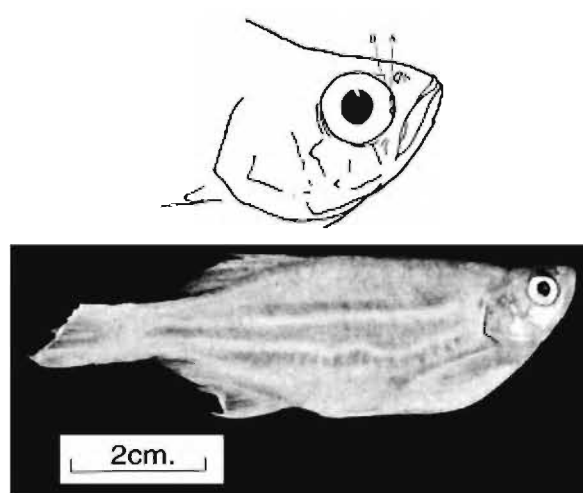


Fig. 1. Head region showing (A) preorbital spine and (B) supraorbital spine, and lateral view of *Devario assamensis* (Barman) (Holotype).

Diagnosis : D ii, 12; A ii, 16-17; P 12; LL 36; Ltr 7½/2½; predorsal scales 16; scales around caudal peduncle 14; barbels 2 pairs, short. Anterior rim of orbit with a small backwardly projecting spine and one forwardly directed spine on antero-superior margin. Body depth 2.6 to 2.7, head length 3.75 to 3.93 in standard length. Mouth small, directed upward. Snout shorter than eye diameter. Lower jaw with a small knob at its symphysis, fitting into a more or less distinct notch of the upper jaw. Lateral line complete, descending abruptly under pectoral fin for first 8 scales and then running in the same horizontal scale row closer to ventral profile. In preserved specimens, 'P-stripe' three in

numbers with two distinct narrow pale interspaces. Black cleithral spot present behind upper edge of gill opening.

Distribution : Darang district, Assam, India, possibly in West Bengal also. It is known by type specimens only but probably occur in aquarium trade.

DISCUSSION

Distinction of the genus *Brachydanio* Weber and de Beaufort by Kottelat (1989) based on the characters such as six or seven branched dorsal fin rays and incomplete or no lateral line has been discarded on the basis of phylogenetic analysis, karyotype and molecular studies (Kullander, 2001). The genus *Danio* Hamilton (type species : *Cyprinus dangila* Hamilton, 1822) is now recognized by having two pairs of long barbels, about the eye diameter or longer; stripe on anal fin rays (A-stripe) and more than one horizontal stripes (P-stripe) extending to the end of caudal fin rays and, the genus *Devario* Heckel (type species : *Cyprinus devario* Hamilton, 1822, by tautonymy) is diagnosed by presence of short barbels, about half the eye diameter or less; a 'P stripe' along midline of body extending to end of middle caudal fin ray; relatively developed infraorbital and other osteological characters.

The genus *Devario* Heckel is now being represented by 37 species (Froese and Pauly, 2010) and 11 are found in India. Among the species from Indian subcontinent, at least 7 species, viz., *D. aequipinnatus* (McClelland), *D. annandalei* (Chaudhuri), *D. assamensis* (Barman), *D. kakhienensis* (Anderson), *D. patherana* (Kottelat and Pethiyagoda), *D. regina* (Fowler) and *D. spinosus* (Day), are known to have a backwardly directed spine on anterior rim of orbit. Jayaram, (1999) erroneously included *D. fraseri* (Hora) and *D. malabaricus* (Jerdon) among this group, but they do not possess a preorbital spine (Kottelat and Pethiyagoda, 1990; Barman, 1991).

It has rightly been observed that like *D. assamensis*, only *D. spinosus* possess a blunt spine on antero-superior margin of orbit (Tilak and Jain, 1987). All other species included here do not have this characteristic supraorbital spine. *D. spinosus* can easily be distinguished from *D. assamensis* in having higher lateral line scale count (above 50 vs

less than 40). Apart from absence of supraorbital spine, *D. annandalei* have higher lateral line scale count (above 50); *D. patherana* have a distinct barred colour pattern with 3 unbranched rays in dorsal and anal fins; *D. kakhienensis* have lower dorsal and anal fin rays (D iii, 9-10; A iii, 12-13) and *D. aequipinnatus* have a relatively slender body.

While erecting a new subgenus *Rambaibarnia*, Fowler (1934) observed that *D. spinosus* has '.... a second broader and blunter spine before the centre of the preorbital', indicating its absence in *D. regina*. Apart from absence of supraorbital spine, *D. regina* has a smaller head (4.05 to 4.33 in standard length vs 3.75 to 3.93) and 5 pale narrow longitudinal bands (2 pale bands in *D. assamensis*).

At this point Talwar and Jhingran (1991) were erroneous in keeping *D. regina* along side with *D. spinosus*, as both having supraorbital spine. With regard to the clubbing of *D. assamensis* with *D. regina*, both the species are distinctly separable and as observed in Tilak and Jain (1987), *D. assamensis* is rather closely resemble *D. spinosus* than *D. regina*. Hence, in the key to species given in Talwar and Jhingran (1991) and Jayaram (1999), *D. regina* should be replaced by *D. assamensis*.

Further, *D. regina* was never reported from India till Talwar and Jhingran (1991) brought it in against *D. assamensis*. Kapoor *et al.* (2002) has stated occurrence of both the species in Assam obviously following Talwar and Jhingran (1991) in respect of *D. regina* and Kullander (2001), where *D. assamensis* is shown as a valid species. The synonymy given in Talwar and Jhingran (1991) has been followed throughout the world and *D. regina* is thought to occur in Assam, India, where as there is no material confirmation. It further led to report *D. regina* from northern West Bengal (Patra and Dutta, 2010). The materials collected from north Bengal need to be checked for presence of supraorbital spine along with backwardly directed lacrimal spine. Distribution of *D. regina* is confined to Thailand, Malaysia and Mekong basin (Laos). Its occurrence in Myanmar needs to be verified

CONCLUSION

Devario assamensis Barman is a valid species that closely resemble *Devario spinosus* (Day) in having a backwardly directed spine on anterior border of

eye and a forwardly directed supraorbital spine anteriorly. *D. regina* (Fowler) do not possess the supraorbital spine and also differ from *D. assamensis* in having a smaller head and different P-stripe pattern. Hence, Talwar and Jhingran (1991) is erroneous in considering *D. assamensis* as a junior synonym of *D. regina* and thus, distributional records of *Devario regina* in India are result of mistaken identity.

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DIVERSITY OF TRUE FLIES (DIPTERA : INSECTA) IN THE BIBHUTIBHUSAN WILDLIFE SANCTUARY

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INTRODUCTION

Bibhutibhusan Wildlife Sanctuary is situated in the district of North 24-Parganas (Lat.: 23°11.28'1' Long.: 88°46.10'5') under Bagdah P.S., Bongaon sub-Division. The Sanctuary is bounded on all its three sides by the River Ichamati while the eastern side is bounded by adjoining village areas namely Parmadan and Jhupa.

This sanctuary is the riverine succession forest and the floral diversity encompasses a wide variety of species that include herbs, shrubs, creepers and trees. A total of 205 species were reported that belonged to 60 families. Among them, 94 species were herbaceous, 35 species shrubs, 22 species were found to be creepers/climbers and 60 species were trees. It is found that the herbs are the dominant ones among all the floral species, followed by the trees, the shrubs and the climbers. Among them, trees like *Polyalthia suberosa*, *Terminalia arjuna* and *Cassia seamea* are the dominant plant species. Tropical monsoon climate with four distinct seasons viz summer, monsoon, winter and autumn. Annual temperature ranges from 43°C to 9°C. Average annual rainfall 1400 mm. Area is primarily a river plain with alluvial soil profile. Altitude is average 6 mts. above sea level.

The relatively fast changes of the tropical forest landscapes present a challenge to biodiversity management. Many studies have contributed with important information about habitat requirements for organism groups in tropical forests, such as birds, mammals like higher vertebrates. In conservation research, there is a taxonomic bias against insects, and especially less charismatic insect groups. Insects constitute the great majority

of all species associated with forests. We have very little idea about what factors are most important for species richness, and the relative importance of local and large scaled factors. There are few publications on the dipteran faunal diversity of the protected areas in India (Mitra et al, 2002, 2004, 2006 and Mitra & Parui, 2007 and 2010). But these studies were not analysed how the dipterans relate to habitat qualities of the protected forest like BBWLS. Therefore an attempt has been made to explore the Diptera fauna of BBWLS which may focus on the health of the forest ecosystem at present.

The present communication reports 31 species of 28 genera under 14 families of Diptera for the first time from the Bibhutibhusan Wildlife sanctuary, West Bengal.

LIST OF SPECIES

Family TIPULIDAE

1. *Conosia irrorata* Wiedemann

Family STRATIOMYIDAE

2. *Oplodontha minuta* (Fabricius)

Family TABANIDAE

3. *Tabanus* sp.

Family ASILIDAE

4. *Philodicus femoralis* Ric
5. *Michotamia aurata* (Fabricius)
6. *Astochia longistylus* Wiedemann

Family BOMBYLIIDAE

8. *Petrorossia ceylonica* (Brunetti)

Family DOLICHOPODIDAE

- 9.
- Chrysosoma vittatum vittatum*
- (Wiedemann)

Family SYRPHIDAE

10. *Asarkina* (*Asarkina*) *ericetorum* (Fabricius)
 11. *Eristalinus* (*Eristalinus*) *arvorum* (Fabricius)
 12. *Eristalinus* (*Eristalinus*) *obscuritarsis* (de Meijere)
 12. *Episyrphus balteatus* (De Geer)
 13. *Paragus* (*Paragus*) *serratus* (Fabricius)
 14. *Melanostoma orientale* (Wiedemann)
 15. *Eristalis* (*Eoseristalis*) *arbustorum* (Linnaeus)
 16. *Eristalinus* (*Eoseristalis*) *obliquus* (Wiedemann)

Family PLATYSTOMATIDAE

- 17.
- Plagiostenopterina*
- (
- Plagiostenopterina*
-)
- aenea*
- (Wiedemann)

Family TEPHRITIDAE

18. *Dacus* (*Bactrocera*) *dorsalis* Hendel
 19. *Carpomyia* nr. *vesuviana* Costa

Family SCIOMYZIDAE

- 20.
- Sepedon ferruginosa*
- Wiedemann

Family MICROPEZIDAE

- 21.
- Mimegralla albigana*
- (Dobleschall)

Family MUSCIDAE

22. *Musca* (*Musca*) *domestica* Linnaeus
 23. *Orthellia indica* (Robineau-Desvoidy)
 24. *Orthellia lauta* (Wiedemann)
 25. *Stomoxys calcitrans* (Linnaeus)

Family CALLIPHORIDAE

26. *Calliphora vicina* Robineau-Desvoidy
 27. *Chrysomya megacephala* (Fabricius)
 28. *Stomoxys discolor* (Fabricius)
 29. *Lucilia cuprina* (Wiedemann)

Family SARCOPHAGIDAE

30. *Bercaea cruentata* Meigen
 31. *Parasarcophaga* (s. str.) *albiceps* (Meigen)

Family TIPULIDAE

This is one of the largest families of Diptera, with approximately 14,000 species described to date, commonly known as crane flies or daddy-long-legs, tipulids are world-wide in distribution, although their greatest diversity is in the humid tropics. Adults tend to be short-lived and are typically found in shaded, humid areas of woodland where they feed on honeydew and nectar. The larvae are much longer-lived, up to a year or more, and are primarily aquatic or semi-aquatic, although some species live in decaying wood, soil and fungi.

In BBWLS, only one species of the family has been collected from the buffer area of the sanctuary. This species is common in West Bengal and distributed throughout the World.

1. *Conosia irrorata* Wiedemann

1828. *Limnobia irrorata* Wiedemann, *Aussereurop. Zweifl. Insekt*, 1 : 574.

Material examined : 2 ♀♀, BBWLS, 11.01.2008, coll. B. Mitra

Family STRATIOMYIDAE

Immature stages of Stratiomyidae are found in a variety of habitats. They are usually associated with decaying plant matter ranging from leaf litter to rotting fruits. Adult soldier flies are often found sitting on leaves in sunny patches in forest habitats and some adults, particularly Stratiomyinae and some Clitellariinae, frequent flowers. They are rarely come to light, indicating that they are primarily diurnal.

Only one species of this family has been collected from the medicinal plant garden near the guest house. This is a common species in West Bengal and distributed only in Sri Lanka of the Oriental Region other than India.

2. *Oplodontha minuta* (Fabricius)

1794. *Stratiomys minuta* Fabricius, *Ent. Syst.*, 4 : 268. Type-locality: Tranquebar, India

Material examined : 1 ♂, BBWLS, 11.09.2009, coll. B. Mitra

Family TABANIDAE

Adult Tabanidae are large flies with broad bodies and bulging eyes. The males are easily differentiated from female flies because eyes are

contiguous in the males and widely separated in the females. The antennae are three segmented. The adults of both sexes feed on nectar and pollen of flowers. Females of most species have piercing mandibles and also take blood meals. They can be serious pests of cattle, horses, and other mammals and may be very annoying to man with their persistent attacks. Adults are only of minor importance as mechanical transmitters of disease within the regions covered here.

Only one species of *Tabanus* has been collected from the grass meadow near the fencing of the sanctuary. The species couldn't be identified due to bad condition of the material.

3. *Tabanus* sp.

Material examined : 1 ♂, BBWLS, 25.10.2009, coll.B.Mitra

Family ASILIDAE

Adult stages are medium to large flies often observed on stems of plants, on the ground and grass or flying low. Species vary in appearance and some mimic wasps and bees. Most species are gray to black, hairy-bodied, have a long, narrow, tapering abdomen containing segments that may be banded, patterned or contrasting in color. Adults prey on a variety of arthropods; considered to be beneficial insects, except for those that feed on bees and other beneficial insects. Because of their predatory habit of feeding on other insects and their voracious appetites, they contribute to the maintenance of the natural balance among insect populations.

Three species under three different genera of the family Asilidae have been reported from this sanctuary. All the specimens were collected from the buffer zone of the sanctuary near to the medicinal plant garden. Among them two species are commonly distributed in India and Oriental in distribution. But the third one, *Astochia longistylus* Wiedemann is the first report from West Bengal other than Great Nicobar in India. This species is also Oriental in distribution

4. *Philodius femoralis* Ricardo

1921. *Philodius femoralis* Ricardo, *Ann. Mag. Nat. Hist.* (9) 8 : 190. Type-locality: Okkyl, Schwegu, Burma

Material examined : 3♂♂, 1♀, BBWLS, 24.10.2009, coll.B.Mitra

5. *Michotamia aurata* (Fabricius)

1794. *Asilus aurata* Fabricius, *Ent., Syst.* 4 : 387. Type-locality: East India

Material examined : 1♂, 1♀, BBWLS, 24.10.2009, coll. B. Mitra

6. *Astochia longistylus* Wiedemann

1828. *Asilus longistylus* Wiedemann, *Aussereurope. Zweifl. Insekt.*, 1 : 433. Type-locality: Java

Material examined : 1♂, BBWLS, 24.02.2008, coll.B.Mitra

Family BOMBYLIIDAE

These are generally rather large gentle looking flies with a long thin proboscis, which can be seen flying low across the ground from flower to flower, or hovering expertly in front of a flower for feeding nectar. Unlike their relatives robber-flies, the Bee-flies larva are the predators. The female Bee-fly drops its eggs near the entrance to the burrow of a solitary bee or wasp. The egg hatches into the first stage larva which is a minute worm-like animal which searches actively for a cell of the bee or wasp's burrow which it enters. It feeds at first on the pollen and nectar supplied by the cells owner until its first moult. The second stage larva is very different, looking far more like a maggot, and it feeds on the larva of the bee or wasp with whose cell it has been sharing peacefully up until this time. After it has finished devouring the helpless bee or wasp larva the Bee-fly larva pupates in the soil from where it emerges, the adults in comparison with their carnivorous larva feed entirely on nectar.

Only one species of bee fly has been encountered from the medicinal plant garden of the sanctuary throughout the survey. This species is common in India including West Bengal also. This species extends its distribution in the country like Malaysia, Pakistan, and Sri Lanka of the Oriental Region.

8. *Petrorossia ceylonica* (Brunetti)

1909. *Argyromoeba ceylonica* Brunetti, *Rec. Indian Mus.*, 2 : 471. Type locality: Ceylon [Srilanka]

Material examined : 1♂, BBWLS, 13. 01.2008, coll. B. Mitra

Family DOLICHOPODIDAE

The dolichopodids or "long-legged flies" comprise one of the most diverse fly families. Most dolichopodids are recognised by their small and slender bristly bodies in metallic blue or green colour, short fleshy proboscis, dorsal or terminal hair-like arista, thorax adorned with strong setae, discal and 2nd basal cells united and shortened. Adults are predators of soft bodied invertebrates, mites, thrips, aphids and are important control agents of several pest species. They are usually found in cool, moist habitats, including sea-shore and salt marshes. Adults of many species are known to feed on nectar. Larvae are maggot like found in soil, moss, decaying vegetation, mud and under bark. Most larvae are sometimes aquatic predators or scavengers while few are phytophagous.

Only one species of Dolichopodidae has been encountered during this survey. All the specimens were collected from the under growth of the sanctuary particularly from the buffer zone area. This species is common to India and restricted to the other countries of the Oriental Region.

9. *Chrysosoma vittatum vittatum* (Wiedemann)

1819. *Dolichopus vittatum vittatum* Wiedemann, *Zool. Mag.*
1 : 3 Type-locality: Java

Material examined : 1♀, BBWLS, 13. 01.2008, coll. B. Mitra

Family SYRPHIDAE

The family Syrphidae under the super family Syrphoidea of the infra order Cyclorrhapha in the section Aschiza is one of the largest and easily recognized groups of Diptera. The members of this family are commonly known as 'Flower flies' or 'Hover flies'. Usually moderate to large sized flies, almost always bristle less, very brightly coloured flies and may be striped, spotted or banded yellow on a blue, black or metallic ground colour. The black and yellow colouration often imparts to them a superficial resemblance wasp; other species are densely hairy and resemble bumblebees. The venaspuria is one of their most characteristic features and is rarely found in other dipterans. It is a vein-like thickening of the wing membrane and may be distinguished from the veins in being fainter and terminating without association with other veins. These flies are pollinators of major

significance. In some agro ecosystems, such as orchards, they outperform native bees in pollinating the fruits.

In BBWLS, only eight species of Syrphidae have been collected from the different corners of the sanctuary. All of them are common in West Bengal and India and also distributed in different parts of the globe.

10. *Asarkina (Asarkina) ericetorum* (Fabricius)

1781. *Syrphus ericetorum* Fabricius, *Spec. Insect.*, 2 : 425.
Type - locality: Africa aequinoctial"

Material examined : 1 ♂, BBWLS, 24.02.2008, coll. B. Mitra.

11. *Eristalinus (Eristalinus) arvorum* (Fabricius)

1787. *Syrphus arvorum* Fabricius, *Mantissa Insect.*, 2 : 335.
Type-locality: China

Material examined : 4 ♂♂, BBWLS, 25.02.2008, coll. B. Mitra.

12. *Eristalinus (Eristalinus) obscuritarsis* (de Meijere)

1908. *Eristalis obscuritarsis* de Meijere, *Tijdschr. Ent.*, 51 : 250

Material examined : 12 ♂♂ 3 ♀♀, BBWLS, 25.02.2008, coll. B. Mitra.

13. *Episyrphus balteatus* (De Geer)

1776. *Musca balteata* De Geer, *Mem. pour Serv. Hist. Ins.*, 6 : 116. 1975. Type-locality: Europe

Material examined : 7 ♂♂ 7 ♀♀, BBWLS, 23.10.2009, coll. B. Mitra.

14. *Paragus (Paragus) serratus* (Fabricius)

1805. *Mulio serratus* Fabricius, *Syst. Antliat.*, : 186. Type-locality: Tranquebar, India

Material examined : 3 ♂♂ 2 ♀♀, BBWLS, 10.09.2009, coll. B. Mitra.

15. *Melanostoma orientale* (Wiedemann)

1824. *Syrphus orientalis* Wiedemann, *Analecta Ent.*, : 36.
Type-locality: "Ind. Or."

Material examined : 1 ♂, BBWLS, 23.10.2009, coll. B. Mitra.

16. *Eristalis (Eoseristalis) arbustorum* (Linnaeus)

1758. *Musca arbustorum* Linnaeus, *Syst. Nat. Ed.*, 10 : 591.
Type-locality: Europe.

Material examined : 1♂ 1♀, BBWLS, 24.10.2009, coll.B.Mitra

17. *Eristalis (Eoseristalis) obliquus* (Wiedemann)

Eristalis obliquus Wiedemann, *Analecta Ent.*, : 38. Type-locality: Bengal, India

Material examined : 1♂ 1♀, BBWLS, 25.10.2009, coll. B. Mitra

Family PLATYSTOMATIDAE

The Platistomatids or Signal flies are very variable in external appearance, ranging from small (2.5mm), slender species to large (20mm), robust individuals, often with body colours having a distinctive metallic lustre and with face and wings usually patterned with dark spots or bands. Adults are found on tree trunks and foliage and are attracted to flowers, decaying fruit, excrement, sweat, and decomposing snails. Larvae are found on fresh and in decaying vegetation, carrion, and root nodules. Most larvae are either (eating plant material) or (eating decomposing organic matter).

In BBWLS, only one species of Platystomatidae has been collected from the grass land of the sanctuary. It is also found in other areas of West Bengal and widespread in Oriental and Australian regions other than India.

