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Studies on the fresh water aquatic beetle fauna (Coleoptera: Insecta) of Chilika lake and its adjoining areas and their colonization in brackish water

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Abstract

Studies on the aquatic beetle fauna of 8 selected sites of Chilika Lake, the one of the Ramsar site in Odisha, situated in the east coast of India connecting the Bay of Bengal was carried out during the month of July to August, 2016. Present survey is the second survey exactly after the 100 years of the first survey made by Annandale and his team in the year 1915. Altogether, 42 species under four families of aquatic beetle fauna are reported here including the earlier reported species. Of them, 20 species are reported for the first time from the Chilika Lake and its adjoining areas. Moreover, 16 species are reported for the first time from the Indian brackish water.

Keywords: Aquatic beetle, Chilika Lake, Ramsar site, Brackish water, new records

1. Introduction

The first faunistic study on Chilika Lake was initiated by Annandale in the year 1915 and the results of these studies have been published in a series of papers from 1915 to 1924^[1]. In that series^[2] it was being reported the occurrence of aquatic insects excluding beetles. The second attempt on the exploration of the faunal diversity of the Chilika Lake has been taken by the Estuarine Biological Station, Zoological Survey of India (presently EBRC) from 1985 to 1987 and the studies were carried out starting from limnology to faunal account from protozoa to mammals excluding insects^[1].

Aquatic beetles are very integral part of the biotic component and the best indicator of any water body or wetland. So far knowledge goes, Arrow^[3] was the first man who reported two species of aquatic beetles from Chilika Lake areas, each one from the family Dytiscidae and Hydrophilidae from the collection of Annandale in 1915. Afterwards, one new species was described^[4], *Hydroglyphus regimbarti* as *Bidessius regimbarti* *Gschwendtner*, 1936 of the family Dytiscidae. After that, initiative was taken^[5] to report the dytiscid species of Chilika Lake collected by Annandale and his team in the year 1915. Vazirani has included all these species in his revisionary works on subfamilies Noterinae, Laccophilinae, Dytiscinae and Hydroporinae of family Dytiscidae.

Present communication is the outcome of the recent survey (2016) exclusively on the insect faunal diversity of Chilika Lake and aquatic beetles in particular. This present survey was made exactly hundred years after the first collection made by Annandale in the year 1915 and his team. The present communication reports 42 species including earlier reported species which are distributed in 4 families, Noteridae (4 species), Dytiscidae (24 species), Hydrophilidae (13 species) and Hydrochidae (1 species). Of them, 20 species are reported for the first time from the lake and adjoining areas. All these collections were made from both fresh and brackish water of the lake and adjoining areas. Among the 42 species, 16 species were collected from both fresh and the brackish water of the Chilika Lake and its adjoining areas.

2. Material and Methods

2.1 Study area: Chilika lagoon (85°20' E, 19°40' N), situated in the east coast of India connecting the Bay of Bengal, is the largest brackish water wet land and one of the Ramsar sites in India^[6]. It is spread over Puri, Khurda and Ganjam districts of Odisha state on the east coast of India, at the mouth of the Daya River, flowing into the Bay of Bengal, covering an area of over 1,100 Sq km (Map 1).

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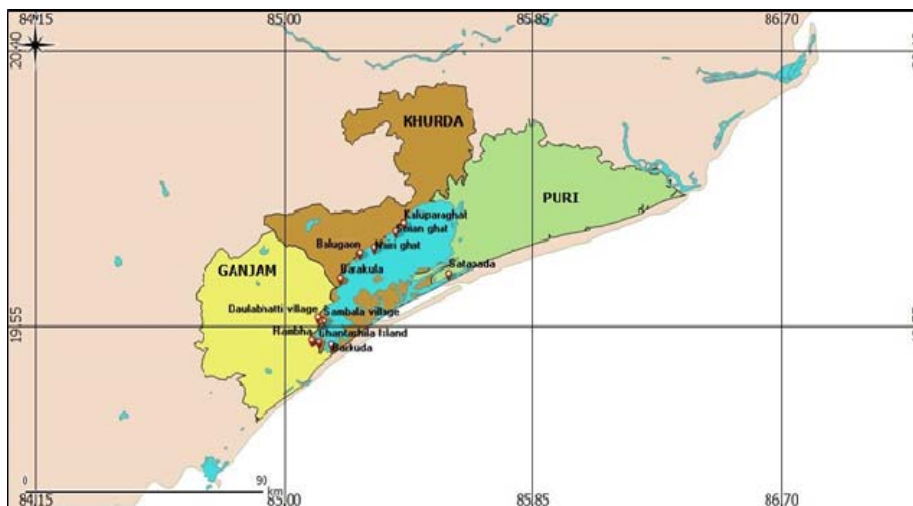