18. *Plagiostenopterina (Plagiostenopterina) aenea* (Wiedemann)

1819. *Dacus aenea* Wiedemann, *Zool. Mag.*, 3 : 29. Type-locality: Java

Material examined : 1♂♂, 3♀♀, BBWLS, 25.10.2009, coll. B. Mitra

Family TEPHRITIDAE

The members of the family Tephritidae are commonly called as "fruit flies" and are easily recognized by their maculated, spotted or ornate colouration of their wings. Subcostal vein of wings bend forward, toward costa almost perpendicularly; inner eye orbits completely sclerotised, nearly always with inwardly directed anterior orbital bristles, post vertices not convergent. Crop (diverticulum) projected into abdomen, used for storage of fluid, abdominal segment 6 well developed. The adult tephritids are serious economic pests.

There are two species of Tephritidae collected from the vegetation of the sanctuary. Of them *Dacus (Bactrocera) dorsalis* Hendel is distributed all over the countries in the globe.

19. *Dacus (Bactrocera) dorsalis* Hendel

1912. *Dacus dorsalis* Hendel, *Supplta ent.*, 1 : 18. Type-locality : Koshun, Formosa

Material examined : 7♂♂, 1♀, BBWLS, 25.10.2009, coll. B. Mitra

20. *Carpomyia nr. vesuviana* Costa

Material examined : 1♀, BBWLS, 25.10.2009, coll. B. Mitra

Family SCIOMYZIDAE

The Sciomyzidae belongs to the typical flies () of the . They are commonly called marsh flies, and in some cases snail-killing flies due to the food of their.

Marsh flies are generally slender, yellowish or brownish, about 0.5-1 cm long. They have fairly prominent eyes, prominent forward-pointing antennae, and bristles on the hind (upper hind leg). The wings are often mottled with various light brown markings according to species. Marsh flies are common along the edges of ponds and rivers, and in marshy areas. The adults drink dew and . The prey on or become of (slugs and snails). Very little is known about the complete of these flies.

In BBWLS, only one species of Sciomyzidae has been collected from the grass meadow of the sanctuary. This species is common in India but restricted its distribution in the Oriental Region.

21. *Sepedon ferruginosa* Wiedemann

1824. *Sepedon ferruginosa* Wiedemann, *Analecta. Ent.*; 56. Type-locality: East Indies

Material examined : 6♀♀, 7♂♂, BBWLS, 25.10.2009, coll. B. Mitra

Family MICROPEZIDAE

The Insects of the family Micropezidae are commonly called stilt-legged flies, after their characteristically long legs. The fore legs are markedly smaller than the other pairs. Mostly they are long-bodied, often black flies, usually with infuscated (darkened) wings. Little is known of the larval habits, but they are probably phytophagous or saprophagous. Adults are either predaceous on

small insects or are attracted to excrement or decaying fruit.

In BBWLS, only one species of Micropezidae has been collected from the under growth of the sanctuary. This is the common species of the family Micropezidae found in India, throughout the Oriental region, Japan, New Guinea, Oceania

22. *Mimegralla albirana* (Doleschall)

1856. *Taenioptera albirana* Doleschall, Natuurk. Tijdschr. Ned-Indie 10 (n. Ser. 7) : 413, Type-locality: Djokjakarta, Java

Material examined : 2 ♂♂, 1 ♀, BBWLS, 9.02.2010, coll. B. Mitra

Family MUSCIDAE

Muscidae is a family of found in the superfamily. The apical segment of the of Muscidae are plumose, and the basal portion is smooth. Muscidae, some of which are commonly known as or due to their, are worldwide in distribution and contain almost 4,000 described species in over 100 genera.

Most species are not synanthropic. Adults can be predatory, or feed on a number of types of plant and animal exudates. They can be attracted to various substances including sugar, sweat, tears and blood. Larvae occur in various habitats including decaying vegetation, dry and wet soil, nests of insects and birds, fresh water, and carrion.

In BBWLS, only four species of Muscidae have been collected from the different parts of the sanctuary. All the species reported here are very common throughout the globe.

23. *Musca (Musca) domestica* Linnaeus

1758. *Musca domestica* Linnaeus, *Syst. Nat. Ed.* 10, 1 : 596. Type-locality: Europe

Material examined : 15 ♀♀, 10 ♂♂, BBWLS, 22.07.2008, coll. B. Mitra, 6 ♀♀, 18 ♂♂, BBWLS, 9.02.2010, coll. B. Mitra

24. *Orthellia indica* (Robineau-Desvoidy)

1830. *Lucilia indica* Robineau-Desvoidy, *Mem. Pres. div. Sav. Acad. Sci. Inst. Fr.*, 2: 453. Type-locality: Bengal

Material examined : 5 ♀♀, 11 ♂♂, BBWLS, 9.12.2008, coll. B. Mitra, 1 ♀♀, 7 ♂♂, BBWLS, 9.02.2010, coll. B. Mitra

25. *Orthellia lauta* (Wiedemann)

1830. *Musca lauta* Wiedemann, *Aussereurop. Zweifl. Insekt.* 2 : 410. Type-locality: Java

Material examined: 6 ♀♀, 2 ♂♂, BBWLS, 12.02.2010, coll. B. Mitra

26. *Stomoxys calcitrans* (Linnaeus)

1758. *Conopscalcitrans* Linnaeus, *Syst. Nat., Ed.*, 10, 1 : 604 Type-locality : Sweden

Material examined: 8 ♀♀, 12 ♂♂, BBWLS, 10.02.2010, coll. B. Mitra

Family CALLIPHORIDAE

The family Calliphoridae is a cosmopolitan group and predominantly tropical in distribution closely related to Muscidae, Tachinidae and Sarcophagidae. The calliphorids are generally ubiquitous. They fly mainly by day, though a number of specimens also were attracted by light. Adults are often attracted to sweet liquids, and can be collected at flowers, where they feed on nectar. They also feed on the liquid products of organic decomposition, which provide the proteins essential to the female for egg maturation. Some of the species are of significant veterinary importance, causing the cutaneous myiasis of livestock known as 'fly strike'. Larvae are scavengers or parasitic on insects, earthworms, snails, and other animals.

In BBWLS, only four species of Calliphoridae have been collected from the different parts of the sanctuary. The calliphorids of this sanctuary are very common in West Bengal, India and other parts of the globe.

27. *Calliphora vicina* Robineau-Desvoidy

1826. *Calliphora erythrocephala* (Meigen): Senior-White, Aubertin & Smart, *Fauna Brit. India, Dipt.*, 6 : 33. Type-locality: Philadelphia

Material examined: 4 ♀♀, 8 ♂♂, BBWLS, 11.01.2008, coll. B. Mitra

28. *Chrysomya megacephala* (Fabricius)

1794. *Musca megacephala* Fabricius, *Syst. Ent.* 4 : 317. Type-locality: Guinea

Material Examined: 12 ♂♂ 7 ♀♀, BBWLS, 11.01.2008, coll. B. Mitra

29. *Stomorphina discolor* (Fabricius)

1794. *Musca discolor* Fabricius, *Ent. Syst.*, 4 : 320. Type-locality: Ind. Or.

Material examined : 3 ♂♂, 3 ♀♀ BBWLS, 13.01.2008, coll. B. Mitra

30. *Lucilia cuprina* (Wiedemann)

1830. *Musca cuprina* Wiedemann, *Aussereurop. zweiffl. Insekt.*, 2 : 654. Type-locality: China

Material examined : 1 ♂, 2 ♀♀, BBWLS, 14.01.2008, coll. B. Mitra, 12 ♂♂ 7 ♀♀, BBWLS, 25.02.2008, coll. B. Mitra

Family SARCOPHAGIDAE

Flies of the family Sarcophagidae are commonly known as flesh flies. Most flesh flies breed in , dung, or decaying material, but a few species lay their eggs in the open wounds of mammals; hence their common name. Some flesh fly larvae (maggot) are internal of other insects. 3-segmented, with an; vein Rs 2-branched, present, well developed. Medium-sized flies with black and gray longitudinal stripes on the and checkering on the . Arista commonly plumose on basal half; bare in a few species. Four bristles (short, long, short, long, from front to rear). Hindmost bristle located even with or toward midline from bristle.

In BBWLS, only two species of Sarcophagidae have been collected from the different parts of the sanctuary. These two species are common throughout the world.

31. *Bercaea cruentata* (Meigen)

1826. *Sarcophaga cruentata* Meigen, *Syst. Besch. europ. zweifl. Insekt*, 5 : 28; Kano and Shinonaga, 1994, *Jap. J. sanit. Zool.*, 45 : 270. Type-locality: Europe

1986. *Bercaea cruentata* : Verves, *Cat. Palae. Dipt.*, 12: 159; Pape, 1991, *Jap. J. Ent.*, 59(1): 213; Nandi, 1992. *J. Beng. Nat. Hist. Soc.*, 11(2) : 35.

Material examined : 2 ♂♂ 7 ♀♀, BBWLS, 11.01.2008, coll. B. Mitra

32. *Parasarcophaga* (s. str.) *albiceps* (Meigen)

1826. *Sarcophaga albiceps* Meigen, *Syst. Besch. zweifl. Insekt.*, 5 : 22, Kano and Shinonaga, 1994, *Jap. J. sanit. Zool.* 45 : 256. Type-locality: Europe

Material examined : 3 ♂♂ 4 ♀♀, BBWLS, 22.10.2008, coll. B. Mitra

DISCUSSION

Of the 14 families recorded in this study, the family Syrphidae having the highest number of species (8) followed by Muscidae (4), Calliphoridae (4), Asilidae (3), Tephritidae (2) and Sarcophagidae (2). Rest of the families like Tipulidae, Tabanidae, Bombyliidae, Dolichopodidae, Platystomatidae, Sciomyzidae, Micropezidae and Stariomyidae each having single species.

Among the 14 families of Diptera , the syrphids are mostly saproxylic (which are wholly/partially dependant on dead or decaying wood of managed or unmanaged ecosystems) in nature (Mitra & Mehta, 2010). The muscids, calliphorids and sarcophgids are predominantly human associated group of insects. Therefore it can be said that the forest is good for saproxylic group of insects like syrphids and asilids but in the same time the presence of closely associated groups like muscids, calliphorids and sarcophgids indicate the sanctuary is under threat of human pressure.

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ARTHROPOD FAUNAL DIVERSITY IN SOME SACRED TREES OF SERAMPORE, HOOGLY, WEST BENGAL

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INTRODUCTION

Kalpavriksha and Chaityavriksha scriptures mention that worshipping trees have been an ancient Indian practice. Considering trees as sacred entities, dates back to the era of the Aryans who worshiped nature. Plants and trees are associated with several Indian rituals and tree worshipping continues to be an aspect of modern Indian traditions. These trees are an important storehouse of biodiversity, having remained largely undisturbed by human interference and these are the last remnants of natural forests which should be preserved for conserve the local biodiversity.

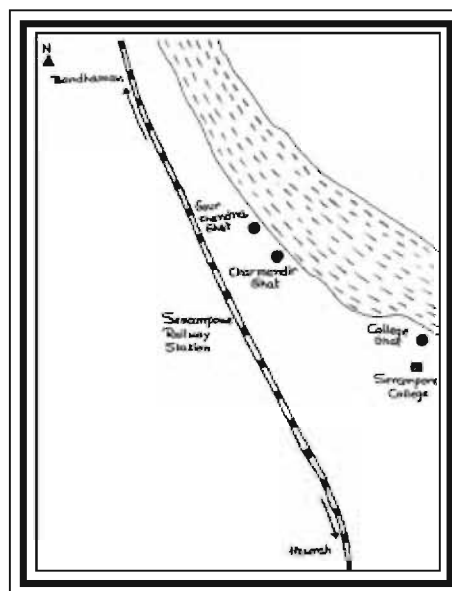
Gadgil (1985) pioneered the view that sacred groves and sacred trees belong to a variety of cultural practices which helped Indian society to maintain an ecologically steady state with wild living resources. Kushalappa, C.G. and Bhagwat, S. A. (2001) reported about 14% of tree species, 26% of bird species and 44% of the fungal morpho types from the sacred groves. Besides this, there are plenty of published documents on the sacred groves related with socio-economy, cultural, floral compositions etc. But information on the insect and spider faunal diversity in general and their abundance in the sacred groves and sacred trees are very poor.

With this background the present study was undertaken in three sacred places situated near the College ghat, Gourchandra ghat and Charmandir ghat of Serampore, Hoogly (Map-1). The plants of these sacred groves are *Ficus religiosa* (Aswatha), *Ficus bengalensis* (Bot), *Opuntia dillevii* (Fani Manosa),

Murraya paniculata (Kamini), *Ocimum* sp. (Tulsi) and *Catharanthus roseus* (Nayantara). This study is an attempt to build a database of arthropod faunal diversity of the sacred trees which highlights the ecological importance of these trees.

The collections have been made from the different parts of the plants, surrounding bushes and also from the soil of these sacred places. Altogether 59 species of insects under 8 orders and 5 species of the order Araneae reported from 3 selected sacred places.

The collections were mostly made by handpicking, aerial sweeping by Insect net. Pit fall traps were also used to collect the ground insects. The collections were mostly made in the morning



Map-1. Map of serampore and study area

Table-1: List of species and their distribution in three different ghats

ORDER	Sl. No	Species	Co.Ghat	Ch. Ghat	G. Ghat
COLEOPTERA	1	<i>Coelostoma</i> sp.	5		
	2	<i>Berosus indicus</i> Mots	5		
	3	<i>Berosus pulchellus</i> M'leay	3		
	4	<i>Helochaeres anchoralis</i> Sharp	1		
	5	<i>Guignotus flammulatus</i> Sharp	1		
	6	<i>Guignotus signatellus</i> Klog	1		
	7	<i>Coelophora unicolor</i> (Fabricius)	7		
	8	<i>Acupalpus</i> sp.	1		1
	9	<i>Odacantha</i> sp.			3
	10	<i>Cassida</i> sp.		3	4
	11	<i>Cicindela</i> sp.		1	
	12	<i>Micraspis cardoni</i>	3	1	
	13	<i>Henosepilachna septima</i>	2		
	14	<i>Pullus apiciflavus</i>	1		
	15	<i>Onthophagus</i> sp.	1		
ISOPTERA	16	<i>Odontotermes feae</i> (Wasmann)	7	11	10
DIPTERA	17	<i>Mesembrius bengalensis</i> (Wiedemann)	1		
	18	<i>Musca</i> (<i>Musca</i>) <i>domestica</i> Linnaeus	2	2	3
	19	<i>Parasarcophaga</i> (p) <i>albiceps</i> Meigen	1		1
	20	<i>Tinda javana</i>			1
	21	<i>Microchrysa flaviventris</i>	1		
	22	<i>Chrysomia aenea</i>	1		
	23	<i>Hermetia illucens</i> (Linnaeus)	1		
	24	<i>Styilia</i> sp.		1	
	25	<i>Dolichopus</i> sp.	1		
	26	<i>Culex</i> sp.	1		2
	27	<i>Physiphora aenea</i>	1		
	28	<i>Orthelia</i> sp.	1		
	29	<i>Callantra</i> sp.	2		1
	30	Unidentified sp.	1	1	
	31	Unidentified sp.	2	1	
HYMENOPTERA	32	<i>Apis indica</i> Fabricius	2		
	33	<i>Ropalidia</i> sp.			1
	34	<i>Vespa affinis</i> (Linnaeus)	1		
	35	<i>Polistes</i> (<i>Gyrostoma</i>) <i>olivaceous</i> (De Geer)	1		

ORDER	Sl. No	Species	Co.Ghat	Ch. Ghat	G. Ghat
	36	<i>Polistes(Gyrostoma) wattii</i> Cameron	1		
	37	<i>Camponotus compresus</i> (Fabricius)	5	5	2
	38	<i>Paratrechina longicornis</i> (Lateralis)		4	3
	39	<i>Tetraponera rufonigra</i> (Jerdon)	5	3	2
	40	<i>Polyrhachis (Myrmhopla) dives</i> Smith		4	
	41	<i>Pheidole</i> sp.	13	29	10
	42	<i>Pheidole spathifera</i> Forel		3	
	43	<i>Tetramorium walshi</i> (Forel)	9	10	12
HEMIPTERA	44	<i>Tropistethus indicus</i> Dall	3		
	45	<i>Rhodiginus dispar</i> Walker	1		
	46	<i>Serinetha angur</i> (Fabricius)		1	
	47	<i>Leptocentrus taurus</i> (Fabricius)	1		
	48	<i>Sadoletus validus</i> Distant	1		
	49	<i>Boccharis significatus</i> Distant	1		
LEPIDOPTERA	50	<i>Papilio polytes</i> Linnaeus	2		
	51	<i>Euploea core</i> Cramer	7		
	52	<i>Catopsila pomona</i>	1		
	53	<i>Precis lemonias</i> Linnaeus	1		
	54	<i>Precis</i> sp.	1		
DICTYOPTERA	55	<i>Blatella humbertiana</i> (Sauss)	4		3
	56	<i>Blatella germanica</i> (Sauss)			2
ORTHOPTERA	57	<i>Brachytrypes portentosus</i> (Lich)	1	1	
	58	<i>Aiolopus thalamus tamulus</i> (Fabricius)	1		1
	59	<i>Oxya hyla hyla</i>	1		2
ARANEAE	60	<i>Hersalia savignyi</i> Lucas	5	1	2
	61	<i>Salticus</i> sp.	6		1
	62	<i>Oxyptila reena</i> Basu	3		2
	63	<i>Clubiona</i> sp.	7	1	2
	64	<i>Oxyopes ratnae</i> Tikadar	2	1	
			137	82	72

Table-2 : Diversity and evenness indices of different groups and species and richness index of different species in three different localities

	COLLEGE GHAT		CHARMANDIR GHAT		GOURCHANDRA GHAT	
	GROUP	SPECIES	GROUP	SPECIES	GROUP	SPECIES
DIVERSITY INDEX	2.078	3.575	1.035	2.242	1.687	2.809
EVENNESS INDEX	0.422	0.727	0.235	0.509	0.394	0.657
SPECIES RICHNESS INDEX	-	10.163	-	4.312	-	4.910

and the late afternoon. Each sacred place was surveyed in three alternative months of the year 2009 (July, September and November). All the groups were identified separately and their numbers were determined. All the entomofaunal collections and plant species were identified from the Zoological Survey of India and Botanical Survey of India, Kolkata respectively.

STUDY AREA

The study was conducted in three sacred places of the Serampore (in between Lat. 22 ° 45 ' 8" N and Long. 88 ° 21' 1"E), 25 kms away from Kolkata to the North in the district of Hoogly.

College Ghat : The name of this ghat is after the Serampore College which is very close to the river Hoogly. The grove has different plant species like *Ficus religiosa*, *Ficus bengalensis*, *Opuntia dilleyii*, and *Cathranthus roseaus*. There is a small temple of Durga and Shiva in that ghat and people come everyday for worship.

Gourchandra Ghat : This ghat is closer to the river Hoogly than College ghat. This ghat was named after the name of Mahapravu Sri Chaitanya Deb (Gouranga). In that sacred groove, the important plant species is *Ficus religiosa* along with *Opuntia dilleyii*, *Ocimum* sp. and *Muraya paniculata*. As such no temple is built here but the idols of the goddess of Durga and Shiva are worshiped here.

Charmandir Ghat : In the name of four Shiva temples this area is called Charmandir Ghat. The ghat is also very close to the river Hoogly. The trees like *Ficus religiosa*, *Muraya paniculata*, *Plumeria obtusa* and *Opuntia dillevi* are found in this ghat. People come for worship to Lord Shiva.

RESULTS AND DISCUSSION

The observation from the present study indicates that a good number of species harbor in these sacred places which maintain the biodiversity of this particular area. During this survey 291 examples of 64 species belongs to 9 orders of phylum Arthropoda like, Diptera (15), Coleoptera (15), Hymenoptera (12), Hemiptera (6), Lepidoptera (5), Dictyoptera (2), Orthoptera (3) and Isoptera (1) and Araneae (5) have been collected from the different sacred groves. 6 different plant species were recorded collectively from the study sites of College ghat, Charmandir ghat and Gourchandra ghat to support those faunal groups (Table-1).

Among the 291 examples, College ghat shares maximum number of examples (137 examples) followed by Charmandir ghat (82 examples) and Gourchandra ghat (72 examples). Considering the species strength, out of 64 species of insects and spiders, College ghat shares maximum number of species (51), followed by Gourchandra ghat (22) and Charmandir ghat (20) (Table-1).

Species richness shows the maximum strength of any locality. In terms of both number of examples and number of species, College ghat stood in the highest rank and overall, the sacred grove of the College ghat is the most diversified and evenly distributed area by groups and species. Because of the availability, maximum number of fauna has been sampled from that ghat also. Comparing other two ghats, they have lower number of sampled fauna; however, Gourchandra ghat is more diversified and evenly distributed than the Charmandir ghat (Table-2).

It might be possible that the *Ficus* spp. were the most supportive habitat for overall faunal diversity. College ghat has more *Ficus* spp. than the other two localities. Probably the stable resource and environment of College ghat area could provide more number of arthropod groups and species. Gourchandra ghat and Charmandir ghat have almost same types of plant species. So, they have almost same types of species diversity and richness. The more detail study reveals the faunal inventory of the sacred groves and also describes the overall

reasons of the selection of the habitats by various groups of insect and spiders.

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EVALUATING POLLINATOR EFFECTIVENESS ON *TAGETES PATULA* LINNAEUS

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INTRODUCTION

Genda (*Tagetes patula* Linnaeus, Family Asteraceae) is an erect, branched and hardy annual, usually growing about 60 cm high. Flowers of one solid colour, the typical colour being lemon yellow, but it ranges from a light sulphur yellow to a deep orange. Recently, commercial cultivation of marigold in India has risen to an estimated 13,000 hectares with annual production of 200,000 tones of flowers, the highest for any flowers grown in India. This increasing demand of growing *Tagetes* is not due to only religious or social purposes but for its valuable essential oil components.