Map 1: Location of Chilika Lake in the three districts of Odisha

2.2 Aquatic Insects Sampling

The collections were mostly made from adjoining areas and marginal waters of lake in the mainland and within the Island (Map 2). The study was carried out during July to August, 2016 from 8 selected sites of Chilika Lake. The Aquatic beetles were collected with the help of suitable insects

collecting net made of nylon cloth and in some cases using a net of mesh size 500 μm whereby the vegetation was disturbed and the net was dragged around the vegetation for a unit of time or light trap was used. The beetles were killed with 90% alcohol solution and next day transfer to 70% solution.



Map 2: Showing all the collection localities of both the surveys

3. Results and Discussion

In this present communication a list of 42 species of 4 families of aquatic beetles, Noteridae (4 species), Dytiscidae (24 species), Hydrophilidae (13 species) and Hydrochidae (1 species) have been provided along with their current scientific names (Table 1). Of them, 22 species reported earlier, 8 species reported in both the occasions (marked with *), 14 earlier reported species were not found during this present survey (marked with #) and 20 species more added during this present survey (marked with \blacklozenge) (Table 1).

During the present survey, 16 species under 3 subfamilies have been reported from both the fresh & brackish water habitats. Out of 3 species of the genus *Canthydrus* Sharp of the family Noteridae, 2 species are reported from both the type of waters. Moreover, 4 species of the genera *Hydroglyphus* Motschulsky & *Laccophilus* Leach of the family Dytiscidae are commonly found in both the type of water. But the majority of the species of the family Hydrophilidae (11 species) shows their affinity to fresh and

brackish water both. All the species of the genus *Berosus* Leach except *nigriceps* of the family Hydrophilidae are very much commonly distributed in fresh & brackish waters of these areas (Table 1).

Among the 11 collection localities (including previous and present localities), Balugaon shares the maximum number of species (19%) and the minimum number of species (1%) reported from Barkuda Island (presently Honey-moon Island), Kalupara Ghat and Soran Ghat. There are 3% of species having no specific locality only reported as Chilika (Fig 1).

Among the 42 species reported here, *Hydroglyphus flammulatus* (Sharp, 1882) and *Canthydrus laetabilis* (Walker, 1858) are the most common species found in almost fifty five percent of the collection localities in and around Chilika Lake (Table 2).

The assessment of diversity and preparation of the aquatic beetle inventories are considered a needful task now a day, due to the importance of wetlands in the conservation planning and endeavours. But unfortunately, there is only one

faunistic survey was made on the aquatic insect faunal diversity of Chilika Lake and its adjoining areas. After that study, very little work on the aquatic insect faunal aspects was carried out except a few on the mosquitoes [7] and Odonates [8].

The hot and humid coastal climate, wide spread paddy fields, small water pools and marginal water of the Chilika Lake provide favourable habitats for the aquatic beetles. With single new species, 22 species of aquatic beetles were known so far till 2015. During this present survey, another 20 species were recorded from this area. Altogether, present communication reports 42 species under 4 families of aquatic beetles, Noteridae (4 species), Dytiscidae (24 species), Hydrophilidae (13 species) and Hydrochidae (1 species) from this Ramsar site of Odisha.