In view of above, a study was conducted in an unmanaged Marigold field in Bhaduri village, district Nadia, West Bengal. Altogether 32 species of 4 orders of insect flower visitors were recorded from the *Tagetes patula* of them Lepidoptera group had highest number of species followed by Diptera, Hymenoptera and Coleoptera (Table-1).

Pollinator efficiency of different insect pollinators may be evaluated on the basis of number of characteristics. This study reveals that lepidopterans are the effective group of pollinators on the basis of foraging speed followed by Diptera and Hymenoptera and hymenopterans are the effective pollinator group on the basis of foraging rate followed by Diptera and Lepidoptera. But if we consider both the criteria (foraging speed and rate) for evaluating the effectiveness for a pollinator species then Diptera as a whole may be the effective pollinator group of *Tagetes patula* Linnaeus.

MATERIALS AND METHODOLOGY

Diurnal abundance of insect flower visitors was monitored in three selected plots of each 144 sq ft area. The flower visitors were collected throughout the day from each study plot on November, 2007 and January, 2008. Flower visitors were counted by individuals collected by a sweep net of 30 cm radius. Insects were preserved for taxonomic identification in the laboratory of Zoological survey of India, Kolkata. In this study the measurement of effectiveness was considered on the basis of foraging speed (time spent per flower) and foraging rate (number of flowers visited per unit of time).

RESULTS AND DISCUSSION

Total 32 species of 4 different groups were recorded from the study area (Table-1). Lepidoptera group had highest number of species (19 species) followed by Diptera (6 species), Hymenoptera (5 species) and Coleoptera (2 species). The total numbers of individuals in the two study periods were added and the values were mentioned species-wise for different quadrats (Table-1).

Table-2 shows that group diversity in three different plots were almost same. Evenness values are almost same in three different plots, which clearly indicate that all the species reported here are also commonly distributed in three different plots. On the other way, it can be stated that the less numbered species group like Hymenoptera and Coleoptera and maximum numbered species group like Lepidoptera and Diptera are evenly distributed in all the three study plots.

Table-1 : List of insects as the flower visitor of *Tagetes patula*

Group	Species	Q1	Q2	Q3
Lepidoptera	<i>Neptis sp</i>	15	13	9
	<i>Moduza procris</i>	11	8	6
	<i>Hypolimnas misipus</i>	6	7	8
	<i>Danaus chrysippus</i>	8	9	7
	<i>Junonia almana</i>	9	7	5
	<i>Catopsilila pomona</i>	4	4	2
	<i>Précis atlites</i>	10	10	9
	<i>Nototcrypta curvifascia</i>	7	5	5
	<i>Euploea core</i>	4	3	2
	<i>Suastus gremius</i>	8	8	8
	<i>Barbo cinnara</i>	4	2	1
	<i>Euthalia aconthea</i>	12	10	8
	<i>Leptosia nina</i>	6	4	3
	<i>Ypthima huebneri</i>	4	2	0
	<i>Appias sp.</i>	2	1	0
	<i>Ariadne ariadne</i>	4	1	2
	<i>Danus genutia</i>	5	6	6
	<i>Eurema sp.</i>	11	10	10
	<i>Papilio polites</i>	4	2	1
Hymenoptera	<i>Apis dorsata</i>	16	15	18
	<i>Apis florae</i>	12	10	9
	<i>Ceratina sp.</i>	3	1	0
	<i>Eumerus sp</i>	8	5	6
	<i>Polites s.</i>	12	8	9
Diptera	<i>Eristalinus arvorum</i>	12	17	16
	<i>Mesembrius bengalensis</i>	18	19	17
	<i>Orthellia timorensis</i>	14	12	8
	<i>Musca ventrosa</i>	8	7	3
	<i>Lucilia sp.</i>	13	11	12
Coleoptera	<i>Eristalinus laetus</i>	18	16	16
	<i>Menochilus sexamaculatus</i>	11	11	11
	<i>Pullus pyrochilus</i>	4	4	1

(Q1= Quadrat 1; Q 2= Quadrat 2; Q 3= Quadrat 3)

Table-2 : Diversity and evenness indices of different order and species in three study quadrats

Indices	Q1		Q2		Q3	
	Order	Species	Order	Species	Order	Species
Diversity	1.178	3.335	1.186	3.261	1.207	3.153
Evenness	0.209	0.591	0.215	0.591	0.224	0.586

Q1= quadrat 1; Q2= quadrat 2; Q3= quadrat 3

Considering the maximum time spends (group wise) on a single flower, the coleopterans are the predominant group. In the present study *Menochilus sexamaculatus*, *Pullus pyrochilus* of Coleoptera spend maximum time on the flowers, but they touched only one flower throughout the day (Fig. I and IV). Verma & Joshi (1983) and Sihag (1988) stated that, reliable and effective pollinators can be found out on their foraging efficiency on flowers and longer duration on the substrates. So, in this study the coleopterans couldn't be considered as pollinators. After Coleoptera, the order Lepidoptera and Diptera were spend more time on a single flower followed by Hymenoptera. Among the flower visiting species *Danaus chrysippus*, *Neptis sp.*, and *Euploea core* of Lepidoptera, *Apis dorsata* and *Eumerus sp.* of Hymenoptera, *Eristalinus arvorum* of Diptera spend much time on a single flower (Fig. I and II).

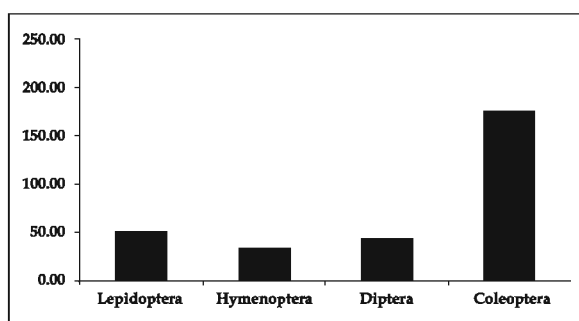


Fig. I. Maximum time spend (in second) by different insect flower visitors order

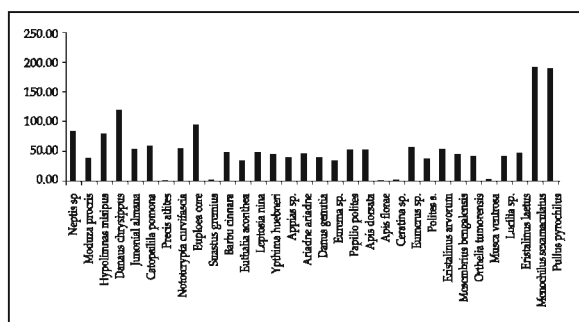


Fig. II. Maximum time spend (in second) by different insect flower visitor species

Fig. IV showed the average number of flower visited by single species in per unit of time (3 minutes). Group wise Hymenoptera visited maximum number of flowers in per unit of time followed by Diptera, Lepidoptera and Coleoptera. Among the species, *Moduza procris* (Lepidoptera), *Apis florae* (Hymenoptera), *Eristalis laetus* (Diptera) were touched highest number of flower in the unit of time with respect to the other species.

Mani and Sarvanan (1999) reported that, among the insect visitors of Asteraceae, butterflies predominate, representing 75% of all visitors. In other study, Mitra & Roy (2006) showed that a large number of dipterans also visited the flower heads of Asteraceae.

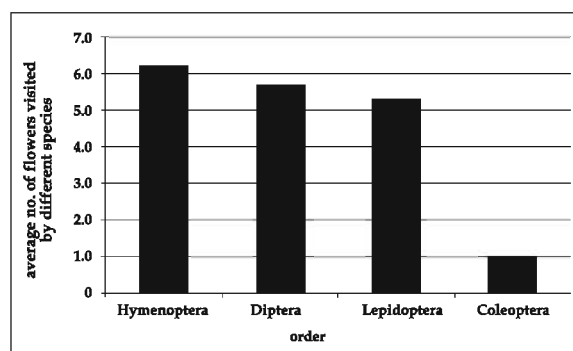


Figure III: Average number of flowers visited in each 3 minutes by different insect orders

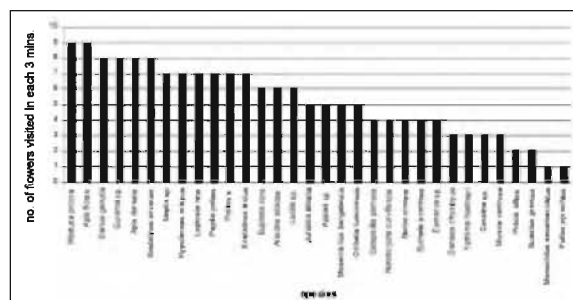


Figure IV: Average number of flowers visited in each 3 minutes by different insect visitor species of *Tagetes patula*

If we consider spending time on substrates will be the determining factor of the effectiveness for the pollinator species, then Lepidoptera is the effective pollinator group and *Danaus chrysippus* is the effective pollinator species. But if we consider the effectiveness on their number of flower touches in per unit of time then Hymenoptera is the effective pollinator group and *Moduza procris* (Lepidoptera), *Apis florae* (Hymenoptera) are the effective pollinator species of *Tagetes patula*.

But if we consider both foraging speed and rate for evaluating the effectiveness for a pollinator species then Diptera as a whole may be the effective pollinator group of *Tagetes patula* Linnaeus.

ACKNOWLEDGEMENTS

The authors are thankful to the Director, Zoological Survey of India, Kolkata for permitting us to undertake this study and the facilities provided.

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TAXONOMIC STATUS OF THE INDIAN SPECIES AND SUBSPECIES OF THE GENUS *CYNOPTERUS* F. CUVIER

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INTRODUCTION

The two species of the genus *Cynopterus* Cuvier viz. *Cynopterus sphinx* and *Cynopterus brachyotis* are known to occur in Indian Territory, and are widely distributed in different parts of the country. *Cynopterus sphinx* has one subspecies, the nominate one. The subspecies of *brachyotis* occurring in India are *angulatus*, *brachysoma*, *ceylonensis* and *scherzeri*, Ellerman & Morrison Scott (1966), however, Hill and Thonglongya (1972) found *angulatus* more similar to *sphinx* and regarded it as a subspecies of *sphinx* on the basis of its external and cranial measurements being closer to *sphinx*. All the measurements of different forms of *Cynopterus* occurring in India are so overlapping that it is difficult not only to distinguish the two species but also the measurements of different subspecies of both the species on the basis of which they have been separated, are also very much confusing and quite often one is confused for the other. Koopman (1989) also states that *brachyotis* and *sphinx* are usually confused. Hence, a detailed taxonomic study of different species and subspecies of the genus *Cynopterus* occurring in the Indian Territory has been made to overcome this problem and a large number of specimens from almost all parts of India has been examined for this purpose (Ghosh, M.K. 2005).

MATERIALS AND METHOD

The specimens of *Cynopterus* present in the National Zoological Collections, Zoological Survey Of India, Kolkata were utilized for studying the taxonomic status of its species and subspecies. In order to avoid any confusion only fully adult specimens were selected for this purpose. A total of about 700 specimens from 229 localities from all

over the country were examined. All the measurements taken are in millimeters. A detailed comparative study of the various measurements of the specimens of the above genus collected from different parts of India was made. The following is the list of various measurements with their symbols (in parenthesis) and definitions (Das, P.K. 2003):

Length of the forearm (Fa): The distance from the elbow to the wrist.

Length of the ear (E): The distance from the tip of the pinna to the notch at its base.

Length of the tibia (Tb): The distance from the knee-joint to the wrist.

Length of the foot and claw (F & Cl): The distance from the heel to the tip of longest toe with its claw.

Greatest length of the skull (l): Maximum length of the skull, measured from the hindermost point of the occipital surface in the middle line to the anterior most point of the premaxillary symphysis.

Condylobasal length (cb): The distance between the hindermost point of the occipital condyle of one side and anterior most point of the premaxilla of that side.

Length of cranial rostrum (cr): The distance from the front of the orbit of one side to the anterior extremity of the nasal bone of that side.

Length of maxillary tooth-row (mtr): The distance from the anterior surface of the crown of the upper canine of one side to the posterior surface of the crown of the last upper molar of that side.

Length of the lower tooth-row (ltr): The distance from the anterior surface of the crown of lower

canine of one side to the posterior surface of the crown of last lower molar of that side.

Mandibular length (ml): the distance between the hindmost point of the mandibular condyle to the anterior most point on the mandibular symphysis.

SYSTEMATIC ACCOUNTS

Class MAMMALIA

Order CHIROPTERA

Suborder MEGACHIROPTERA

Family PTEROPODIDAE

Genus *Cynopterus* F. Cuvier, 1824

1824. *Cynopterus* F. Cuvier, *Dents Mamm.* p.248.

Cynopterus sphinx sphinx (Vahl, 1797)

1797. *Vespertilio sphinx* Vahl. *Skr. Naturh-Selsk.* Copenhagen, 4: 123

(Tranquebar, Thanjavur district, Tamil Nadu, India).

Differential characters : Ears relatively longer, 18-20.5 mm. from orifice. Forearm 66-83 mm. (Andersen, 1912).

Cynopterus brachyotis Muller, 1838

1838. *Pachysoma brachyotis* Muller, *Tijdschr. Natuur. Gesch.*, v. pt. i. p. 146. Borneo.

Differential characters : Ears relatively shorter, 13-18 mm. from orifice. Forearm smaller, 54.5-72 mm (Andersen, 1912).

Cynopterus brachyotis scherzeri Zelebor, 1869

1869. *Cynopterus marginatus* var. (*Pachysoma scherzeri*) Zelebor, *Reise Novara, saugeth*, 13. Car Nicobor, Nicobor Islands.

Differential characters : Ears averaging shorter and narrower. Length from orifice 13-15 mm, forearm 69.5-70.5 mm (Andersen, 1912).

Cynopterus brachyotis ceylonensis Gray, 1870

1870. *Cynopterus marginatus* var. *Ceylonensis* Gray, *Cat. Monkeys, Lemurs and Fruit-eating Bats*. B.M. 122. Sri Lanka.

Differential characters : Ears relatively larger, 15-17 mm, forearm 54.5-70 mm (Andersen, 1912).

Cynopterus brachyotis brachysoma Dobson, 1871

1871. *Cynopterus brachysoma* Dobson, *Proc. Asiat. Soc. Bengal*, 105. Andaman Islands, Bay of Bengal.

Differential characters : Forearm 59-66 mm, Ears 13-15 mm (Andersen, 1912).

Cynopterus brachyotis angulatus Miller, 1898

1898. *Cynopterus angulatus* Miller, *Proc. Acad. Nat. Sci. Philadelphia*, 316. Lower Thailand.

Differential characters : Forearm 65-72 mm, Ear 16-18 mm (Andersen, 1912).

RESULT

By comparing the measurements of huge number of specimens of *Cynopterus* collected from different parts of India and present in the collection of the Zoological Survey of India, it is obvious that measurements on the basis of which the two species i.e. *Cynopterus sphinx* and *Cynopterus brachyotis* have been separated are all overlapping and also the range of measurements of different subspecies of *Cynopterus brachyotis* i.e. *brachyotis ceylonensis*, *brachyotis brachysoma*, *brachyotis angulatus* and *brachyotis scherzeri* are not consistent and it is difficult to separate one from the other on the basis of the characters by which they have been separated such as length of forearm, ear, total length of skull, condylobasal length and length of cranial rostrum. Also no other significant difference is detectable in different forms of *Cynopterus* occurring in Indian territory. Therefore, all the Indian forms of *Cynopterus* are synonymized here with *Cynopterus sphinx sphinx*.

DISCUSSION

Andersen (1912) differentiated the two species of *Cynopterus* viz. *Cynopterus sphinx* and *Cynopterus brachyotis* on the basis of the length of ears as ranging from 18 mm to 20.5 mm and the length of forearm from 66-83 mm in the former Vs. length of ears ranging from 13 mm to 18 mm and forearm from 54.5-72 mm in the latter. He further mentioned that *Cynopterus sphinx sphinx* and *Cynopterus brachyotis angulatus* are very similar occurring together in Assam, Myanmar and Thailand, but distinguished them on the basis of longer cranial rostrum and larger ears in *sphinx*. Later on Hill and Thonglongya (1972) discussed the affinities of the *angulatus* and considered it to be a subspecies of *Cynopterus sphinx* rather than *Cynopterus brachyotis* with which it had been previously associated by the majority of authors. Koopman (1989) states that *brachyotis* is frequently confused with *sphinx*. Different forms of *brachyotis* occurring in Indian territory have been distinguished on the

TABLE

Comparative measurements of different forms of *Cynopterus* found in India viz. *Cynopterus sphinx sphinx* (Cyn. s. s.), *Cynopterus brachyotis angulatus* (Cyn. b. a.), *Cynopterus brachyotis scherzeri* (Cyn. b.s.), *Cynopterus brachyotis ceylonensis* (Cyn. b.c.), and *Cynopterus brachyotis brachysoma* (Cyn. b.b.):

	<i>Cyn. s.s.</i>	<i>Cyn. b.a.</i>	<i>Cyn. b.s.</i>	<i>Cyn. b.c.</i>	<i>Cyn. b.b.</i>
	627 specimens	34 specimens	16 specimens	33 specimens	10 specimens
	120 skulls	24 skulls	09 skulls	15 skulls	04 skulls
FA	58.8-84.5 (71.2)	63.2-72 (70.3)	58.4-73.8 (69.8)	63-70 (68.5)	68-72 (70.0)
Tb	18.8-32.9 (26.8)	22-27.5 (26.4)	23.2-28 (25.8)	19-28.6 (26.3)	21-27 (25.9)
E	15-24.4 (17.9)	14.5-18.9 (17.3)	15-18.8 (17.0)	13.0-19.0 (16.9)	13.0-17 (16.7)
F & Cl	15.0-20.5 (17.4)	14.8-18.5 (16.8)	15.5-19.9 (17.2)	13-17.8 (16.6)	13.1-17.4 (16.5)
l	30.3-34.5 (32.8)	30.5-33.2 (32.5)	30.2-35.3 (33.0)	29.5-32.9 (31.6)	29.0-32.1 (30.8)
cb	27-30.6 (29.8)	29.5-32 (30.1)	27.2-30 (29.5)	26.5-29.9 (29.1)	27-29.8 (29.4)
cr	8.0-10.5 (9.2)	7.9-9.6 (8.9)	8.2-10.2 (9.3)	7.5-9.8 (8.8)	7.9-10 (9.0)
utr	10.5-12.5 (11.1)	10.2-11.3 (10.9)	10.7-12.0 (11.4)	9.9-11.2 (10.7)	10.2-11.0 (10.6)
ltr	11.3-14.0 (12.1)	11.1-13.2 (11.9)	11.2-12.0 (11.7)	11.0-12.2 (11.6)	11.1-12.1 (11.9)
ml	23.2-26.2 (24.6)	22.2-25.6 (24.2)	24.1-25.4 (24.0)	23.0-25.0 (23.9)	22.5-25.0 (23.8)

basis of very little difference in the size of their forearm and ear and are always confusing viz. forearm 65-72 mm, ear 16-18 mm in *angulatus*. Forearm 54.5-70 mm and ear 15-17 mm in *ceylonensis*; Forearm 59-60 mm and Ear 13-15 mm in *brachysoma* and Forearm 69.5-70 mm and Ear 13-155 mm in *scherzeri*. The relative size of total length of skull and cranial rostrum also do not show any significant difference as mentioned by Andersen (1912). The comparative measurements (Ghosh, M.K., 2005) of over 700 specimens (Table) show that there is no clear difference in different forms of the genus *Cynopterus* available in India. None of the characters based on which different forms of *Cynopterus* have been separated, holds good and are always confusing. Hence, the merger of all the species and subspecies of *Cynopterus* occurring in Indian Territory is the only solution.

SUMMARY

Indian species and subspecies of the genus *Cynopterus* have been studied in detail with special reference to the measurements on the basis of which they have been distinguished and it has been concluded that there is no significant difference between measurements of different forms of *Cynopterus* occurring in Indian territory and all the Indian forms are synonymized here with *Cynopterus sphinx sphinx*.

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AQUATIC AND SEMIAQUATIC HETEROPTERA (HEMIPTERA : INSECTA) OF GREAT NICOBAR BIOSPHERE RESERVE, ANDAMAN AND NICOBAR ISLANDS, INDIA

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INTRODUCTION

Aquatic bugs are an integral link in the food chain, forming food for larger organisms, which in turn are consumed by even larger organisms. They are also indicators of water quality. The Great Nicobar Biosphere Reserve having an area of 88,500 ha. is the only island in the Nicobar having five perennial rivers namely, the Galathea, the Jubilee, the Dak Aniang, the Dak Tayal and the Amrit Kaur originate from Mt. Thullier. The Galathea is the longest and widest river flows southward to meet the sea at Galathea Bay. The aquatic Hemiptera are poorly known in this Biosphere Reserve. In the present study 534 aquatic and semi-aquatic Heteroptera of Great Nicobar Biosphere Reserve were collected by the second author from 24th October 2010 to 8th December 2010, which resulted the identification of 13 species under 8 genera belongs to six families. Of these 5 species were newly recorded to Andaman and Nicobar Islands. It is quite interesting that the representatives of all the three infraorders of aquatic Heteroptera namely Gerromorpha, Nepomorpha and Leptopodomorpha were collected through a single field trip. Through the information from Polhemus and Starmühlner (1990) and Thirumalai (2002 and 2007), 39 species of Gerromorpha and Nepomorpha were already known from Andaman and Nicobar Islands. A checklist of 43 species of aquatic and semiaquatic Hemiptera of Andaman and Nicobar islands is also provided in this paper.

Abbreviations used: GNBR – Great Nicobar Biosphere Reserve; mpt. – macropterous form (fully developed winged form); apt. – apterous form

(without wings); bpt. – brachypterous (half developed wings) Is. – Immatures; exs. – Examples.

Infraorder : GERROMORPHA

Family VELIIDAE

Subfamily MICROVELIINAE

Microvelia albomaculata Distant, 1909

1909. *Microvelia albomaculata* Distant, *Ann. Mag. nat. Hist.*, 3(8): 499.

1910. *Microvelia albomaculata* Distant: *Fauna of British India*, 5: 138.

Material examined : GNBR, Govind Nagar, 12.xi.2010, (4 mpt. and 5 Is. exs.), 17.xi.2010, (1 mpt. and 1 apt. exs.), 6.xii.2010, (1 ♀ ex.).

Diagnosis : Length: 1.5 mm – 2 mm; colour : Dull piceous black; head with inner margin of eyes greyish pubescence more pronounced forming a marginal fascia; anterior margin of pronotum with ochraceous fascia and its lower central margin has incision; hemelytra iridescent with 8 greyish white irregularly shaped spots; eyes sanguineous.

Distribution : Andaman and Nicobar Islands (GNBR), Madhya Pradesh and West Bengal.
Elsewhere : Bangladesh.

Remarks : This species is new record to Andaman and Nicobar Islands.

Microvelia (Microvelia) diluta Distant, 1909

1909. *Microvelia diluta* Distant, *Ann. Mag. nat. Hist.*, 3(8): 500.

1910. *Microvelia diluta* Distant, *Fauna of British India*, 5: 139-140.

Material examined : GNBR, Johinder Nagar, 25.xi.2010, (30 mpt. ♂, 5 mpt. ♀, 25 apt. ♂, 20 apt. ♀, 30 Is. exs.).

Diagnosis : Length: 2.1 mm; colour: Piceous; head dull black; anterior marginal fascia of pronotum reddish ochraceous; hemelytra dull greyish white, robust veins piceous; second antennal joint slightly shorter or subequal to first segment, distinctly shorter than the third; pronotum with lateral margin sinuate; connexivum visible from above with densely pilose; hemelytra scarcely reaching the apex of abdomen.

Distribution : Andaman and Nicobar Islands (GNBR), Bihar, Delhi, Maharashtra, Meghalaya, Odisha, Tamil Nadu, Tripura and West Bengal. **Elsewhere :** Bangladesh, Indonesia, Myanmar, Singapore and Sri Lanka.

Remarks : These insects were collected from floating filamentous algae of stagnant water and a new record to Andaman and Nicobar Islands.

Subfamily RHAGOVELIINAE

Rhagovelia (Neorhagovelia) sumatrensis

Lundblad, 1936

1934. *Rhagovelia femorata* var. *sumatrensis* Lundblad, *Arch Hydrobiol. Suppl.*, 4: 287.

1936. *Rhagovelia sumatrensis* Lundblad, *Ark. Zool.*, 28(21): 19.

Material examined : GNBR, Govind Nagar, 6.xi.2010, (1 mpt. ♂, 3 mpt. ♀, 8 apt. ♂, 11 apt. ♀, 2 Is. exs.), 9.xi.2010, (8 apt. ♂, 5 apt. ♀, 2 Is. exs.), 10.xi.2010, (29 apt. ♂, 37 apt. ♀, 3 Is. exs.), 12.xi.2010, (1 apt. ♂, 1 apt. ♀ exs.), 15.xi.2010, (18 apt. ♂, 11 apt. ♀, 8 Is. exs.); Johinder Nagar, 25.xi.2010, (1 mpt. ♂, 3 mpt. ♀, 5 apt. ♂, 2 apt. ♀, 7 Is. exs.), 7.xii.2010, (1 apt. ♀ ex.).

Diagnosis : Length: 2.8 mm; colour : Black; 6th abdominal segment of female shining; mesosternum with slanting curved fascia formed by shining pubescence; anterior region of pronotum with orange brown transverse band; mid coxa ochraceous; basal half of mid femur with 3-4 spines in male; posterior margin of pronotum straight; basal inner margin of hind femur of males with 14-18 teeth and females with 3-6 teeth and distal region of hind femur with 7-8 teeth in males and 5-6 teeth in females after long curved middle spine; hind trochanter with 4-6 denticles; eyes ash with red tinge.

Distribution : Andaman and Nicobar Islands (GNBR), Madhya Pradesh and Sikkim. **Elsewhere:** Africa, Indochina, Indonesia, Peninsular Malaysia and South China.

Remarks : Collected from fast flowing streams. In winged form, the basal spines of hind femur are not so clear.

Family MESOVELIIDAE

Subfamily MESOVELIINAE

Mesovelia vittigera Horvath, 1895

1895. *Mesovelia vittigera* Horvath., *Revue. ent.*, 14: 160.

2002. *Mesovelia vittigera* Horvath: Thirumalai, *Rec. zool. Surv. India*, 100 (Part 1-2): 73.

Material examined : GNBR, Govind Nagar, 6.xii.2010, (1 bpt. ♂ ex.).

Diagnosis : Length: 2.6 mm; colour: Luteous; inner margin of mid leg in males with 9 small spines and 5 minute spines; apices of rostrum, tibia and tarsi fuscous; tarsi 3 segmented; inner subapical margin of fore femur with 5 minute spines; 6th abdominal sternum of male with a group of median spines and the lateral region longly pilose; eyes reddish brown colour.

Distribution : Andaman and Nicobar Islands (GNBR), Arunachal Pradesh, Bihar, Karnataka, Kerala, Maharashtra, Odisha, Puducherry, Tamil Nadu, Uttar Pradesh and West Bengal. **Elsewhere:** Africa, Australia, Bangladesh, Eastern Palearctic, Egypt, Ethiopia, Indonesia, Malaysia, Myanmar, Palestine, Philippines, Solomon Islands, South Europe, Sri Lanka and Syria.

Remarks : Most of this species collected from stagnant waters with floating aquatic plants.

Family GERRIDAE

Subfamily GERRINAE

Limnogonus (Limnogonus) fossarum fossarum (Fabricius, 1775)

1775. *Cimex fossarum* Fabricius, *Syst. Ent.*, 727.

2002. *Limnogonus* (L.) *fossarum* (Fabricius): Thirumalai, *Rec. zool. Surv. India*, 100(1-2): 62.

Material examined : GNBR, Chingam Basthi, 8.xi.2010, (3 ♂, 5 ♀, 3 Is. exs.), 7.xii.2010 (1 ♀ ex.); Laxmi Nagar, 25.xi.2010, (5 ♂, 7 ♀, 3 Is. exs.); Govind Nagar, 5.xii.2010, (1 ♂, 6 ♀, 3 Is. exs.), 6.xii.2010, (2 ♂, 2 ♀, 2 Is. exs.).

Diagnosis : Colour: Reddish brown to piceous; body of moderate size; antennae 4-jointed, 2nd and 3rd joints shortest and nearly subequal in length; 4th antennal joint slightly smaller than the 1st joint or subequal; pronotum with the mid-longitudinal carination moderately prominent, posterior tip of pronotum remarkably angular; 7th abdominal segment with connexival spines.

Distribution : Andaman and Nicobar Islands (GNBR), Andhra Pradesh, Assam, Bihar, Delhi, Karnataka, Kerala, Odisha, Rajasthan, Uttar Pradesh, Tamil Nadu, Tripura and West Bengal. *Elsewhere*: Bangladesh, Java, Malay Peninsula, Myanmar, Sri Lanka and Sumatra.

Remarks : It is a common species of Gerrinae in Indo-Australian regions, found in wide variety of habitats including hot springs and brackish pools.

Limnometra ciliata Mayr, 1865

1865. *Limnometra ciliata* Mayr, *Verh. zool-bot. Vereins Wien.*, **15**: 444.
1865. *Limnometra inermis* Mayr, *Verh. zool-bot. Vereins Wien.*, **15**: 444.
1933. *Limnometra ciliatus* Lundblad, *Archiv. für Hydrobiologie, "Tropische Binnengewässer"*, **4**(12): 371.
1964. *Tenagobius (Limnometra) ciliatus* (Mayr): Andersen, *Entomologische Meddelelser*, **32**: 333.
2002. *Limnometra ciliata* Kirkaldy, *Proc. of Linn. Soc. of N.S. Wales*, **33**: 367.

Material examined : GNBR, Chingam Basthi, Johinder Nagar, Campbell Bay, 7.xii.2010, (1 apt. ♂ ex.).

Diagnosis : Length 14.9 mm; colour: Brown; head with a piceous diamond shaped longitudinal marking; lateral side of the head inside the eyes with piceous fascia; between the anterior region of the eyes and antennae has a piceous stripe; antennae and legs uniformly brown without pale annulations; base of mid femur with a short black streak; foreleg with 1st tarsal segment longer than the second; abdominal segments with spindle shaped pale spot in the centre; connexival spines reaches beyond the tip of the abdomen; 8th abdominal sternum visible with lower concave margin; pronotum with a central brown line and its adjacent region ochraceous; fore femur not stouter than mid femur; mid femur and tibia fringed with cilia; abdominal sternum with a faint of median longitudinal carina; 1st genital segment of male with a triangular projection on both side.

Distribution : Andaman & Nicobar Islands (GNBR). *Elsewhere* : Borneo, Celebes, Guams, Java, Fiji, Lesser Sunda Islands, Malay Peninsula, Moluccas, New Britain, New Guinea, Philippines, Solomon Islands, Sumatra and Thailand.

Remarks : The species *Limnometra cursitans* is also having cilia on the mid femur. But *Limnometra ciliata* Mayr can easily identified by the presence of cilia, triangular projections on the first genital segment and the black streak on the base of mid femur. The length of the species varies from 13 mm to 19.5 mm. Previously it has been reported from Kar Nicobar and Manila of Nicobar group of islands by Andersen (1964).

Limnometra minuta Mayr, 1865

1865. *Gerris minuta* Mayr, *Verh. zool-bot. Wien*, **15**: 444.
- 1903a. *Gerris minuta* (Mayr): Distant, *Fauna of British India*, **2**: 181.
1964. *Tenagobius (Limnometra) minutus* (Mayr): Andersen, *Entomologische Meddelelser*, **32**: 327.

Material examined : GNBR, Govind Nagar, 12.xi.2010, (2 ♂, 1 ♀ exs.), 13.xi.2010, (2 ♀, 2 Is. exs.), 28.xi.2010, (2 ♂ exs.); Chingam Basthi, 7.xii.2010, (1 ♂ ex.).

Diagnosis : Length: 8.5 mm; colour: Ochraceous to brown; head with 4 lines between eyes, outer black and inner two pale brown lines, which united in the upper and lower region, and upper united region is black; 4th antennal segment very long, 1st and 3rd segments are more or less subequal, 2nd shorter; head with two brown spots, one near to the apex of black line ie., near to the inner anterior margin of eye, and another spot behind the apex of antenna; head and pronotum bright ochraceous; pronotum with a central median line and lateral region with black line which is evanescent to middle; lower margin with white milky white outline; lateral margin of mesosternum with brown fascia; hemelytra cinerous brown.

Distribution : Andaman and Nicobar Islands (GNBR) and West Bengal.

Remarks : This species mainly found in lentic ecosystem and slow running streams.

Infraorder NEPOMORPHA

Family PLEIDAE

Paraplea frontalis (Fieber, 1844)

1844. *Ploa frontalis* Fieber, *Entomologische Monographien* Liepzig, **18**.

2006. *Paraplea frontalis* (Fieber): Thirumalai & Sureshkumar, *Rec. zool. Surv. India*, 105: 9.

Material examined : GNBR, Govind Nagar, 17.xi.2010, (2 exs.); Chingam Basthi, 7.xii.2010, (109 exs.).

Diagnosis : Length: 2 mm; colour: Ochraceous; head of front with 3 dashes, i.e., one median stripe, behind that 2 dashes; two spots above the neck; eyes reddish brown; apex of clavus and corium darker; body punctured, most punctures with brown spots and few are empty; tegmina obliquely truncate behind.

Distribution : Andaman and Nicobar Islands (GNBR), Andhra Pradesh, Arunachal Pradesh, Bihar, Chandigarh, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Ponducherry, Punjab, Tamil Nadu, Uttar Pradesh and West Bengal.

Elsewhere : China, Moluccas, South East Asia, Sri Lanka, Sumatra, Taiwan, Thailand and West Malaysia.

Remarks : Few specimens with indistinct head marking were observed in this species.

Family NOTONECTIDAE

Subfamily NOTONECTINAE

Anisops barbatus Brooks, 1951

1951. *Anisops barbata* Brooks, *Kan. Univ. Sci. Bull.*, 34: 387.

2004. *Anisops barbatus* Brooks: Nieser, *Raff. Bull. Zoology*, 52: 84.

Material examined : GNBR, Govind Nagar, 6.xii.2010, (1 mpt. ♀ ex.).

Diagnosis : *Female*: Length: 8.9; head width five to six times the anterior width of vertex; tylus slightly swollen, without tufts of hairs; scutellum milky white; clavus yellowish white.

Distribution : Andaman and Nicobar Islands (GNBR), Bihar, Chandigarh, Haryana, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. **Elsewhere** : China, Java, Perak, Singapore, South East Asia and Sumatra.

Remarks : Collected from undisturbed pond.

Anisops naustus Fieber, 1851

1851. *Anisops nausta* Fieber, *Abhandl. Konigl. Bohm. Ges. Wiss.*, 7: 484-485.

2004. *Anisops naustus* Fieber: Nieser, *Raff. Bull. Zoology*, 52: 87.

Material examined : GNBR, Govind Nagar, 5.xii.2010, (1 ♂ exs.).

Diagnosis : *Male*: Dorsal view of male head has a cephalic projection with a broadly indented apex, in lateral view less than half the total length of the frons anteriorly of eyes ; tylus has a median depression; frons is narrowed in the middle and dorsally with a median depression forming a spoon shaped appearance; rostral prong slightly shorter than the third rostral segment; fore femur apically narrowed, stridulatory comb of fore tibia with about 14 teeth which are longest in the middle; scutellum milky white.

Distribution : Andaman and Nicobar Islands (GNBR), Andhra Pradesh, Assam, Madhya Pradesh, Odisha, West Bengal. **Elsewhere** : Australia, Indonesia, Melaka, Pacific Islands, Singapore, Southern China and West Malaysia.

Remarks : A single specimen was collected from an area with less anthropogenic activity.

Anisops niveus (Fabricius, 1775)

1775. *Notonecta nivea* Fabricius, *Systema Entomologiae Flensburgi et Lipsiae*, 690.

2001. *Anisops niveus* (Fabricius): Nieser, *Raff. Bull. Zoology*, 52: 88.

Material examined : GNBR, Govind Nagar, 17.xi.2010, (2 ♂ exs.).

Diagnosis : *Male*: Length: 4.8 mm – 5.1 mm; colour: Milky white; eyes piceous to reddish brown colour; 2nd antennal segment piceous; prosternum brown colour; labrum with long white hairs; tylus and frons are excavated; outer margin of fore femur blackish; stridulatory comb with 13 teeth in equal length; rostral prong shorter than the 3rd rostral segment, originating near its proximal margin; wings surpassing the last abdominal segment.

Distribution : Andaman and Nicobar Islands (GNBR), Assam, Bihar, Kerala, Madhya Pradesh, Maharashtra, Odisha, Tamil Nadu, Uttar Pradesh and West Bengal. **Elsewhere** : Indonesia, Johar, Malaka, Singapore and South East Asia.

Remarks : Collected from lentic ecosystem.

Anisops tahitiensis Lundblad, 1934

1934. *Anisops tahitiensis* Lundblad, *Bull. Bishop. Mus. Honolulu*, 113: 121.

2005. *Anisops tahitiensis* Lundblad: Nieser, Chen & Young, *Raff. Bull. Zoology*, 53: 206.

Material examined : GNBR, Govind Nagar, 6.xii.2010, (1 ♀, 1 I. exs.), 12.xi.2010, (1 ♂, 3 ♀ exs.), 17.xi.2010, (6 ♂, 12 ♀, 3 Is. exs.); Laxmi Nagar, 25.xi.2010, (17 ♂, 13 ♀, 8 Is. exs.); Chingam Basthi, 7.xii.2010, (9 ♂, 6 ♀ exs.).

Diagnosis : Length: 5.1mm – 6.0 mm; colour: Yellowish white; synthipsis about one third the anterior width of vertex; tylus swollen with carina; rostral prong longer than third rostral segment, originating middle of the segment; stridulatory comb of males with 23-34 teeth; middle of last abdominal sternum of female with black longitudinal stripe.

Distribution : Andaman and Nicobar Islands (GNBR). *Elsewhere* : Australia, Guadalcanal, Johor, Malaysia, Okinawa, Pahang, Perak, Selangor, Singapore, Tahiti, Terengganu and Vietnam.

Remarks : This species found only in lentic ecosystem. Scutellum of male mainly ochraceous but in female piceous and also few with milky white. Last abdominal segment of female with black stripe on the median ridge.

Infraorder LEPTOPODOMORPHA

Family LEPTOPODIDAE

Valleriola cicindeloides (Distant, 1908)

1908. *Leptopus cicindeloides* Distant, *Ann. Mag. nat. Hist.*, 8(3): 140.

1910. *Leptopus cicindeloides* (Distant): *Fauna of British India*, 5: 224.

Material examined : GNBR, Johinder Nagar, 3.xii.2010, (1 ♂, 4 ♀ exs.).

Diagnosis : Length: 5.5 mm; colour: Greyish ochraceous; body with pale pilosity; head with ocelli and median tubercle; first antennal segment

stout, small and the 3rd segment very longer; pronotum with four dark brownish grey fascia, which is not reached upto the apex of pronotum; base, postero-lateral margin and apex of pronotum ochraceous; scutellum and wings fuscous; clavus with two ochraceous spots, one at the apex and another at the base; middle and apex of the corium with two ochraceous spots; membrane greyish ochraceous.

Distribution : Andaman and Nicobar Islands (GNBR), Bihar, Madhya Pradesh and West Bengal.

Remarks : Anterior central longitudinal line and the fascia on the posterior region of pronotum not prominent in all specimens. Sometimes the fascia united and only leaving the central prominent apical and obscure postero sub lateral ochraceous patch.

SUMMARY

In the present study 7 species of Gerromorpha, 5 species of Nepomorpha and 1 species of Leptopodomorpha were recorded. *Microvelia albomaculata* Distant, *Microvelia diluta* Distant from the family Veliidae., *Anisops naustus* (Fieber), *Anisops barbatus* Brooks from the family Notonectidae and *Valleriola cicindeloides* Distant from the family Leptopodidae were the five new records to Andaman and Nicobar Islands. *Limnometra minuta* Mayr previously reported from (Little) Nicobar, Galathea by Andersen (1964), now has been recorded for the first time from Great Nicobar.

ACKNOWLEDGEMENT

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- Thirumalai, G. 2007. A synoptic list of Nepomorpha (Hemiptera: Heteroptera) from India. *Rec. zool. Surv. India. Occ. Paper No.*, 273: 1-84.



Microvelia albomaculata Distant



Microvelia (Microvelia) diluta Distant



Rhagovelia (Neorhagovelia) sumatrensis Lundblad



Mesovelia vittigera Horvath



Limnogonus (Limnogonus) fossarum fossarum (Fabricius)



Limnometra ciliata Mayr



Limnometra minuta Mayr



Paraplea frontalis (Fieber)



Anisops barbatus Brooks



Anisops naustus Fieber



Anisops niveus (Fabricius)



Anisops tahitiensis Lundblad



Valleriola cicindeloides (Distant)



A pond behind the Govind Nagar, Tsunami shelter



A pond on Chingam Basthi



A water pit on Chingam Basthi



A water pit on Ring road



Rain water drainage on Laxmi Nagar



Rain water drainage on Ring road



A stream adjacent to 16th km bridge,
Govind Nagar



A stream on Chingam Basthi



A stream on Johinder Nagar



A stream on agricultural field, Ring road



A stream on Laxmi Nagar



A concrete wall near a stream on Johinder Nagar,
where *Valleriola cicindeloides* were collected

A CHECKLIST OF AQUATIC AND SEMIAQUATIC HEMIPTERA (INSECTA) OF ANDAMAN AND NICOBAR ISLANDS

Order HEMIPTERA

Suborder HETEROPTERA

Infraorder GERROMORPHA Popov, 1971

Superfamily GERROIDEA Reuter, 1910

Family GERRIDAE Leach, 1815

Subfamily GERRINAE Bianchi, 1896

Genus *Limnogonus* Stål, 1868

Subgenus *Limnogonus* Stål, 1868

1. *Limnogonus (Limnogonus) fossarum fossarum* Fabricius, 1775

2. *Limnogonus (Limnogonus) hungerfordi* Andersen, 1975

3. *Limnogonus (Limnogonus) nitidus* (Mayr, 1865)

Genus *Limnometra* Mayr, 1865

4. *Limnometra minuta* Mayr, 1865

5. *Limnometra ciliata* Mayr, 1865

Genus *Tenagogonus* Stål, 1854

6. *Tenagogonus nicobarensis* Andersen, 1964

Subfamily PTILOMERINAE Bianchi, 1896

Genus *Ptilomera* Amyot & Serville, 1843

Subgenus *Ptilomera* Amyot & Serville, 1843

7. *Ptilomera (Ptilomera) laticaudata* (Hardwicke, 1823)

8. *Ptilomera (Ptilomera) tigrina* Uhler, 1860

Subfamily HALOBATINAE Bianchi, 1896

Genus *Halobates* White, 1883

9. *Halobates elephanta* Andersen & Foster, 1992

10. *Halobates formidabilis* Distant, 1910

11. *Halobates frauenfeldnus* Buchanan,

12. *Halobates germanus* White, 1883

13. *Halobates hayanus* White, 1883

14. *Halobates micans* Eschscholtz, 1822

15. *Halobates proavus* White, 1883

16. *Halobates trynae* Herring, 1964

Subfamily TREPOBATINAE Matsuda, 1960

Genus *Calyptobates* Polhemus & Polhemus, 1994

17. *Calyptobates andaman* Polhemus & Polhemus, 1994

Family VELIIDAE Amyot & Serville, 1843

Subfamily HALOVELIINAE Esaki, 1930

Genus *Strongylovelia* Esaki, 1924

18. *Strongylovelia* sp. *Polhemus & Starmuhlner, 1990

*Remarkd as new to science but not yet described.