Mostly the aquatic beetles live in clean, shallow and slow running water but some are found in stagnant water rich in detritus [9]. This communication reports for the first time the occurrence of 16 species in the brackish water of India. According to [2] this may be the part immigrants from fresh water and drift or fly into to the brackish water of the lake. But according to [10], for aquatic insects, salinity is a natural stress or that can disrupt metabolism and water balance, and therefore, species inhabiting saline waters have developed a

range of physiological mechanisms to deal with ionic fluctuations, which fall into two main strategies: osmoconformation and osmoregulation. But information on the osmotic mechanisms of aquatic beetles in saline waters is almost entirely lacking, with only a few aquatic species having been studied [11-12], e.g. the freshwater *Dytiscus verticalis* Say, 1823 and larvae of fresh water *Helodes Latreille* [13] and a handful of saline water species such as *Berosus spinosus* Steven, 1808 [14] and *Hygrotus salinarius* (Wallis, 1924) [15]. The knowledge on the evolutionary history of colonization of saline waters by beetles is limited, but it is clear that salinity tolerance has arisen independently in a number of different aquatic lineages; for example, independent and direct transitions from freshwater to saline habitats have been reported in *Enochrus* Thomson species of the subgenus *Lumetus*. In the case of aquatic Coleoptera, the development of drought tolerance in lineages subjected to strong seasonal aridity may, therefore, have provided the genetic and physiological basis behind hyporegulation capacity, making colonisation and diversification in saline waters possible [16].

Therefore, the present findings are the flagship for the future study on the colonization aspect of aquatic beetles from freshwater to saline water in the Indian perspective.

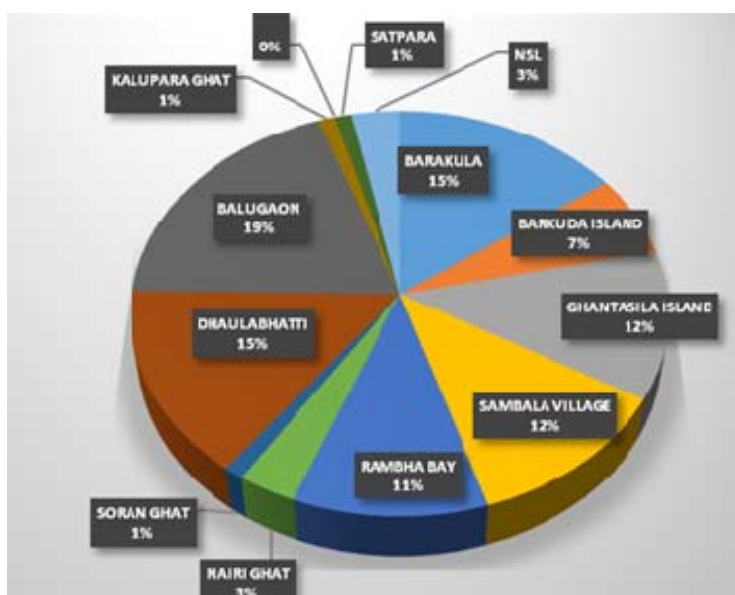


Fig 1: Aquatic beetle species diversity in each locality (%-wise)