Subfamily MICROVELIINAE China & Usinger, 1949

Genus *Microvelia* Westwood, 1834

Subgenus *Microvelia* Westwood, 1834

19. *Microvelia albomaculata* Distant, 1909

20. *Microvelia diluta* Distant, 1909

21. *Microvelia (Microvelia) douglasi* Scott, 1874

Genus *Neoalardus* Distant, 1912

22. *Neoalardus typicus* (Distant, 1903)

Subfamily RHAGOVELIINAE China & Usinger, 1949

Genus *Rhagovelias* Mayr, 1865

Subgenus *Neorhagovelias* Matsuda, 1956

23. *Rhagovelias (Neorhagovelias) andaman* Polhemus, 1990

24. *Rhagovelias (Neorhagovelias) sumatrensis* Lundblad, 1936

Superfamily MESOVELIOIDEA Douglas & Scott, 1867

Family MESOVELIIDAE Douglas & Scott, 1867

Subfamily MESOVELIINAE Douglas & Scott, 1867

Genus *Mesovelias* Mulsant & Rey, 1852

25. *Mesovelias vittigera* Horvath, 1895

Superfamily HYDROMETROIDEA Billberg, 1820

Family HYDROMETRIDAE Billberg, 1820

Genus *Hydrometra* Latreille, 1796

26. *Hydrometra greeni* Kirkaldy, 1898

27. *Hydrometra maindroni* Hungerford & Evans
 Infraorder NEPOMORPHA Popov, 1968
 Superfamily NEPOIDEA Latreille, 1802
 Family NEPIDAE Latreille, 1802
 Genus *Laccotrephes* Stål, 1866
28. *Laccotrephes ruber* (Linnaeus, 1764)
 Subfamily RANATRINAE Douglas & Scott, 1865
 Genus *Ranatra* Fabricius, 1790
29. *Ranatra distanti* Montandon, 1910
30. *Ranatra parmata* Mayr, 1865
 Family BELOSTOMATIDAE Leach, 1815
 Genus *Diplonychus* Laporte, 1833
31. *Diplonychus rusticus* (Fabricius, 1781)
 Subfamily LETHOCERINAE Lauck & Menke, 1961
 Genus *Lethocerus* Mayr, 1853
 Subgenus *Lethocerus* Mayr, 1853
32. *Lethocerus indicus* (Lepeletier & Serville, 1825)
 Superfamily NOTONECTOIDAE Latreille, 1802
- Family NOTONECTIDAE Latreille, 1802
 Genus *Anisops* Spinola, 1837
33. *Anisops barbatus* Brooks, 1951
34. *Anisops bouvieri* Kirkaldy, 1904
35. *Anisops naustus* Fieber, 1851
36. *Anisops niveus* (Fabricius, 1775)
37. *Anisops sardeus sardeus* Herrich-Shaffer, 1850
38. *Anisops tahitiensis* Lundblad, 1934
39. *Anisops* sp. Polhemus & Starmuhlner, 1990
 Genus *Enithares* Spinola, 1837
40. *Enithares ciliata* (Fabricius, 1798)
41. *Enithares rogersi* Distant, 1910
 Superfamily PLEOIDEA Fieber, 1851
 Family PLEIDAE Fieber, 1851
 Genus *Paraplea* Esaki & China, 1928
42. *Paraplea frontalis* (Fieber, 1844)
 Infraorder LEPTOPODOMORPHA Popov, 1971
 Family LEPTOPODIDAE Brulle, 1836
 Genus *Valleriola* Distant, 1904
43. *Valleriola cicindeloides* (Distant, 1908)



MORPHOLOGICAL DIFFERENCES IN THREE SPECIES OF THE GENUS *DIPLONYCHUS* (HEMIPTERA : BELOSTOMATIDAE) KNOWN FROM INDIA

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INTRODUCTION

Belostomatidae commonly called as giant water bug belongs to the infraorder Nepomorpha. Thirumalai (2007) recorded three species of the genus *Diplonychus* from India. These predatory insects feed on aquatic crustaceans, fishes, amphibians and mosquito larvae. The results of Saha (2007) reveal that a single adult of *D. rusticus* could consume 11-87 fourth instar larvae of *Culex quinquefasciatus* Say per day and *D. annulatus* consume 33-122 fourth instar larvae per day, depending upon the prey and predator densities. These insects are used as bioindicators of water quality and biocontrol method. Corbi *et al.* (2010) analysed the Ion concentration of Al, Cd, Cr, Cu, Zn, Fe and Mn in adult Belostomatidae. For undertaking any kind of applied research, the correct species identification is important. Since the species *Diplonychus molestus* resembles *Diplonychus rusticus*, which pose to doubt in the determination of species, therefore the present study was undertaken to provide clear cut identification of all the species of the genus known from India.

MATERIALS AND METHODS

Differences in some important morphological characteristics of three species of genus *Diplonychus* belongs to the infraorder Nepomorpha and family Belostomatidae, were studied from the reference collections of Zoological Survey of India, Jabalpur. The specimens were collected by using D- frame aquatic net and preserved in 75 % alcohol. Some of the specimens were pinned. The specimens were identified and measurements were taken by using Leica Stereozoom microscope (Leica M205 A) and

the photographs were taken by using Leica Microscope (Leica MZ 125) and Leica Stereozoom microscope (Leica M205 A). In case of *D. rusticus* only the flightless morphs are considered for taking measurements and for mentioning the characters in the Table 2, since more number of flightless morph were examined in the present study.

Key to the species of *Diplonychus* of India

1. Hemelytra with spiny patch on corium, fore tarsus 1 jointed, small species 2
- Hemelytra without spiny patch on corium, fore tarsus 2 jointed, apex of head acute, respiratory straps without cluster of setae, large species..... *D. annulatus*
2. Respiratory straps without cluster of setae, posterior pronotal angles more obtuse *D. molestus*
- Respiratory straps with cluster of setae, posterior pronotal angles less acute *D. rusticus*

Diplonychus annulatus (Fabricius, 1781)

1781. *Nepa annulata* Fabricius, Carol. Ernest. Bokhni. Hamburgi et Kiloni, 333.

2002. *Diplonychus annulatus* (Fabricius): Thirumalai, Metha & Sharma, Res. Bull. Panjab Univ., 52: 157.

Material examined : Bastar, Jagadapur, 12.i.1974, (2 ♀, 1 ♂ exs.), Coll. R.K. Singh & Party., Bilaspur, Khutaghat, 7.iii.1992, (3 ♀ exs.), Korba, 8.iii.1992, (2 ♂, 1 ♀ exs.), Coll. U.A. Gajbe & Party; Jabalpur, Amkhas, 25.vi.1970, (1 ♂ ex.); Mohania Village, 27.X.1975, (2 ♂ exs.); Nansat Village, 24.iii.1964, (1 ♀ ex.); Surajla tank, Nagpur Road, 24.vii.1970, (1 ♀ ex.); Urana tank, Patan Village, 23.iv.1964, (1 ♀ ex.),

Coll. H.P. Agrawal; Banala, 2.i.1961, (1 ♂ ex.), Coll. S. Chakarapany; Garha Village, 20.HU965, (1 ♀ ex.), Coll. MX. Khosta; Barela tank, 29.v.1974, (1 ♂, 2 ♀ exs.), Coll. D.S. Mathur & Party; Panagar tank on Katni Road, 28.ii.1974, (1 ♂ ex.), Coll. R.K. Singh; **Morena**, Noorabad, 6.i.1995, (1 ♂ ex.); **Raipur**, Khosi Nala, 5.xii.1991, (2 ♀ exs.), Coll. H.S. Sharma; **Rewa**, Lakhori Bagh, 17.x. 1986, (1 ♀ ex.), Coll. D.S. Mathur & Party; **Sarguja**, Ambikapur, 9.i.1975, (1 ♂ ex.), Coll. H. Khajuria & Party; **Shivpuri**, SSS Club, 24.iii.1980, (1 ♂ ex.), Coll. D.K. Harshey.

Distribution : Andhra Pradesh, Assam, Bihar, Chandigarh, Chhattisgarh, Delhi, Gujarat, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. *Elsewhere*: Bangladesh and Pakistan.

***Diptonychus molestus* (Dufour, 1863)**

1863. *Appasus molestum* Dufour, *Ann. Soc. Ent. France*, 4(3): 395.

2004. *Diplonychus molestus* (Dufour): Bal & Basu, *Zool. Surv. India, State Fauna Series*, 10: 302.

Material examined : **Bharauch**, PWD Rest House, 19.i.1980, (5 ♂, 5 ♀ exs.) Coll. U.A. Gajbe; **Bhopal**, Bhopal Lake, 23.iii.1979, (1 ♀ ex.), Coll. P.D. Rane; **Bilaspur**, Korba, 8.iii.1992, (1 ♂, 3 ♀ exs.); Chhattisgarh, Shanti Nagar, **Rajnandgaon**, 22.xii.1983, (1 ♂ ex.) Coll. U.A. Gajbe; **Damoh**, VDWLS, 18.xi.2009, (1 ♂, 2 ♀ exs.); Kodi Kalam, 23.vi.2010, (2 ♂, 5 ♀ exs.), Sangrampur, 24.vi.2010, (2 ♂, 4 ♀ exs.); Kola Nala, 25.vi.2010, (1 ♂, 3 ♀ exs.), Coll. J. Thilak; Bhaisaghat, 22.vii.2009, (1 ♂, 1 ♀ exs.), Coll. K. Chandra; **Hoshangabad**, Bandsobhan Village, 13.i.1990, (1 ♀ ex.); Narmada Railway Road Bridge, 9.i.1990, (4 ♂, 2 ♀ exs.); Tewa River Bridge, 12.i.1990, (3 ♂, 6 ♀ exs.), Coll. U.A. Gajbe; Narmada river, 29.iii.1979, (1 ♀ ex.) Coll. P.D. Rane & Party; **Jabalpur**, Amkhas, 19.viii.1966, (1 ♂ ex.), Bhedaghat, 19.vii.1965, (2 ♀ exs.), Coll. H.P. Agrawal; Budhagar tank, 22.xii.1975, (1 ♀ ex.), Coll. D.S. Mathur & Party; Garha Village, 20.iii.1965, (1 ♂ ex.), Coll. M.L. Koshta; Heron River, Katangi Road, 10.vi.1969, (7 ♂, 3 ♀ exs.), Coll. V.V. Rao; Indrana Village, 9.xii.1980, (1 ♂, ♀ exs.) Coll. H.S. Sharma; Lamataghat, 3.v.1975, (1 ♂ ex.) Coll. H. Khajuria; 6.i.1967, (1 ♂, 5 ♀ exs.) Coll. H.S. Sharma & Party; 3.iv.1968, (1 ♂ ex.), Coll. H.P. Agrawal; 11.x.1967, (1 ♀ ex.) Coll. V.S. Durve; 31.x.1969, (1 ♂, 2 ♀ exs.),

Coll. V.V. Rao; Medical College Area, Nagpur Road, 13.ix.1966, (6 ♂, 1 ♀ exs.), Coll. H.P. Agrawal & Party; Murrai Katangi Road, 28.x.2003, (1 ♀ ex.), Coll. M.L. Dhimeh; Pariat River on Katni Road, 11.xi.1965, (2 ♀ exs.), Coll. H.P. Agrawal; 5.X.1966, (1 ♀ ex.), Coll. V.S. Durve; 11.x. 1968, (1 ♂ ex.), Coll. V.S. Durve; Patan Village, 26.vii.1966, (2 ♂, 1 ♀ exs.), Coll. H.P. Agrawal; Sardar bazaar, 17.ii.1966, (3 ♂, 4 ♀ exs.), Coll. M.L. Koshta; 23.iii.1966, (1 ♀ ex.), Sasan Village, 20.vii.1968, (1 ♀ ex.) Coll. H. Khajuria; Shapura Road, 31.xii.1975, (1 ♂, 2 ♀ exs.), Coll. P.D. Rane; Sukha Village, 30.vii.1965, (1 ♂, 5 ♀ exs.), Coll. H.P. Agrawal; CZRC, ZSI Res. Colony, 29.vii.2010, (6 ♂, 1 ♀ exs.), Coll. Devanshu; 27.ix.2010, (1 ♂ ex.), 30.ix.2010, (23 ♂, 20 ♀ exs.), 26.vi.2011, (1 ♂ ex.), Coll. E. E. Jhamalar. Khandwa, Om Kare Road, 28.ix.2007, (1 ♀ ex.), Coll. D.K. Harshey; **Khargone**, Badwah, 8.x.2007 (2 ♂, 3 ♀ exs.), Coll. D.K. Harshey; **Mirzapur**, Kaimur WLS, 30.vii.1999, (1 ♀ ex.) Coll. K. Chandra; Morena, Kunwari River, 13.x.1995, (1 ♂ ex.), Noorabad, 6.x.1995, (1 ♀, ex.), Pilua Dam, 8.i.1995, (5 ♀ ex.), Coll. H.S. Sharma; **Narsinghpur**, Barman Kala Village, 17.xii.1964, (3 ♀ ex.), Coll. H. Khajuria; **Panna**, Beni sagar, 17.xi.1988, (1 ♀ ex.), Coll. H.P. Agrawal; **Raipur**, Baloda Bazar, 7.xii.1991, (2 ♂ ex.), Coll. H.S. Sharma & Party; **Raisen**, Reechaa River, 2.x. 1995, (1 ♀ ex.), Coll. H.S. Sharma & Y.N. Gupta; Singhori WLS, Peepalvali, 17.ii.2010, (1 ♀ ex.), Coll. J. Thilak; **Rajgarh**, Newas River, 8.x.1995, (1 ♀ ex.), Coll. Y.N. Gupta & H.S. Sharma; **Rewa**, Beehar-Bichia river, Ghaghar area, 15.x.1986, (1 ♀ ex.), Coll. D.S. Mathur & Party; **Sagar**, Ratona village, 16.iii.1979, (3 ♂, 2 ♀ exs.), Coll. P.D. Rane; **Seoni**, Karmajhiri, 24.vi.2001, (1 ♀ ex.), Coll. K. Chandra; **Shivpuri**, Madav Lake, 29.iii.1980, (1 ♂ ex.), Coll. D.K. Harshey; SSS Club, 29.ix.1975, (3 ♀, 1 ♂ exs.), 21.ix.1975, (29 ♀ exs.), 23.ix.1975, (1 ♀ ex.), 24.ix.1975, (1 ♀ ex.), Coll. R.K. Singh; 24.iii.1980, (1 ♀ ex.), Coll. D.K. Harshey; **Sidhi**, Mohania, 24.vii.1999, (1 ♀ ex.), 25.vii.1999, (1 ♀ ex.), Coll. K. Chandra; **Ujjain**, Jaisinghpura, 25.ii.1981, (1 ♀ ex.), Coll. H.P. Agrawal; Hama Depo, 4.x.1993, (1 ♀ ex.), Coll. R.K. Singh.

Distribution : Andhra Pradesh, Bihar, Chandigarh, Chhattisgarh, Delhi, Himachal Pradesh, Jammu & Kashmir, Kerala, Madhya Pradesh, Maharashtra, Manipur, Odisha, Punjab, Tripura, Uttar Pradesh and West Bengal.

***Diplonychus rusticus* (Fabricius, 1781)**

1781. *Nepa rustica* Fabricius, *Species insectorum*, 2: 333.

2005. *Diplonychus rusticus* (Fabricius): Thirumalai & Sureshkumar, *Rec. zool. Surv:India*, 105: 13.

Material examined : **Bilaspur**, Korba, 8.iii.1992, (1 ♂, 4 ♀ exs.), Coll. U.A. Gajbe; Nawer Talab, Ratanpur, 20.ii.1979, (8♂, 8♀ exs.), Coll. K. Reddiah; **Damoh**, Hatta, 18.i.1994, (4♂, 3♀ exs.), 17.i.1994, (3♂, 4♀ exs.). Coll. H.P. Agrawal; **Hoshangabad**, Narmada River, 25.xii.1964, (1♂, 3♀ exs.), 14.iii.1980, (3♂, 5♀ exs.), Coll. H. Khajuria & Party; Joga, 17.xii.1965, (1♂ ex.), Kacherighat, Coll. H.P. Agrawal & Party; **Jabalpur**, Amkhas, 16.iv.1966, (2♂, 3♀ exs.); 19.viii.1966, (1♀ ex.), 19.x.1968, (1♀ ex.), Coll. H.P. Agrawal; 19.iv.1975, (1♀ ex.), 15.i.1976, (2♀ exs.), Coll. B.S. Guram & Party; 10.viii.1966, (1♀ ex.), Coll. V.V. Rao & Party; Amkhash, 6.v.1975, (1♂, 1♀ exs.), Coll. P.D. Rane & Party; Amkhas, 4.ix.1970, (2♂ exs.), Coll. H.S. Sharma; Baleha tank, Panagar Village, 20.ii.1968, (1♂ ex.), 8.1.1969, (6♂, 3♀ exs.), 30.xii.1969, (4♂, 1♀ exs.), 12.vi.1970, (6♂, 9♀ exs.), Coll. H.P. Agrawal; 7.ii.1968, (4♀ exs.), Coll. V.V. Rao & Party; Bargi Village, 5.ix.1969, (1♂ ex.), Coll. H.P. Agrawal; Basan Village, 13.iv.1983, (2♀ ex.), Coll. U.A. Gajbe; Bheraghat, Nagpur Road, 7.iii.1970, (2♀ exs.), 19.vii.1965, (1♀ ex.), Coll. H.P. Agrawal; Bhiloda village, 24.vii.1965, (1♀ ex.), Coll. D.N. Basu & Party; Boria Village, 14.ix.1965, (1♀ ex.), Budagar tank, Katni Road, 25.ii.1969, (2♂, 2♀ exs.), 15.vii.1970, (13♂, 10♀ exs.), Coll. H.P. Agrawal; 20.iii.1974, (9♂, 4♀ exs.), 22.xii.1975, (9♂, 13♀ exs.), 23.i.1976, (19♂, 12♀ exs.), Coll. D.S. Mathur & Party; 19.vii.1969, (1♀ ex.), 14.iv.1970, (1♀ ex.), Coll. V.V. Rao & Party; 26.x.1976, (1♂, 1♀ exs.), Coll. K. Reddiah; 30.vii.1969, (1♂, 1♀ exs.), 29.x.1971, (1♂, 2♀ exs.), Coll. H.S. Sharma & Party; Dertal tank, Garha, 20.iv.1966, (2♂, 4♀ exs.), Coll. M.L. Koshta & Party; Gandhigram, Katni Road, 8.x.1968, (1♂ ex.), Coll. H.P. Agrawal & Party; 5.x.1966, (1♀ ex.), Coll. V.S. Durve; Garha Village, 26.ii.1962, (16♂, 23♀ exs.), Coll. P. Singh; 20.iii.1965, (2♂, 3♀ exs.), Coll. M.L. Koshta; Ganga Sagar tank, 26.ii.1963, (1♀ ex.), Coll. P. Singh; Heron River, Ganiari village, 12.v.1966, (2♂ 9♀ exs.), Katangi

village, 16.vi.1966, (6♂, 7♀ exs.), Coll. H.S. Sharma & Party; Heron River on Katni Road, 5.x.1966, (1♂ ex.), Coll. V.S. Durve; Kiti village, 26.xii.1965, (2♀ exs.), Coll. H.P. Agrawal & Party; Madan Mahal, 3.v.1966, (1♀ ex.), Coll. H.P. Agrawal; 17.ii.1967, (1♂ ex.), Coll. H. Khajuria & Party; 4.iv.1975, (1♀ ex.), Coll. S.K. Mishra & Party; Medical College Area, Nagpur road, 13.ix.1966, (1♂ ex.), Coll. H.P. Agrawal & Party; Panagar Village, 29.vi.1968, (2♂, 2♀ exs.), Coll. H.P. Agrawal & Party; Pariat River, 5.xii.1969, (6♀ exs.), Coll. V.V. Rao & Party; Ranital, 15.vii.1969, (1♂ ex.), Coll. V.V. Rao; Richhai Village, 29.iv.1964, (1♂ ex.), 20.iv.1965, (10♂, 13♀ exs.), Coll. H.P. Agrawal; 9.ii.1966, (5♂, 3♀ exs.), Coll. V.V. Rao & Party; Sasan Village, Patan Road, 20.vii.1968, (1♂, 1♀ exs.), Coll. H. Khajuria; Shapura Road, 31.xii.1975, (3♂, 3♀ exs.), Coll. P.D. Rane; Supatal, 6.vi.1968, (1♂ ex.); Surajla tank, Nagpur Road, 20.ii.1968, (1♀ ex.), 12.ii.1970, (1♂, 3♀ exs.), 24.vii.1970, (4♂, 2♀ exs.); Supatal on Nagpur Road, 6.vi.1968, (1♀ ex.); Tewal Village, 16.v.1964, (2♀ exs.); Tilwaraghat, 16.iv.1969, (2♀ exs.), Coll. H.P. Agrawal & Party; ZSI Res. Colony, Ekta Chowk, 27.ix.2010, (1♂ ex.), Coll. E.E. Jehamalar; **Mandsaur**, Near Gandhi Sagar, 17.viii. 1990, (1♀ ex.), Coll. R.K. Singh & Party; **Narsinghpur**, Burman Village, (6♂ exs.), 18.xii.1964, Coll. H. Khajuria & Party; Panna, A nala on Panna, 20.xi.1988, (1♀ ex.), Coll. H.P. Agrawal; Sagar, A tank on Sagar, 17.iii.1979, (1♀ ex.), Coll. R.D. Rane & Party; **Sarguja**, Ambikapur, 9.i.1975, (6♂, 9♀ exs.), Coll. H. Khajuria & Party; **Shivpuri**, A nala on Bhadaya Kund Road, 26.iii.1980, (1♀ ex.), Coll. D.K. Harshey.