Fig 2: Collection from fresh water in Balugaon village



Fig 3: Collection from brackish water at Barakula, Chilika Lake

Table 1: List of species so far reported in and around Chilika Lake

No	Family	Species	Collected from	Remarks
1	Noteridae	* <i>Neohydrocoptus subvittulus</i> (Motschulsky, 1859)	At light nr. Brackish water	Recorded as ^[5] <i>Hydrocoptus subvittulus</i> from Chilika & also reported during this survey from Barkul & Daulabhathi village.
2		# <i>Canthydrus angularis</i> Sharp, 1882	Fresh water	Recorded as ^[5] <i>Canthydrus morsbachi</i> from Barkuda Island.
3		* <i>Canthydrus laetabilis</i> (Walker, 1858)	Both brackish & fresh water	Recorded by ^[5] , from Rambha & Barkuda Island & also reported during this survey from Barakula, Daulabhathi village, Ghantasila Island, Sambala village, Balugaon.
4		* <i>Canthydrus luctuosus</i> (Aube, 1838)	Both brackish & fresh water	Recorded by ^[5] , from Rambha & also reported during this survey from Sambala village, Balugaon & Kalupara Ghat.
1	Dytiscidae	# <i>Rhantaticus congestus</i> (Klug, 1832)	Fresh water	Recorded by ^[5] , from Barkuda Island.
2		# <i>Sandracottus dejeani</i> (Aubé, 1838)	Fresh water	Recorded by ^[5] , from Barkuda Island.
3		# <i>Cybister confusus</i> Sharp, 1882	Fresh water	Recorded by ^[5] , from Barkuda Island.
4		# <i>Cybister limbatus</i> (Fabricius, 1775)	Fresh water	Recorded by ^[5] , from Rambha.
5		# <i>Cybister tripunctatus lateralis</i> (Fabricius, 1798)	Fresh water	Recorded as <i>Cybister tripunctatus asiaticus</i> by ^[5] , from Satpara.
6		# <i>Eretes griseus</i> (Fabricius, 1781)	Fresh water	Recorded as <i>Eretes stiticus</i> by ^{[3],[5]} , from Rambha.
7		# <i>Clypeodytes bufo</i> (Sharp, 1890)	Fresh water	Recorded by ^[5] , from Rambha.
8		* <i>Hydroglyphus flammulatus</i> (Sharp, 1882)	Both brackish & fresh water	Recorded by ^[5] as <i>Guignotus flammulatus</i> from Rambha and also reported during this survey from Barakula, Daulabhathi village, Ghantasila Island, Sambala village, Balugaon.
9		# <i>Hydroglyphus inconstans</i> (Régimbart, 1892)	Fresh water	Recorded by ^[5] , from Chilika of Ganjam district.
10		# <i>Hydroglyphus pendjabensis</i> (Guignot, 1954)	Fresh water	Recorded by ^[5] , from Chilika of Ganjam district.
11		* <i>Hydroglyphus regimbarti</i> (Gschwendtner, 1936)	Both brackish & fresh water	Described by ^[4] , as <i>Bidessius regimbarti</i> from Chilika and also reported during this survey from Barakula, Daulabhathi village, Sambala village.
12		◆ <i>Hydroglyphus signatellus</i> (Klug, 1834)	Fresh water	First time reported from Chilika and collected from Daulabhathi village
13		◆ <i>Leiodytes orissaensis</i> (Vazirani, 1969)	Fresh water	First time reported from Chilika and collected from Sambala village.
14		# <i>Uvarus livens</i> (Régimbart, 1892)	Fresh water	Recorded by ^[5] , from Chilika.
15		◆ <i>Hydrovatus acuminatus</i> Motschulsky, 1859	Fresh water	First time reported from Chilika and collected from Daulabhathi village.
16		◆ <i>Hydrovatus bonvouloiris</i> Sharp, 1882	Fresh water	First time reported from Chilika and collected from Daulabhathi village & Barakul.
17		◆ <i>Hydrovatus confertus</i> Sharp, 1882	Fresh water	First time reported from Chilika and collected from Daulabhathi village.
18		# <i>Hyphydrus lyratus flavicans</i> Régimbart, 1892	Fresh water	Recorded by ^[5] , from Rambha.
19		# <i>Hyphydrus renardi</i> Severin, 1890	Fresh water	Recorded by ^[5] , from Rambha.
20		◆ <i>Laccophilus anticatus anticatus</i> Sharp, 1890	Fresh water	First time reported from Chilika and collected from Daulabhathi village, Balugaon & Sambala village.
21		# <i>Laccophilus flexuosus</i> Aube, 1838	Fresh water	Recorded by ^[5] , from Rambha.
22		* <i>Laccophilus parvulus parvulus</i> Aube, 1938	Both brackish & fresh water	Recorded by ^[5] , from Rambha & Barkuda and also reported during this survey from Daulabhathi village, Ghantasila Island, Sambala village, Balugaon.
23		* <i>Laccophilus sharpi</i> Régimbart, 1889	Both brackish & fresh water	Recorded by ^[5] , from Rambha and also reported during this survey from Barakul & Ghantasila Island.
24		◆ <i>Laccophilus uniformis</i> Motschulsky, 1859	Fresh water	First time reported from Chilika and collected from Balugaon.
1	Hydrophilidae	◆ <i>Helochaers anchoralis</i> Sharp, 1890	Both brackish & fresh water	First time reported from Chilika and collected from Balugaon, Sambala village & Barakul.
2		◆ <i>Helochaers densus</i> Sharp, 1890	Fresh water	First time reported from Chilika and collected from Balugaon, Sambala village & Barakul.
3		◆ <i>Helochaers lentus</i> Sharp, 1890	Fresh water	First time reported from Chilika and collected from Daulabhathi village.