Distribution : Andaman & Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chandigarh, Chhattisgarh, Delhi, Goa, Gujarat, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Odisha, Puducherry, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal. *Elsewhere :* Australia, Austria, China, Formosa, Indonesia, Japan, Java, Malay Peninsula, Myanmar, New Zealand, Philippines, Sri Lanka, Thailand and New Guinea.

Table 1. LENGTH AND WIDTH OF SOME MORPHOLOGICAL CHARACTERS OF THREE SPECIES OF *DIPLONYCHUS*

Characters	Measurements (mm)	<i>Diplonychus annulatus</i>	<i>Diplonychus molestus</i>	<i>Diplonychus rusticus</i>
Number of specimens examined		27 (12 ♂, 15 ♀)	206 (90 ♂, 116 ♀)	383 (176 ♂, 207 ♀)
Body	Length	20.59 - 22.01	15.52 - 17.23	15.56 - 16.46
	Width	13.75 - 14.21	9.74 - 10.04	9.92 - 10.12
Head	Length	2.10 - 2.63	1.22 - 1.45	1.23 - 1.44
	Width	5.46 - 5.52	4.26 - 4.47	3.97 - 4.28
Spiny wing patch	Length	absent	0.37 - 0.41	0.81 - 0.97
	Width		0.43 - 0.46	0.42 - 0.45
Hemelytra	Length	15.57 - 16.02	12.84 - 13.16	11.91 - 12.39
	Width	6.88 - 7.21	4.83 - 5.67	4.72 - 5.45
Wing membrane	Length	1.54 - 1.73	1.98 - 2.18	0.86 - 1.29
	Width	1.53 - 2.08	3.02 - 3.74	1.52 - 2.01

Table 2. COMPARISON OF THE MORPHOLOGICAL CHARACTERS OF THREE SPECIES OF *DIPLONYCHUS*

Characters	<i>Diplonychus annulatus</i>	<i>Diplonychus molestus</i>	<i>Diplonychus rusticus</i>
Apex of head	Acute (Fig. 1)	Blunt (Fig. 2)	Blunt (Fig. 3)
Posterior pronotal angle	Acute, with setae (Fig. 4)	More obtuse, without setae (Fig. 5)	Less acute, without setae (Fig. 6)
Anterior tarsus	Two segmented (Fig. 7)	One segmented (Fig. 8)	One segmented (Fig. 9)
Hemelytra	Broad	Longer than broad	Longer than broad
Wing membrane	Small and not extended to inner margin	Large and extended to inner margin	Small and extended to inner margin
Spiny patch of corium	Absent	Almost round	Oblong
Inner subapex of corium	Straight	Inwardly curved	Almost straight
Male genital plate	More acute	Less acute	More obtuse
Hind wing	Linear (Fig. 10)	Linear (Fig. 11)	Broad (Fig. 12)
Pubescent stripe of abdominal sternum	More distinct (Fig. 13)	Obscure (Fig. 14)	More distinct (Fig. 15)
Males with tuft of setae on respiratory strap	Absent (Fig. 16)	Absent (Fig. 17)	Present (Fig. 18)
Male paramere	Almost straight (Fig. 22)	Almost straight (Fig. 23)	Curved (Fig. 24)

SUMMARY

The measurement values of three species of *Diplonychus* were presented in the Table-1. *D. annulatus* is the largest species having the maximum length and width of whole body, head and the wing, when compared to *D. molestus* and *D. rusticus*. In *D. molestus* the membrane of hemelytra and the hind wing is well developed and can be easily diagnose from other two. Inner subapex of corium is inwardly curved in *D. molestus* and flight morph of *D. rusticus* but which is straight in *D. annulatus* and flightless morph of *D. rusticus*. Pubescent stripe on the lateral abdominal sternum having much variation among three species. The pubescent stripe is distinctly sinuate along the inner margin in *D. annulatus*, it is less sinuate and the stripe not so prominent in *D. molestus* when compared to *D. annulatus* and *D. rusticus*. The pubescent stripe is lean, very prominent and sinuate in the inner margin in *D. rusticus*. In *D. molestus* the outer bare stripe is less in width than the pubescent stripe.

Few aforesaid characters are not uniform in all the individuals of the same population, the postero pronotal angle, the hemelytra and the hind wing varies remarkably in *D. rusticus*. The flightless morph can easily be distinguished from *D. molestus* by their acute postero pronotal angle, poorly developed hemelytral membrane and strap-like hindwing. But the flight morph (which attracted towards light) very closely resemble to the *D. molestus* except by their tuft of hairs on the respiratory strap in males, male paramere and the pubescent stripe on the abdominal sternum. Lee (1991) found different wing morphs in a single population of *D. rusticus*. Little differences also noticed in the same population of *D. molestus* in the postero pronotal angle and the hemelytral membrane. The structure of postero pronotal angle not differs much but sometimes it overlaps the base of hemelytra and sometimes it is not overlaps. The hemelytral membrane is also with slight difference in the flight and flightless morphs. Lip mark character on the sub apex of scutellum of *D. rusticus* which was used by Lee (1991) is not

prominent in all the individuals of the same species but sometimes visible in wet condition and once get dried the lip mark is not prominent. Venkatesan and Rao (1980) mentioned that segment 1 of the tarsus shorter than segment II and the division being visible on the ventral side. This character is also not prominent in the specimens examined in the present study. So in the present study these characters are not considered. Male female differences of these three species of *Diplonychus* were also provided in the photograph, which helps the scientific community to perform various studies. The male subgenital plate is little longer and acute than the females of all the three species. Slight variation in the genital structure of *D. rusticus* and *D. molestus* were noticed in the present study. The size of *D. rusticus* also varied from region to region.

Venkatesan and Rao (1980) mentioned that *D. rusticus* male without setal tufts on the respiratory strap. It is a wrong concept, all the male specimens of *D. rusticus* we examined are having setal tufts on respiratory strap. After studying the specimens of *D. indicus* Venkatesan and Rao, 1980, Polhemus (1995) found that the *D. indicus* and *D. rusticus* are the same species, there are no differences between them and he concluded that *D. indicus* must fall as a junior synonym of *D. rusticus*. The naming of *D. indicus* by Venkatesan and Rao (1980) four species were previously known from India. Many workers consider *D. indicus* as a separate species and used in their scientific studies. The present study clearly mentioned the variation among the three species from the genus *Diplonychus* so far known from India. Polhemus (1995) pointed out that *Diplonychus annulatus* (Fabricius) has a much more restricted distribution than *D. rusticus* (Fabricius). Later one is widely distributed in India than *D. annulatus* and *D. molestus*.

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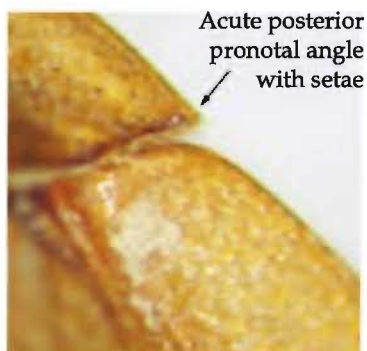
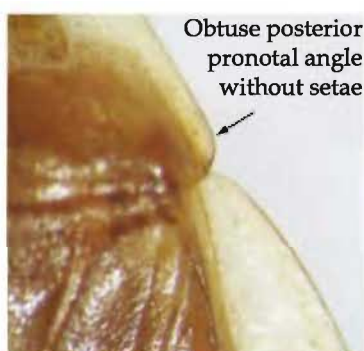
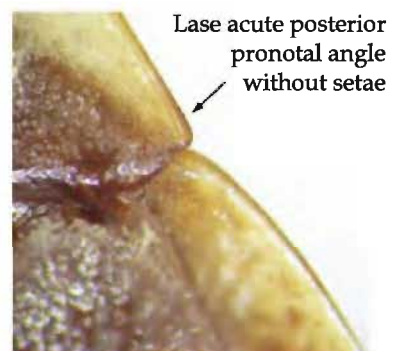
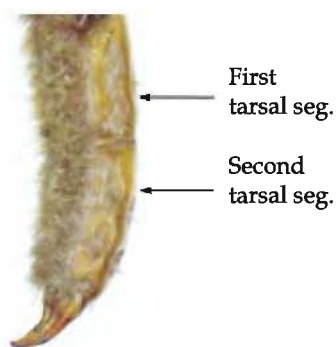
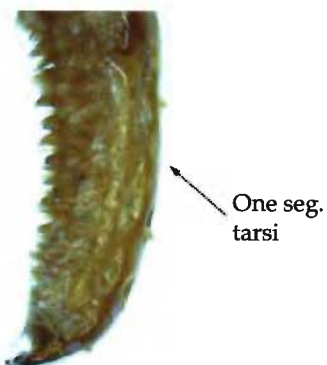
Fig. 1. *Diplonychus annulatus*Fig. 2. *Diplonychus molestus*Fig. 3. *Diplonychus rusticus*Fig. 4. Part of pronotum and abdomen of *D. annulatus* showing posterior pronotal angleFig. 5. Part of pronotum and abdomen of *D. molestus* showing posterior pronotal angleFig. 6. Part of pronotum and abdomen of *D. rusticus* showing posterior pronotal angleFig. 7. Fore tarsus of *Diplonychus annulatus*Fig. 8. Fore tarsus of *Diplonychus molestus*Fig. 9. Fore tarsus of *Diplonychus rusticus*



Fig. 10. Hind wing of *D. annulatus*



Fig. 11. Hind wing of *D. molestus*



Fig. 12. Hind wing of *D. rusticus*

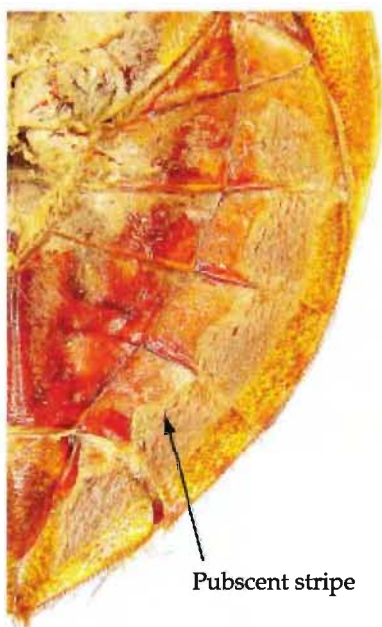


Fig. 13. Part of abdominal sternum of *D. annulatus* showing pubescent stripe



Fig. 14. Part of abdominal sternum of *D. molestus* showing pubescent stripe



Fig. 15. Part of abdominal sternum of *D. rusticus* showing pubescent stripe



Subiapex
without
cluster of
setae

Fig. 16. Genitalia and respiratory straps of male *Diplonychus annlatus*



Subiapex
without
cluster of
setae

Fig. 17. Genitalia and respiratory straps of male *Diplonychus molestus*



Subiapex
without
cluster of
setae

Fig. 18. Genitalia and respiratory straps of male *Diplonychus rusticus*



Subiapex
without
cluster of
setae

Fig. 19. Genitalia and respiratory straps of female *D. annlatus*



Subiapex
without
cluster of
setae

Fig. 20. Genitalia and respiratory straps of female *D. molestus*



Subiapex
without
cluster of
setae

Fig. 21. Genitalia and respiratory straps of female *D. rusticus*



Straight

Fig. 22. Left paramere of *Diplonychus annlatus*



Straight

Fig. 23. Left paramere of *Diplonychus molestus*



Curved

Fig. 24. Left paramere of *Diplonychus rusticus*



OBSERVATION ON THE DIVERSE MODE OF FEEDING HABIT BY A PHOLCID SPIDER [*CROSSOPRIZA LYONI* (BLACKWALL, 1867)] FROM BORTIBEEL, NORTH 24 PARGANAS, WEST BENGAL

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INTRODUCTION

Information on feeding behavior of Pholcid spider from Bortibeel, a potential wetland in the history of Gangatic estuarine system in North 24 Parganas district of West Bengal is lacking. Studies on feeding behaviors of areneid spiders from India were available with Tikader (1961, 1982). Majumder (2001). Kumar and Prasad (1977) published a note on dragonflies caught in spider webs. Recently Majumder and Talukdar (2006), Talukdar and Majumder (2006, 2007a, 2007b, 2008) and Talukdar (2008) did some interesting observation on food and feeding behavior of four araneid species of the genus *Argiope* and *Neoscona* and one species each from family *Tetragnathidae* and *Pholcidae* from west Bengal. But studies on the feeding behaviour of *Crossopriza lyoni* (Blackwall 1867) from this area are not available.

During late winter of February, 2007 while carrying out the behavioral studies on the spiders of Bortibeel wetland, the author came across a female spider (*Crossopriza lyoni*) which was displaying its feeding behavior on a comparatively huge dragon fly *Pantala flavescens* (Fabricius) in the undistinguished web built in a concrete shed at the grid between 22°49'20.50" N and 88°24'17.40" E near paddy field of the wetland.

The present paper deals with several items like a). the details of the ecological condition of the wetland, b). The sites where the spider builds its web for trapping insects in the dry seasons only, c). the food and the diverse pattern of feeding habits of *Crossopriza lyoni* (Blackwall), d). the pattern of retreat, e). The morphological structure and measurements of the spider and its prey among

which a good number of paddy pests are included, f). The time span it needs to capture the prey, and digestive mechanism along with the biological significance regarding the advancement of predatory behavior and g). the pest control ability of the spider. Some of these observations might be carefully utilized for the purpose of biological pest control in paddy field ecosystem.

MATERIALS AND METHOD

The Study Area : A 13km stretch of Bortibeel marsh land crept up on several agricultural and fishing villages covering about 3,00,000 bighas of cultivated land situated between 22°43'29.70"-22°56'44.10" degrees of North and 88°22'22.60"-88°28'44.20" degrees of east between the altitude of 6.00m -15.00m in 5 assembly segments of Jagaddal, Khordaha, Amdanga, Naihati and Barasat. The study area is situated between the 87/A bus root and Nilganj road in North-South and between NH34 and Kalyani high way in East-West. Several rail stations like Halisahar, Naihati, Kankinara, Jagaddal, Shyamnagar, Ichhapur, Palta, Barrackpur and Barasat connect the large wetland area. Many villages like Ratanpur, Taraberia, Beharia, Boseganchia, Baraganchia, Kushdanga, Tapanpur and Tentulia are bordering the east while Dogachi, Panpur, Mukundapur, Uchhegarh, Mahakaltala, Basudevpur, Kadamtala, Uttar Hansia, Dashgaria, Kaliaghata and Mathurapur, are bordering the West of the Wetland. The most important thing of this wetland is the network of several canals namely Ichhapur Khal, Pancha khal, Trimohini khal, Koirapur khal, Basudevpur khal, Haujana khal and Pakhimara Khal etc. are connecting Noai Khal (Noai River) which was

previously connecting the Vidyadhari River and also included with the riverine net work of GANGA which is now almost disconnected.

Climate : Monsoon prevails for about four months from mid of June to mid of October with high humidity. Annual range of humidity is between 85-95%. July-August are the heavy rainfall months with precipitations as high as 400mm. Maximum temperature reaches up to 45 degree C in May while the mean maximum temperature is 30° C. observed in June. On the other hand the minimum temperature drops up to 8 degree C in January and the mean minimum temperature is 20° C.

Instruments : Collections were made by an inverted umbrella, forceps with soft-tension, small brush with a standard hand sweeping net (129 cm in diameter) and a sunca electronic emergency lamp. Taxonomic studies have been made by a Olympus dissecting type binocular microscope with ocular micrometer while behavioral observations were performed by a Sony Mini DV DCR-HC42E and an electronic stop watch. Black velvet paper and tabulated data sheets were used.

Collections : Spiders were collected from the study areas directly from the webs by hand picking method. Web threads were collected in black velvet paper piece.

Preservation : Collected spider specimens were anaesthetized, killed in a killing jar and finally preserved in Oudman's preservative (90 parts 70% ethanol, 5 parts glycerol and 5 parts glacial acetic acid) in glass vials.

Identification : Well preserved spider specimens were sorted transferred in ethyl alcohol and studied under binocular microscope in a Petri dish. The specimens were identified up to species level.

OBSERVATION

On 22nd February, 2007 evening at about 5 PM while passing through the paddy field and was panning the torch lamp haphazardly to the vicinities nearby observed a huge dragonfly (*Pantala.flowescens*) measuring about 50 mm helplessly to toss about in an irregular spider web under a concrete shed and a Pholcid spider (*Crossopriza lyoni*) is moving around closely to the victim. With due attraction an interesting observation carried over for two hours and recorded the mode of feeding displayed by the spider. Generally Pholcid, the daddy-longlegs have a special method of hunting. Their untidy web is

used more as a place to stay than for catching prey. The spider hangs upside down in the web. If the web becomes too dirty, then it is abandoned and a new web is woven. Their poison jaws are far too small to hold a prey. Here in case of this unnatural meal the predator had to struggle for at least one hour to inactivate the prey which have about a 5-6 fold of body length and at least 10 times of its volume. In addition the entangled dragonfly was expressing its vigor so desperately that the predator was not getting a chance rather getting fear to put injection to abate its victim. Later on with extra enthusiasm and courage while the first bite could have managed at 6-15 PM immediately the victim showed nothing effective on its vigor but the frequency of jerking which was displaying before. Gradually by the second and third bite the victim became immobilized. Unlike the other observations on feeding behaviour of the same *Crossopriza* species there was no sign of rapping of viscid silk web on the victim which is also very uncommon. During the whole process patience, courage, and perseverance of the predator expressed remarkably. Just after the movement of the victim settled down most interestingly it is observed that another female *Crossopriza* rush around and started sucking the juices from the same prey and the original predator have no counter-plea. Juice sucking process was executed from different part of the body of the victim though initially it was started from the wing-veins then the connecting junction of head and thorax and so on from every part of the body by almost sticking their body with the prey. After one more hour of observation the author had to leave the place. On the next very morning while reached there, no spider was observed near the apparently intact immobilized *Pantala* but some Pholcid spider feeding on other insects nearby and studied the diversity of their feed. The same observation was continued for almost two years till winter 2007 and there recorded hundreds of occasions regarding the feeding behaviour of Pholcid.

DISCUSSION AND SIGNIFICANCE

It is revealed from this study that prey of *Crossopriza lyoni* (Blackeall) are chiefly insects both in flying and jumping habit. Some times it is also observed that *Crossopriza lyoni* was feeding on other spider species. In one occasion on January, 2007 the author saw a *Crossopriza* adult female measuring about 8.5 mm feeding one male *Crossopriza* of 9.2 mm long showing the habit of cannibalism. More over, *Crossopriza* web is a natural insect trap which

catches many more prey than spider can eat. Observation revealed that during the process of retreat, smaller Pholcid spiders (6-8mm) bite more occasions (4-5) and relatively large spiders (9-11mm) bites less (2-3 times) to inactivate the prey may be due to high amount of venom injected by the larger spiders. It is also revealed from this study that *Crossopriza* consume every insect like flies, ear worms, and beetles and so on. They also put on their menu other spiders like the house spider, wolf spiders, jumping spiders and so on. In short, they can grab almost every insect in and around the house and even other daddy-longlegs through their diverse feeding habits. In the present study 10 insect species were found in the spider web in

and around the paddy fields of Bortibeel which are pest to the crop and naturally controlled by *Crossopriza lyoni* (Blackeall) and highly significant as they regulate the population of insects and spiders in the house. Thus they can be considered as a potentially bio-controlling natural agent in the related environment of agriculture and domestic fields.

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Plate 1



The prey : *Pantala flavescens* (Fabricius, 1798)



The predator :
Crossopriza lyoni (Blackwall, 1867)

Plate 2

Photographs showing the time line of hunting the pray by
Crossopriza lyoni

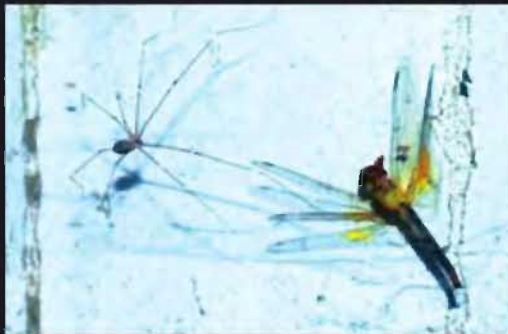
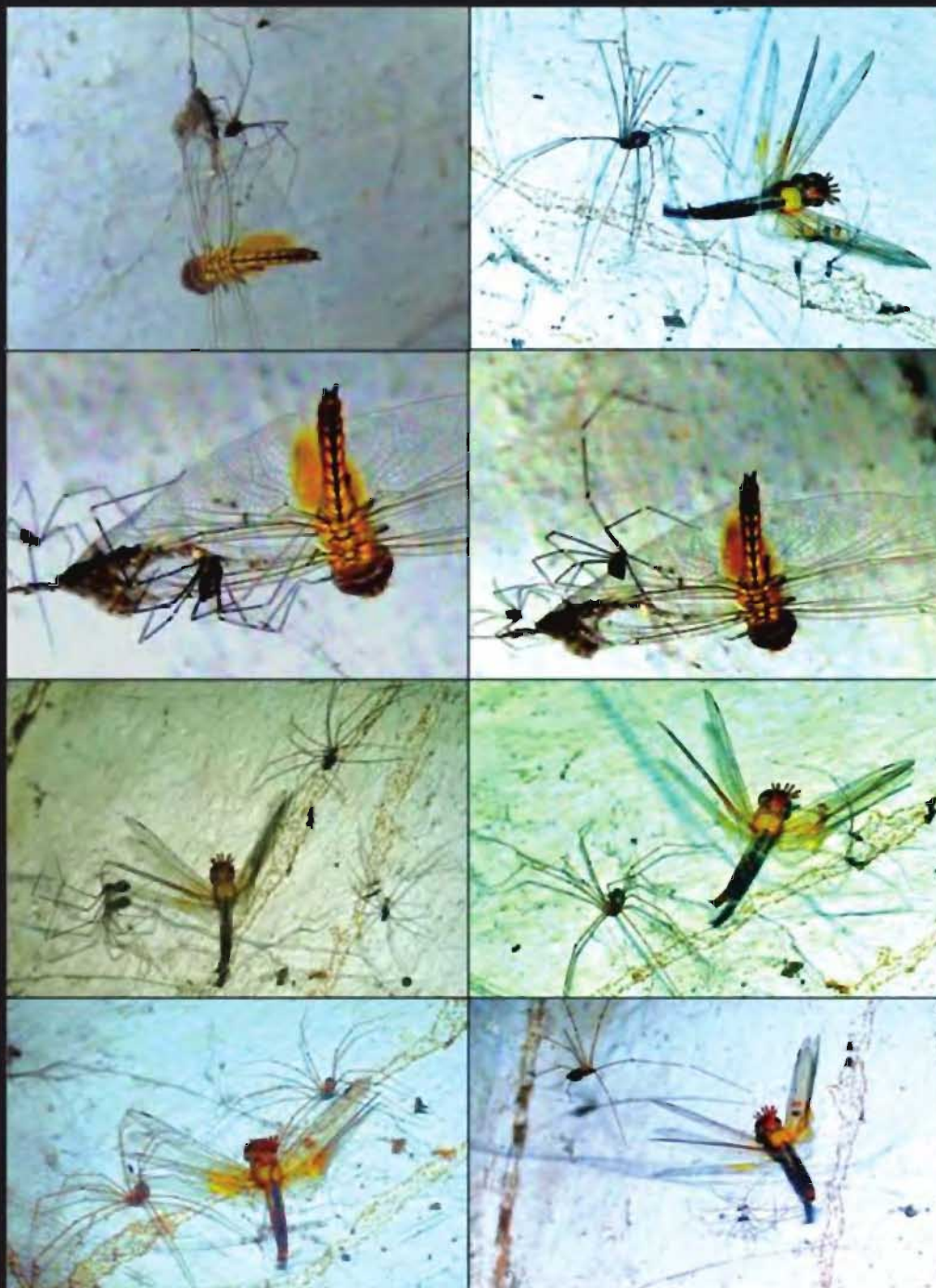


Plate 3

Stages of gregarious feeding by *Crossopriza lyoni*





DIVERSITY AND ECOLOGY OF TURBELLARIAN ANIMALS IN DEEPAR WETLAND OF ASSAM, INDIA

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INTRODUCTION

The class Turbellaria of the Phylum-Platyhelminthes includes free living members of the aquatic worm animals. They have vermiform, dorso-ventrally flattened body and generally bear direct or inverted cup eyes. Freshwater turbellarians are slow moving organisms found crawling on submerged aquatic vegetations. They generally bear some epidermal rod shaped bodies known as *rhabdoids*. Turbellarians are commonly distributed in diverse freshwater habitats like ponds, lakes, marshes and springs etc (Edmondson, 1959; Tonapi, 1980). Since they prey upon numerous dipteran larvae including mosquitoes, they have considerable economic importance (Ali and Mulla, 1983).

Freshwater turbellarians in India are exiguously known. However, a few stray references can be cited from the scientific records of Annandale (1912), Whitehouse (1913), Kapadia (1947) and Basil and Fernando (1975). There are also a few previous reports on the group appearing as bio-limnological component (Goswami, 1985; Chetri, 2000, Kalita, 2007). The present paper deals with the occurrence of four turbellarian animals namely, *Mesostoma tetragonum* (Müller), *Bothrosomastoma* sp., *Dugesia* sp. and an unidentified rhabdocoel animal which has been recorded for the first time from freshwater habitat of Deepar wetland, a Ramsar Site of Assam. The generic status of all the animal has been confirmed from the literature of the Swedish Natural History Museum, located at Stockholm, Sweden. However, their species status has been

compared with Turbellarian Taxonomic Web Database. In the present investigation, *M. tetragonum* (Müller) demonstrates a characteristic microhabitat condition under the littoral, partly rotten and fragmented mats of *Eichhornia crassipes* during March-May, while others appeared as general inhabitant on a variety of littoral macrophytic stands.

MATERIALS AND METHODS

Deepar wetland is a perennial water body situated in between 91°36' to 91°42' East longitude and 26°06' to 26°09'26'' North latitude near Guwahati, the capital city of Assam, India. The wetland covers an area of ca 146.23 ha. Main wetland is subdivided into three major parts, the *Barbeel*, *Kharbari* and the *Chanabeel*. There are some dendritic extensions at the northern part of the wetland. The wetland receives water from the River Brahmaputra through a canal, the *khanajan* which also acts as both inlet and outlet. Besides, it also regularly receives water from *Basistha* stream through a river offshoot of *Mora Bharalu*. The wetland is a good habitat for different migratory birds for which a part of it is now reserved as Bird Sanctuary. Presently this entire wetland has been declared as Ramsar Site in the year 2002 (Vide Ramsar Site no 1207, on 18th August, 2002).

At the beginning of the study, animals appeared accidentally with live sample of macro-invertebrate fauna collected in March, 2005. Thereafter the animals were regularly searched in different macrophytic stands. Three turbellarian species

namely, *Bothromesostoma* sp., *Dugesia* sp. and the unidentified rhabdocoel frequently appeared in the sample. However, the actual habitat of *M. tetragonum* could be determined as soon as the samples were collected from the partly decomposed stands of *Eichhornia crassipes*, a floating macrophytes dominating at the littoral zone of the wetland. Partly decomposed submerged part of *E. crassipes* was scrapped underwater by the edge line of a 250 ml Borosil glass beaker for collection of *M. tetragonum*.

All the samples containing the living individuals of the turbellarian were brought to the Limnological Laboratory of the Department of Zoology, Gauhati University for their identification and micro-structural studies. The micro photographs of the animals were taken with the help of a CCD camera fitted with computerized zoom trinocular microscope. Some of the captured individuals were preserved in 4% formaldehyde after fixing it in Bouin's fluid for future record.

All the species were reared in the laboratory of UGC-SAP (DRS) Project Campus of the Zoology department of Gauhati University in 1 liter capacity sterilized glass beaker during March-July 2006. Each batch of the animals was reared for 20 days. Beakers were half filled with filtered water of the same wetland. Living plant materials were added in to the beaker. Plant materials were selected after physical survey on the habitat of the animals. Plant materials were examined thoroughly with the help of a dissection microscope before introducing into the beaker. Further, the partly decomposed stems and leaves of *E. crassipes* were collected from original wetland water properly washed in distilled water and examined under Olympus dissecting microscope to eliminate existence of other faunae for the rearing of *M. tetragonum* species. The stems and leaves were kept in the rearing beakers to facilitate the animal to grow on their organic parts. The animal grows well in laboratory condition. The water from the middle core region of the beakers were pipette out from time to time and replaced with pure original water.

Water temperature of the habitat was determined with the help of a mercury thermometer while all other chemical parameters were analyzed on the spot following the standard methods of APHA (1975).

Systematic enumeration (after Edmondson, 1959)

Phylum PLATYHELMINTHES

Class TURBELLARIA

Order TRICLADIDA

Family PLANARIIDAE

1. *Dugesia* sp.

Order NEORHABDOCOELA

Family TYPHLOPLANIDAE

Subfamily MESOSTOMINAE

2. *Mesostoma tetragonum* (Müller)

3. *Bothromesostoma* sp.

OBSERVATIONS

The *Dugesia* sp. (Figure 2) has a flatten body with slightly arrow shaped head. The head bears one pair of eyes. While, *Bothromesostoma* sp. (Figure 3) and the unidentified rhabdocoel animal (Figure 4) have spindle shaped body. Eyes were not observed in the matured *Bothromesostoma* sp. The unknown rhabdocoel has one pair of eyes. *Mesostoma tetragonum* (Figure 1) has a star fruit shaped ridged body with two lateral out-pouching in each side. Eyes are prominent. Individuals are transparent bearing some whitish rod shaped bodies of radiating or branching nature lying beneath its outer loose surface. Some of the internal body parts like paired ovary, copulatory duct, copulatory bursa, seminal receptacle, seminal vesicle, uterus etc. can be observed from its ventral surface. The average length of all the animals is 8-12 mm.



Figure 1: *Mesostoma tetragonum*



Figure 2: *Dugesia* sp.



Figure 3: *Bothriomesostoma* sp.



Figure 4: Photograph of unknown Rhabdocoel

In laboratory, rearing *M. tetragonum* demonstrates a skewing movement through both of its dorsal and ventral surfaces. The lateral folds constituting the ridges help in its movement. Individuals of this species bear eggs at both the sides of their ventro-lateral parts. Individual eggs are oval and dark brown in colour. The eggs are arranged in rows inside the ovary. It is observed that the number of eggs is not equal at both the

sides. However, individuals in laboratory rearing demonstrate the increase in number of eggs at a rate of 2 in each ovary per day to a maximum egg production of 26 numbers. The average number of eggs in each ovary has been estimated as 18 ± 3 . Mature individuals release their eggs in the water, which immediately sink into the bottom. Eggs are ca 0.2-0.3 mm in diameter and non sticky. However, during the laboratory rearing the eggs did not hatch. Observed individuals demonstrate response to light and they become more active at dusk and in morning hours than in day times. Mature *Bothriomesostoma* sp. also bears eggs. However, their mode of release and development could not be observed during laboratory rearing.

The water quality of its occurring zone indicates the circum-neutral towards acidic (average pH 6.59 ± 0.20); turbidity 16.25 ± 4.68 NTU; dissolved oxygen 7.28 ± 0.64 mg/l; free carbon-di oxide 9.21 ± 0.87 mg/l; total alkalinity 40.08 ± 5.32 mg/l and total hardness 40.17 ± 4.43 mg/l. Average water temperature during its occurrence has been recorded as $27.3^\circ \text{C} \pm 2.72^\circ \text{C}$ (Table-1).

DISCUSSION

The present diversity of *Mesostoma tetragonum*, *Bothriomesostoma* sp. and the unidentified rhabdocoel in Deepar wetland creates a new occurrence record in the north eastern region of India. However, the ignorance of these faunae in some previous works might be due to the general ignorance of Turbellaria group in the samples (Dey, 1981; Lahon, 1983; Goswami, 1985; Chetri, 2000). The occurrence of *M. tetragonum* in some European countries like Bulgaria, Czech Republic, Danish mainland, Estonia, French mainland, Germany, Lithuania, Poland, etc. and in East Palaearctic region have already been well established (Source: Internet version of *Fauna Europaea*, 2004). Acidic pH, organic turbidity, moderately high FCO₂, low alkalinity and hardness, moderately high temperature ranges and productive dissolved oxygen range of water support the development of these faunae along with many other enmeshed faunae (Jhingran, 1997). Host specificity of *M. tetragonum* in the floating *E. crassipes* stand is unique in its studies. However, all free living freshwater turbellarians are commonly distributed in diverse freshwater habitats like ponds, lakes, marshes, springs etc. (Edmondson, 1959; Tonapi, 1980) and their economic importance

Table-1: Water parameters studied at the habitat of turbellarian species in Deepar wetland during 2005 and 2006

Water parameters	Average	SD	Max	Min
Turbidity (NTU)	16.25	4.68	25	12.5
pH	6.59	0.20	6.85	6.57
Dissolved oxygen (mg/l)	7.28	0.64	8.48	7.0
FCO ₂ (mg/l)	9.21	0.87	10.62	8.6
Total alkalinity (as CaCO ₃) mg/l	40.08	5.32	48.50	36.5
Total hardness (as CaCO ₃) mg/l	40.17	4.43	47	35
Calcium (as CaCO ₃) mg/l	27.42	3.18	32	24.25
Magnesium (as CaCO ₃) mg/l	12.67	1.40	15	10.75
Water Temperature (°C)	27.3	2.72	29.7	24.4

Table-2: Comparison of water parameters recorded by Basil and Fernando (1975) of the habitat of *Mesostoma* and present record at the habitat of turbellarian species.

Sl. No.	Water parameters	Observations of Basil and Fernando, 1975	Present record in Deepar wetland
1	Water basin type	Quarry pool	wetland
2	Water temperature (°C)	30.0-41.0	27.3 ± 2.72
3	Dissolved oxygen (mg/l)	1.53-14.35	7.28 ± 0.64
4	Free carbon-di oxide (mg/l)	0.79-7.9	9.21 ± 0.87
5	Total alkalinity (ppm)	152.0-394.0 mostly 250-394	40.08 ± 5.32 (mg.l ⁻¹)
6	pH	7.8-8.6	6.59 ± 0.20
7	Turbidity	Clear water (0-33 cm and mostly nil)	Moderately turbid (16.25 ± 4.68 NTU)

is understood from Ali and Mulla (1983) since they prey upon numerous dipteran larvae including mosquitos.

The present ecological setup of the habitat quality of these species exhibits strong dissimilarity in most of water quality parameters to what Basil and Fernando (1975) recorded for a *Mesostoma* sp. in southern part of India (Table-2). For example, total alkalinity, dissolved oxygen, pH and water turbidity in both the habitat patterns (when compared) clearly indicate the differences to which it lies in the fact that species of *Mesostoma* can emerge in both highly alkaline water as well as in water with low alkalinity and acidic pH, high and moderate range of water temperature and wide fluctuation of dissolved oxygen. The habitat range from quarry pool to wetland basin also signifies high range spatial character in distribution of the group in India.

SUMMARY

Four turbellarian animals namely, *Mesostoma tetragonum* (Müller), *Bothromesostoma* sp., *Dugesia* sp. and an unknown rhabdocoel has been recorded

in the aquahabitat of Deepar wetland (91°36' to 91°42' East longitude and 26°06' to 26°09'26'' North latitude) of Assam, India. The studied wetland is a Ramsar Site of India and has considerable macro-invertebrate diversity. All these animals except *Dugesia* sp. has been recorded for the first time from the region. Animals are found on the aquatic parts of littoral macrophytes. However, *Mesostoma tetragonum* is collected from the littoral stands of partly decomposed *Eichhornia crassipes* during March 2005 to April 2008. Some of the relevant ecological aspects are also studied.

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NEW RECORD OF THE SPIDER *ARACHNURA ANGURA* FROM MAHARASHTRA WITH ADDITIONAL MORPHOLOGICAL DESCRIPTION (ARANEAE: ARANEIDAE)

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INTRODUCTION

Araneidae includes 29 genera and 154 species from the Indian sub-continent (Sebastian *et al.*, 2009). The genus *Arachnura* Vinson, 1863 is represented by two species only; *A. angura* Tikader, 1970 from Gazing, Sikkim (Lat 27°20' N & Lon 88°40') and *A. melanura* (Simon, 1867).

During recent surveys in some parts of Satara (Maharashtra) at Lat 17°42' N & Lon 74°02' E; a mature female of *Arachnura angura* was sighted, collected and preserved in 70% ethanol. The specimen is deposited in the National Zoological Collections vide Ar/424 at Zoological Survey of India, Pune. Observations were done using the dissecting microscope; the genitalia was dissected and kept in clove oil for 24hrs. The genitalia was observed and drawn. The specimen was identified referring to the morphological descriptions and illustrations given by Tikader 1970.

Arachnura angura Tikader

1970 : *Arachnura angura* Tikader, Rec. Zool. Surv. India, 63 (1-4): 30

1982 : *Arachnura angura* Tikader, Fauna Of India 2 (1):210

Material examined: 2 from India, Maharashtra, Satara, Kurneshwar Garden found in the web constructed on aerial roots of Banyan tree (*Ficus benghalensis*) Coll.- Shripad Manthen, Sidharth Kulkarni on 28 Sept. 2011.

Closer examinations revealed some morphological variations and additions as follows:

Carapace : 4.20 mm long and 2.6 mm;

Abdomen : 5.90 mm long and 3 mm wide.

Cephalothorax : The mid-longitudinal brown patch extends till the anterior medians which differs from *A. angura*. Brown patch present along the lateral margins of the carapace and no distinct markings elsewhere as given in *angura* [Fig 1]. Carapace widest at just anterior to fovea. Anterior medians black ; rest nocturnal. Sternum yellowish, sparsely clothed with spines on anterior region with pea-shaped brown patch at the posterior end [Fig 2]. Leg formula: 4213. Femur of leg I stoutest with spines along the inner margin. Meta-tarsus and tarsus of leg I, II, III covered with strong pubescence. Metatarsus and tarsus of leg III black. During observations the right leg III appeared to be folded from the dorsal side. When upturned, it was found entangled in its own silk; and on removing the silk cover; an ant (Formicidae) was discovered, which probably detects act of food-storage.

Abdomen : Lateral view of abdomen as in [Fig. 3]. Genitalia as given in [Fig 4]

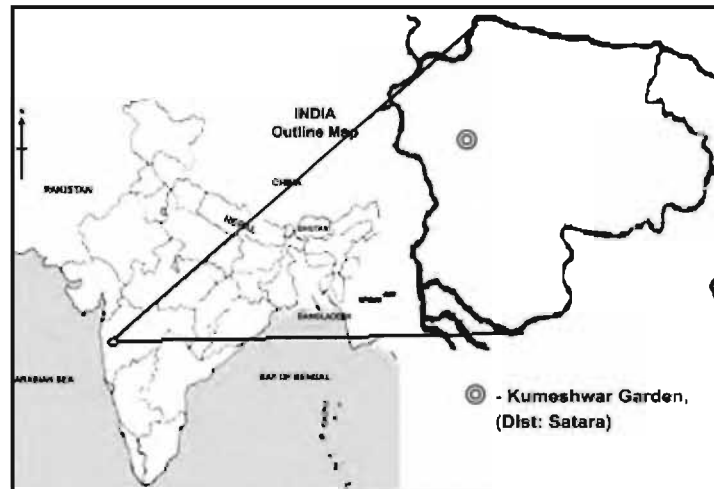
DISCUSSIONS AND CONCLUSIONS

In the present report, three points are intended to put on record:

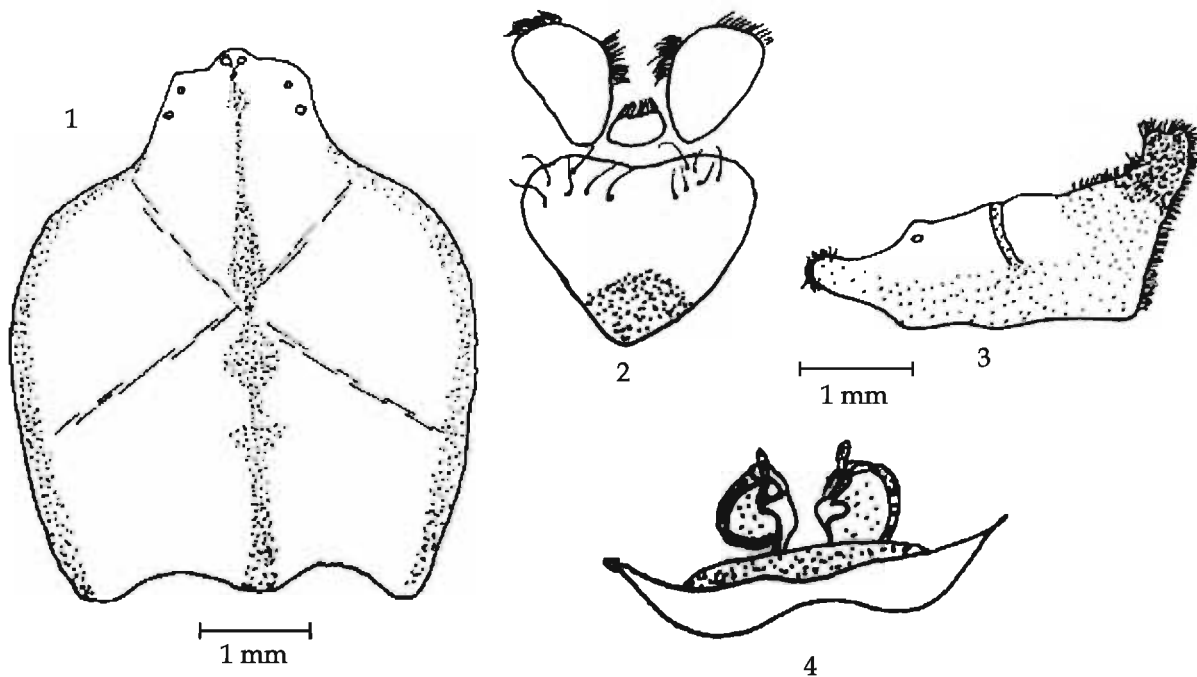
1. Extension of distribution of *A. angura* further westwards (2303 kms)
2. Close variant of species form of species attributed to change in climatic, microhabitat conditions and food composition; and
3. This is the first record of this genus and species from Maharashtra state.

Similar spider of the genus *Arachnura* has been sighted in Amravati (Maharashtra, India) in 2007

but has been proposed to as new genera and family *Gajbesa*, Gajbesidae respectively.