4		◆ <i>Helochaeres pallens</i> (Macleay, 1825)	Both brackish & fresh water	First time reported from Chilika and collected from Daulabhathi village, Ghantasila Island, Sambala village, Balugaon & Barakul.
5		◆ <i>Sternolophus rufipes</i> (Fabricius, 1792)	Both brackish & fresh water	First time reported from Chilika and collected from Nairi Ghat, Ghantasila Island, Balugaon & Barakul.
6		◆ <i>Berosus indicus</i> Motschulsky, 1861	Both brackish & fresh water	First time reported from Chilika and collected from Soran Ghat, Ghantasila Island, Balugaon.
7		◆ <i>Berosus pulchellus</i> Macleay, 1825	Both brackish & fresh water	First time reported from Chilika and collected from Ghantasila Island, Balugaon & Barakul.
8		◆ <i>Berosus nigriceps</i> (Fabricius, 1801)	Fresh water	First time reported from Chilika and collected from Ghantasila Island.
9		* <i>Enochrus esuriens</i> (Walker, 1858)	Both brackish & fresh water	Recorded by ^[3] as <i>Phihydrus esuriens</i> from Chilika and also reported during this survey from Nairi Ghat, Daulabhathi village, Ghantasila Island, Barakul, Balugaon.
10		◆ <i>Regimbartia attenuate</i> Fabricius, 1801	Both brackish & fresh water	First time reported from Chilika and collected from Ghantasila Island, Balugaon.
11		◆ <i>Amphiops pedestris</i> Sharp, 1890	Both brackish & fresh water	First time reported from Chilika and collected from Nairi Ghat, Balugaon..
12		◆ <i>Paracymus evanescens</i> (Sharp, 1890)	Both brackish & fresh water	First time reported from Chilika and collected from Ghantasila Island, Balugaon & Barakul, Sambala village.
13		◆ <i>Cercyon</i> sp.	Both brackish & fresh water	First time reported from Chilika and collected from Barakul.
1	Hydrochidae	◆ <i>Hydrochus binodosus</i> Motschulsky, 1860	Fresh water	First time reported from Chilika and collected from Daulabhathi village, Sambala village.

Table 2: Collection localities of the aquatic beetle species in and around Chilika Lake