Map of India showing the study area



Figs. 1-4 : *Arachnura angura* Tikader; 1. Cephalothorax (dorsal); 2. Sternum and labium; 3. Abdomen lateral view; 4. Internal genitalia.

website of Spiders of Central India (Wankhede G.N.) which has not yet received an official status as a new family and genus, and till date the valid classification of the spider is genus *Arachnura* belonging to family Araneidae.

ACKNOWLEDGEMENTS

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Short Communication

NEW RECORD OF *COSSYPHUS DEPRESSUS* FAB. 1781 (COSSYPHINI : LAGRIINAE : TENEBRIONIDAE: COLEOPTERA) FROM UTTAR PRADESH

INTRODUCTION

While undertaking the general faunistic survey of Hardoi and Sitapur districts (Uttar Pradesh), two examples *Cossyphus depressus* are collected, which constitutes to new record from Uttar Pradesh.

Previously, *Cossyphus depressus* Fabricius, 1781 was first reported by P.S. Nathan in India in 1937 from Nedungadu, Tanjore District, Tamil Nadu and Shimoga, Mysore state (presently Karnataka state) (Hava, 2007). Thereafter, the species has been reported from West Bengal (Saha and Das, 1996).

SYSTEMATIC ACCOUNT

Order COLEOPTERA

Suborder POLYPHAGA

Family TENEBRIONIDAE

Subfamily LAGRINAE, Latreille, 1825

Tribe COSSYPHINI, Latreille, 1802

Genera *Cossyphus*, Oliv. 1975

2000. Scupola. *Cossyphus cossyphus depressus* (Fabricius, 1781) *Atte del Museo Civico di Storia Naturale di Trieste*, 48: 185-249.

2000. Scupola. *Cossyphus cossyphus planus* Fabricius, 1801. *Atte del Museo Civico di Storia Naturale di Trieste*, 48: 185-249.

Diagnostic characters : Brownish in colour, size small, flat body, head and pronotum joined together except a fine suture in between. Elytra similarly and equally flattened as pronotum and each elytron with a longitudinal and elevated ridge in the middle; antennae moderately elongated, basal segment longest, 2 to 7 segments slender, 10th strongly transverse, apical segment rounded, last four apical segments flattened; maxillary palpi fairly elongate, apical segment of maxillary palpi fairly triangular and flattened; labrum and labial



Fig. I: Dorsal view



Fig. II : Ventral view

palpi small, fairly elongated legs. Lateral membranous elevations of elytra completely cover the body. (Fig. I & II).

Material examined : Uttar Pradesh, Hardoi district 02 examples collected under the leaf litter at Sandi Bird Sanctuary, on 21.ii.2011. and 02 examples collected under the mud from Sinhanipur Jheel, Sitapur district on 23.ii.2011 and Coll: V.D. Hegde all party.

Distribution : INDIA: Karnataka, Tamil Nadu, West Bengal and Uttar Pradesh (Hardoi and Sitapur districts).

Elsewhere : SRI LANKA (Scupola, 2000)

ACKNOWLEDGEMENTS

I am thankful to Dr. K. Venkataraman, Director, Zoological Survey of India, Kolkata for the facilities. I am grateful to the Principal Chief Conservator of Forests (PCCF) and Wildlife warden, Uttar Pradesh state for permission to conduct the survey and to collect the samples in the protected area. Thanks are also due to all the forest department officials of Hardoi and Sitapur districts. I am indebted to Dr. Kailash Chandra, Addl. Director, for his valuable suggestions in preparing the manuscript and all the staffs of Coleoptera section, ZSI Kolkata for constant encouragement.

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**Short Communication****NEW RECORD OF THE SPECIES *MELAENUS PIGER* (FABRICIUS)
(MELAENINI: MELAENINAE : CARABIDAE : COLEOPTERA)
FROM UTTAR PRADESH**

Melaenus piger (Fab.) is commonly distributed in southern part of Indian peninsula. During study of the specimens recently collected from Uttar Pradesh, strikingly a single specimen from Ghazipur, Uttar Pradesh has been noticed. There are only two species of the genus *Melaenus* Dejean, in the world; one species *M. elegans* Dejean in Afrotropical region and the other *M. piger* (Fab.) in Oriental region.

SYSTEMATIC ACCOUNT

Order COLEOPTERA

Sub order ADEPHAGA

Family CARABIDAE Latreille, 1802

Subfamily MELAENINAE Allaud, 1934

Tribe Melaenini Dejean, 1831

Genera *Melaenus* Dejean, 1831***Melaenus piger* (Fabricius), 1801 (Figure 1)**

1801. *Brachinus piger* Fabricius, *Syst. Eleuth.* I: 219. (Type Locality: Eastern India; Type Deposited in Zoological Museum, University of Copenhagen, Copenhagen, Denmark)

1847. *Melaenus piger* Schaum, *Stett. Ent. Zeit.* : 49.

1935a. *Melaenus piger*, Andrewes, *Fauna of British India including Ceylon and Burma (Coleoptera: Carabidae) 2, Harpalinae-1*: 28

2005. *Melaenus piger*, Ball & Shpeley, *Zootaxa*, **1099**: 38-39

Diagnosis : Elytra slightly more dull in colour than head and thorax. Clypeus, labrum and anterior margin of head shiny; labrum, mandible, labial palpi, maxillary palpi reddish brown. Sides of the head slightly projected in front of eye; a groove runs along lateral margin of the head upto posterior

margin of the eye; one supra orbital seta on each side; head and thorax with rugose microsculpture. First four segments of antennae glabrous, round surface and dark reddish brown. Second segment nearly half of the third segment. Fourth segment slightly smaller than 3rd segment. Clypeus convex with one prominent seta on either lateral side. Anteriorly emarginate. Surface moderately punctate with very fine punctures and transverse microsculptures. Labrum anteriorly emarginate with 6 setae, some small setae on lateral underside. Transverse microsculpture. Lateral margin slightly reflexed. Mandible with seta in scrobe. Upper basal region obliquely striate. Hooked at apex; 2nd segment of maxillary palpi glabrous and longer than other segments. Apical segment of labial palpi moderately pubescent. Mentum short, emarginated anteriorly with one tooth. Lobes and epilobes well developed. One circular foveae with one seta on either side of base of mentum tooth. One seta on either side of base of submentum. One deep puncture on either side of anterior margin of gula. Submentum and gula fused and with transverse striations. Gena deeply punctate. A straight longitudinal sulcus or groove runs below eye upto its posterior margin. Prothorax cordate. Single seta on anterior half of either lateral side. Anterior angle obtuse and pointed. Posterior angle slightly diverge outwardly. Abdominal sternite rugose punctate. Apical segment with two small setae suggest female sex. Prosternum longitudinally depressed. Tarsal segments pubescent. On terminal region of elytra an oblique raised area present and interval 1st and 3-8th merge with it. Lateral margin slightly reflexed.

Length : 10.5 mm. (Female)



Figure 1

Material examined : 1 ex. ♀ INDIA: Uttar Pradesh, Ghazipur, Social Forest Nursery, 24. ix.2010, Coll. V. D. Hegde & Party, Ex. Under Leaf Litter.

Distribution : INDIA: Andhra Pradesh, West Bengal (Bengal), Madhya Pradesh, Chhattisgarh, Maharashtra, Orissa, Karnataka, Tamil Nadu, Goa, Puducherry, North India (Capt. Boys) and Uttar Pradesh.

Elsewhere : SRI LANKA.

Habitat : Andrewes (1935) found this species common in refuse bordering the rice fields and attracted to lights in the evening. The present specimen was collected under refuse and leaf litter accumulated near the base of a tree trunk.

Variation : Exceptionally one fine and small seta present just beneath the anterior angle of only right side of clypeus (Figure 2).

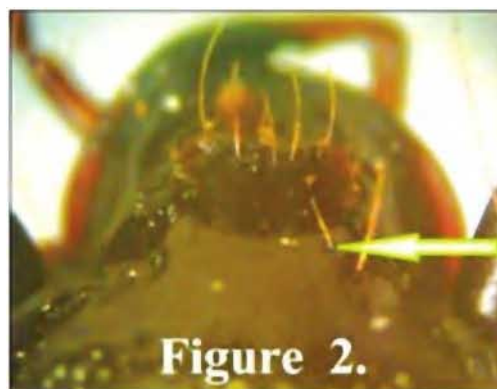


Figure 2.

Remarks : One locality "North India" of Collection of Captain Boys in "HOPE ENTOMOLOGICAL COLLECTIONS, UNIVERSITY MUSEUM, PARKS ROAD, OXFORD OXI 3PW, UNITED KINGDOM" as mentioned by Dr. Ball (2005) is not certain and he mentioned it on Outline map of Southwestern Asia. As the literature shows all collections of Capt. Boys were made in North India and many of them certainly in the neighborhood of Simla (Andrewes, 1935b), the specimen studied here is a first record of the species from Uttar Pradesh.

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Short Communication

NEW RECORD OF *ARGYROPS BLEEKERI* (FAMILY: SPARIDAE) IN INDIAN WATERS.

INTRODUCTON

Sparidae, commonly known as seabreams, are inhabitant of tropical and temperate coastal waters. They are occasional visitors of brackish waters, bays, coastal reefs, etc. They are one of the important food fishes. The family sparidae has about 129 species in 35 genera in Worldwide (Froese & Pauly, 2010). The extensive literature survey on fish records of Indian coast shows records of 9 species from 7 genera in Indian waters (Talwar & Kacker, 1984; Froese & Pauly, 2010). During the surveys at Digha coast, authors have come across one specimen of the family Sparidae and after Close observation of distinguishing features, the specimen is identified as *Argyrops bleekeri* (Oshima, 1927), King Soldier Bream. The literature review shows that it is so far not reported in Indian waters and new addition to Indian ichthyofauna.

CLASSIFICATION

Class ACTINOPTERYGII

Order PERCIFORMES

Family SPARIDAE

COMMON NAMES

Argyrops bleekeri (Oshima, 1927) is commonly known as King Soldier-Bream, Taiwan Tai, Long-spine seabream, Red Bokako, Bowen Snapper, Long Spined Red Bream, Spare royal (French), Sargo real (Spanish). There is no vernacular name in India for this species.

SYNONYMS

1927. *Argyrops bleekeri* Oshima, *Japanese Journal of Zoology*, 1(15): 141 (Taiwan). 2002. *Argyrops bleekeri* Nakabo, *Fishes of Japan with pictorial keys to the species*: 858.

MATERIALS EXAMINED

2 ex., TL 10-21cm, Location: 1 ex from Talsari (Orissa); Date: 08.02.2010, Coll.: Prasanna Yennawar & Prasad Tudu, MARC, ZSI, Digha. The fish was displayed in the aquarium tanks of MARC, ZSI, Digha (Fig. 1a). 1 ex from Mohana (Digha, West Bengal), Date: 10.10.2011, Coll.: Dipanjan Ray. Identified: Dr. Prasanna Yennawar & P. Tudu, Reg No. F 1969 (Fig. 1b)



Fig. 1 a & b: King Soldier Bream *Argyrops bleekeri* (Oshima, 1927).

DISTINGUISHING FEATURES

Body deep, strongly compressed laterally. Upper profile of head steep and almost straight from upper jaw to eye and eyes are large. Dorsal

fin with 11 spines and 11 soft rays, the first spine very short, 2nd to 7th spines flattened and much elongated; anal fin with 3 spines and 8 soft rays; caudal fin deeply emarginated to forked with pointed lobes. Head 2.43 times in SL, CL 3.31 times in SL and eye diameter 2.9 times in head length, Scales large, 54 in lateral line, scaled area between eyes narrow, ending in a point; soft dorsal and anal fins with low basal scaly sheaths. Colour: body mainly silvery pinkish, darker on head; usually dark red on margin of upper, part of opercle; all fins pink. Body with 5-6 vertical red bands, 2nd & 3rd bifurcates dorsally above lateral line. It attains maximum size up to 40cm (Nakabo, 1982), however, the example examined was measured upto 10 cm. The maximum weight attained was recorded 3500g (Nakabo, 1982).

DISTRIBUTION

It is reported in Western Pacific: Japan to southeast Asia (Nakabo, 2002) and northwest coast of Australia which was available in cruise summary of FRV *Soela*, SO 4/80 (unpublished data). In India, this species is so far not reported.

REMARKS

This species is reported for the first time in Indian waters.

ACKNOWLEDGEMENT

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Short Communication

FIRST REPORT OF A FISH FROM FAMILY: ANTENNARIIDAE (*ANTENNARIUS HISPIDUS*) FROM DIGHA COASTAL WATERS, ON THE EAST COAST OF INDIA

INTRODUCTION

Digha (Lat 21°36' Long 87°30') is one of the major marine fish landing stations of the east coast of India. Considering the importance of fish faunal resources, several efforts were made regarding incidences of ichthyofauna of region. The most recent compilation of ichthyofauna of the region contributes 212 species from 145 genera & 88 families (Chatterjee *et al*, 2000). There were also previous reports of 238 species from 72 families (Manna and Goswami, 1985; Goswami, 1992). The consistent efforts from this Centre contributes further few new families in this region (Yennawar and Tudu, 2010; Yennawar *et al.*, unpublished). During the local surveys for ornamental faunal studies in the Centre, the authors came across one fish species which after thorough observations of distinguishing features was identified as *Antennarius hispidus* (Bloch and Schneider, 1801). This species was not reported from this coast previously. The present paper added abundance of one more new family Antennariidae in the area and expands the distribution of *Antennarius hispidus* till northernmost extreme of east coast of India.

Class Actinopterygii

Order Lophiiformes

Family ANTENNARIIDAE

Antennarius hispidus (Bloch & Schneider, 1801)

1801. *Lophius hispidus* Bloch & Schneider, *Syst. Ichth.*: 142

1986. *Antennarius hispidus*, Pietsch, in Smith & Heemstra, *Smith's Sea Fishes*: 367, pi.13, Fig. 102.4.

MATERIALS EXAMINED

1 Ex, SL. 86mm, Collected from: Hospital Ghat, Digha, Reg.No.F772. The specimen was collected in live condition and after detailed morphometric

data collection the specimen was liberated in the aquarium tank for display.

DIAGNOSTIC CHARACTERS

D III, 12; C 9; A 7; P 10; V 6; first and second dorsal spines were of almost equal length and the first one with a large tuft of filaments; second spine curved posteriorly with a narrow membranous connection to the surface of head; third dorsal spine curved posteriorly; Pterygiophore supporting dorsal spines extending slightly beyond the upper jaw; Head, body, and tail densely covered with generally bifid spines making the skin rough; eyes very small; Mouth almost vertical. Sharp, pointed teeth in a single row in sides of upper and lower jaw; Illicium (rod) striped and about the length of 2nd spine. Esca (lure, bait) with large oval-shaped tuft with numerous slender filaments; Colour of the body yellow to dark brown with roughly parallel dark stripes, some radiating from the eye; belly without stripes.

REMARK

Antennarius hispidus (Hispid or Shaggy Frogfish) belongs to the *Antennarius striatus* group (Pietsch &



Fig.1 *Antennarius hispidus* collected from Digha coastal waters.

Grobecker, 1987). This frogfish is sometimes mistaken as *Antennarius striatus*, which has an esca (lure, bait) that looks like a worm and this frogfish has a short lure with a large fuzzy ball-like esca. These fishes may couple dim luminescence from their bait organ for attracting small sized pray and evade the attention of large predators (Ramaiah & Chandramohan, 1992). The species differs from *A. indicus* in not having any pigmented dark ocelli in the body and having no black bars in anal fin & having some darkly pigmented streaks radiating from the eyes (Pitsch & Grobecker, 1987).

HABITAT

These fishes inhabit muddy habitat either deep or offshore regions (Kuitert & Tono-zuka) and also in shallow rocky and coral reef zones (Lieske & Myers).

DISTRIBUTION

The species is distributed through Indo-West Pacific: East Africa, India, and Malaysia to the Moluccas, north to Taiwan, south to northern Australia. Single record from Fiji.

From Indian waters the species is reported from Maharashtra coast (Ramaiah & Chandramohan, 1992), Chennai coast (Krishnan *et al.*, 2007); Andhra coast (Barman *et al.*, 2004); Orissa-coast (Barman *et al.*, 2007).

This report suggests that the species is distributed through out the East coast of India.

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INSTRUCTION TO AUTHORS

Frequency of Publication : Quarterly – 4 parts in one volume.

Publication time : Within 3 months after final acceptance.

Categories of published material : Full paper, Interesting Case Reports, Field Reports, Taxonomic description and distributions, Description of new taxa, Short Communications, Checklists.

Instruction of submission : The article to be organized as :—1. Title; 2. Author/Authors along with address clearly mentioning the corresponding author and Affiliation, e-mail address; 3. Introduction; 4. Materials and Methods; 5. Systematic accounts; 6. Results; 7. Discussion; 8. Summary; 9. Acknowledgement, 10. References; 11. Tables and Figures with appropriate title and legends on separate sheets.

For short communication, the combination of some of the above sections is recommended.

Format of Manuscript : Submission of a manuscript implies that the report is original, unpublished and is not being considered/disqualified for publication elsewhere.

Manuscript in English should be computer-typed, double-spaced with 1.5-inch right-hand margins on one side in A4 paper (210 × 297 mm). Font size 10-12 points, Times New Roman. Text should be justified. Footnotes should be avoided. All units of measurement are in metric. All manuscript sheets must be numbered successively. No portion of the article should be underlined except Latin names of genera and species, if not typed in italics. Submit in triplicate with a CD in MS Word, photo/map/chart/drawings in jpg/psd (photoshop).

Introduction section should clearly describe the objectives of the study and provide enough background information to make it clear why the study was undertaken. Lengthy literature review is discouraged. Some earlier references of work may be cited.

Materials and Methods should provide the reader with all the information necessary to repeat the work. For modification of published methodology, only modification needs to be described with reference to the original source.

Under material examined the following format should be followed strictly for e.g. :

Material Examined : Holotype : Female : India, Kerala, Calicut University campus, 3-xii-1994, coll. T.C. Narendran and Party (Reg. No.)

Results to be presented by referring to tables and figures (if any) and without discussion.

Discussion should include a concise statement of the findings, a discussion of the variety of the observations, a discussion of the findings in the light of other published works dealing with the same or allied subjects.

Summary : A short write up to be given describing the article and its importance/need.

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Silas, E.G. 1961. Occurrence of the Sea-cow *Halicornia dugong* (Erx1) off Saurashtra coast. *J. Bombay nat. Hist. Soc.*, **58**(1): 263-266.

State Fauna/Conservation Areas : Mukhopadhyay, S.K. 1999. Fresh water Oligochaetes. *Fauna of West Bengal, State Fauna Series*, **3**(Part-10) : 95-123. Published by Zool. Surv. India.

Radhakrishna, C. 2007. Amphibia. In : *Fauna of Kudermukh National Park, Karnataka, Conservation Area Series*, **32** : 20-25, Published by Zool. Surv. India.

Book : Gupta, S.K. 1985. *Handbook on Plant Mites of India* : 1-520. Published by Zool. Surv. India.

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- Sivaleela, G. and Venkataraman, K. - Density and distribution of Meiofauna of Tamilnadu Coast 1-21
- Rajkumar Rajan, C. Venkatraman, G. Sivaleela, D. Paranthaman, P. Padmanaban, and K. Venkataraman - Notes on the association of *Lissocarcinus polybiodes* Adams ... Troschel, 1842.....23-26
- Debabrata Sen, Amalendu Chatterjee and Buddhadeb Manna - A new and a known species of Telotylenchinae (Tylenchida: ... West Bengal, India.....27-34
- Sidharth Kulkarni and V.Y. Deshpande - A new species of the Genus *Oxyopes* Latrielle ... Western Ghats 35-37
- De, J. K. and R. Chakraborty - Identification of Dorsal Guard Hairs Of Nine ... (Artiodactyla : Mammalia).....39-52
- Barman, R.P. and S.S. Mishra - On the Status of *Devario assamensis* Barman, 1984 (Pisces: Cyprinidae) ... 1934.....53-55
- Bulganin Mitra and P. Parui - Diversity of True Flies (Diptera: Insecta) in the Bibhutibhusan Wildlife Sanctuary 57-64
- Sarmistha Roy, Kuladeep Roy and Bulganin Mitra - Arthropod Faunal Diversity in some Sacred Trees of Serampore, Hoogly, West Bengal.....65-69
- Kuladeep Roy and Bulganin Mitra - Evaluating Pollinator Effectiveness on *Tagetes patula* Linnaeus.....71-74
- Srivastava, J.P. and M. K. Ghosh - Taxonomic Status of the Indian species and subspecies ... F. Cuvier.....75-78
- Kailash Chandra, E. Eyarin Jehamalar and C. Ragunathan - Aquatic and Semiaquatic Heteroptera ... Andaman and Nicobar Islands, India.....79-89
- Kailash Chandra and E. Eyarin Jehamalar - Morphological Differences in Three Species of the Genus *Diplonychus* India.....91-99
- Sankar Talukdar - Observation on the diverse mode of feeding habit ... West Bengal 101-106
- Girindra Kalita and M.M. Goswami - Diversity and ecology of Turbellarian animals in Deepar Wetland of Assam, India.....107-112
- Sidharth Kulkarni and V. Y. Deshpande - New record of the Spider *Arachnura angura* from ... Araneidae).....113-115
- SHORT COMMUNICATIONS
- V. D. Hegde - New Record of *Cossyphus depressus* Fab. 1781 ... from Uttar Pradesh.....117-118
- Kushwaha, R. K. and V. D. Hegde - New Record of the species *Melaenus piger* ... from Uttar Pradesh 119-120
- Prasanna Yennawar and Prasad Tudu - New Record of *Argyrops bleekeri* ...in Indian Waters.....121-122
- Anil Mohapatra, Prasad Tudu and Prasanna Yennawar - First Report of a Fish from Family: Antennariidae ... on the East Coast of India.....123-124