	Locality	Aquatic beetle species
1	Barakula	<i>Neohydrocoptus subvittulus</i> , <i>Canthydrus laetabilis</i> , <i>Hydroglyphus flammulatus</i> , <i>Hydroglyphus regimbarti</i> , <i>Hydrovatus bonvouloiris</i> , <i>Laccophilus sharpi</i> , <i>Helochaeres anchoralis</i> , <i>Helochaeres densus</i> , <i>Helochaeres pallens</i> , <i>Sternolophus rufipes</i> , <i>Berosus pulchellus</i> , <i>Enochrus esuriens</i> , <i>Paracymus evanescens</i> , <i>Cercyon</i> sp.
2	Barkuda	<i>Canthydrus angularis</i> , <i>Canthydrus laetabilis</i> , <i>Rhantaticus congestus</i> , <i>Sandracottus dejeani</i> , <i>Cybister confusus</i> , <i>Laccophilus parvulus parvulus</i>
3	Ghantasila	<i>Canthydrus laetabilis</i> , <i>Hydroglyphus flammulatus</i> , <i>Laccophilus sharpi</i> , <i>Helochaeres pallens</i> , <i>Sternolophus rufipes</i> , <i>Berosus indicus</i> , <i>Berosus pulchellus</i> , <i>Berosus nigriceps</i> , <i>Enochrus esuriens</i> , <i>Regimbartia attenuate</i> , <i>Paracymus evanescens</i>
4	Sambala	<i>Canthydrus laetabilis</i> , <i>Hydroglyphus flammulatus</i> , <i>Hydroglyphus regimbarti</i> , <i>Leiodytes orissaensis</i> , <i>Laccophilus anticatus anticatus</i> , <i>Laccophilus parvulus parvulus</i> , <i>Helochaeres anchoralis</i> , <i>Helochaeres densus</i> , <i>Helochaeres pallens</i> , <i>Paracymus evanescens</i> , <i>Hydrochus binodosus</i>
5	Rambha	<i>Canthydrus laetabilis</i> , <i>Canthydrus luctuosus</i> , <i>Eretes griseus</i> , <i>Clypeodytes bufo</i> , <i>Hydroglyphus flammulatus</i> , <i>Hyphydrus lyratus flavicans</i> , <i>Hyphydrus renardi</i> , <i>Laccophilus flexuosus</i> , <i>Laccophilus parvulus parvulus</i> , <i>Laccophilus sharpi</i> , <i>Cybister limbatus</i>
6	Nairi Ghat	<i>Sternolophus rufipes</i> , <i>Enochrus esuriens</i> , <i>Amphiops pedestris</i>
7	Soran Ghat	<i>Berosus indicus</i>
8	Dhaulabhathi	<i>Neohydrocoptus subvittulus</i> , <i>Canthydrus laetabilis</i> , <i>Hydroglyphus flammulatus</i> , <i>Hydroglyphus regimbarti</i> , <i>Hydroglyphus signatellus</i> , <i>Hydrovatus acuminatus</i> , <i>Hydrovatus bonvouloiris</i> , <i>Hydrovatus confertus</i> , <i>Laccophilus anticatus anticatus</i> , <i>Laccophilus parvulus parvulus</i> , <i>Helochaeres lentus</i> , <i>Helochaeres pallens</i> , <i>Enochrus esuriens</i> , <i>Hydrochus binodosus</i>
9	Balugaon	<i>Canthydrus laetabilis</i> , <i>Canthydrus luctuosus</i> , <i>Canthydrus luctuosus</i> , <i>Hydroglyphus flammulatus</i> , <i>Laccophilus anticatus anticatus</i> , <i>Laccophilus parvulus parvulus</i> , <i>Laccophilus uniformis</i> , <i>Helochaeres anchoralis</i> , <i>Helochaeres densus</i> , <i>Helochaeres pallens</i> , <i>Sternolophus rufipes</i> , <i>Berosus indicus</i> , <i>Berosus pulchellus</i> , <i>Enochrus esuriens</i> , <i>Regimbartia attenuate</i> , <i>Amphiops pedestris</i> , <i>Paracymus evanescens</i>
10	Kalupara Ghat	<i>Canthydrus luctuosus</i>
12	Satpara	<i>Cybister tripunctatus lateralis</i>
13	NSL	<i>Hydroglyphus inconstans</i> , <i>Hydroglyphus pendjabensis</i> , <i>Uvarus livens</i>

4. Conclusion

From Chilika, 42 species under four families of aquatic beetle fauna are reported here including the earlier reported species. Of them, 20 species are reported for the first time from the Chilika Lake and its adjoining areas. Moreover, 16 species are reported from the brackish water for the first time in India.

Chilika Lake is harbouring rich diversity of aquatic beetle fauna and present documentation is a consolidated report of hundred years of survey in this area. This communication is also the first report of aquatic beetle from brackish water of India. This baseline data will definitely help to the future workers to study the osmotic mechanisms of aquatic beetles in saline waters in the perspective of Indian fauna.

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