

SPECIES DIVERSITY OF ROTIFERS (ROTIFERA: MONOGONONTA) FROM
LY SON ISLAND WITH A NEW RECORD FOR VIETNAM

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Abstract - In order to provide the information on the biodiversity of Rotifera from Ly Son Island, six samples from four water bodies from Ly Son Island, Quang Ngai Province were collected in May 2019. A total of thirty-six species-level taxa have been identified, belonging to 12 families of Rotifera phylum. Of these, the Lecanidae is the most diverse family with 14 taxa recorded (38.9%) followed by Brachionidae (6 taxa, 16,7%), and Trichoceridae (5 taxa, 13,9%). Eight families are present with only a single species, viz. Asplanchnidae, Dicranophoridae, Gastropodidae, Hexathridae, Synchaetidae, Scaridiidae, Notommatidae, and Mytilinidae. *Lophocharis salpina* is recorded new to Vietnamese rotifer fauna.

Key words - Rotifera; *Lophocharis salpina*; Ly Son Island; Biodiversity; new record

1. Introduction

Rotifera is a group of primary freshwater invertebrates. They contain two major groups: Monogononta and Bdelloidea, with ca. 2150 recognized species, (Segers, 2007). They are widely distributed in inland aquatic habitats and play an important role in freshwater ecosystem functioning. Moreover, they can be used as indicators of water quality (Sladeczek, 1983), toxicology test organisms (Arnold *et al.*, 2011), and as feed in aquaculture (Lubzens, 1987; Ogata and Kurokura, 2011). The biology, ecology, and systematics of rotifers were reviewed by Wallace *et al.* (2006).

Ly Son island is located in the Northeast of Quang Ngai province in central Vietnam, about 27 km from the mainland, with an area of nearly 10 km2 and a population of over 21,000 people. This island district has long been considered the Fatherland’s outpost because of its important strategic position on Vietnam’s East sea and has earned the nickname “the Kingdom of garlic” of Vietnam. In September 2014, Ly Son island was connected to the national power grid. Since then, the economic and social growth has increased and the people’s quality of life has improved. Nowadays, Ly Son island is widely known as an attractive tourist destination of Quang Ngai province (total number of visitors in 2018 was over 230,000). However, due to the rapid growth of the economy, Ly Son island are facing environmental problems such as the excessive increase of waste, biodiversity loss, and most notably, the water crisis that has negatively affected the people’s lives, agriculture, and tourism.

2. Materials and Methods

Qualitative samples of rotifer were collected using a 50 µm mesh size cast-net and then preserved in 4% formaldehyde. Rotifer specimens were sorted and examined using a Hund (H600) compound microscope equipped with a camera. The trophi of rotifers were examined by adding a drop of commercial sodium-hypochloride (NaOCl) to dissolve and isolate the hard trophi parts.

The species accumulator and species richness estimators were calculated using the vegan package (Oksanen *et al.*, 2013) in R program (R Development Core Team, 2018). Of these, Jackknife 2 and Chao 2 estimators were selected to estimate the expected diversity of rotifer in Ly Son Island (Trinh-Dang *et al.*, 2019).

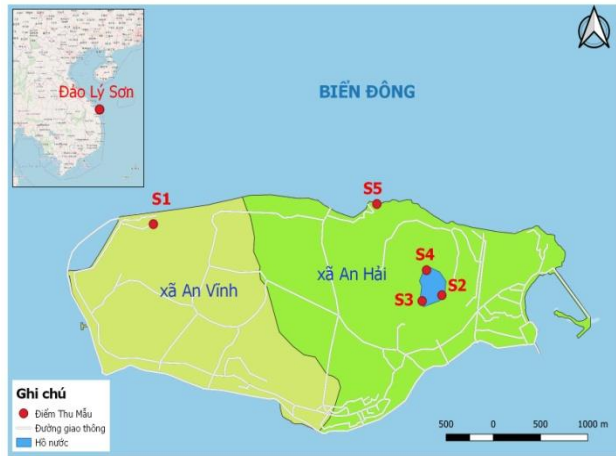


Figure 1. Schematic map of the study area at Ly Son Island

3. Results and discussions

A total of thirty-six taxa of rotifer, belonging to 12 families were recorded from Ly Son Island (Table 1). The most diverse family was Lecanidae (14 taxa, 38.9%), followed by Brachionidae (6 taxa, 16,7%), and Trichoceridae (5 taxa, 13,9%) (Figure 2). Eight families were present with only a single species, viz. Asplanchnidae, Dicranophoridae, Gastropodidae, Hexathridae, Synchaetidae, Scaridiidae, Notommatidae, and Mytilinidae (Figure 2).

Table 1. List of rotifer fauna from Ly Son Island, Quang Ngai province (* = new to Vietnam)

Family Asplanchnidae	
1.	<i>Asplanchna brightwellii</i> Gosse, 1850
Family Brachionidae	
2.	<i>Anuraeopsis coelata</i> de Beauchamp, 1932
3.	<i>Brachionus calyciflorus</i> Pallas, 1766
4.	<i>Brachionus falcatus</i> Zacharias, 1898
5.	<i>Brachionus quadridentatus</i> Hermann, 1783
6.	<i>Brachionus rubens</i> Ehrenberg, 1838
7.	<i>Keratella tropica</i> (Apstein, 1907)
Family Dicranophoridae	
8.	<i>Dicranophorus epicharis</i> Harring & Myers, 1928
Family Gastropodidae	
9.	<i>Ascomorpha ovalis</i> (Bergendal, 1892)

Family Hexarthridae	
10.	<i>Hexarthra intermedia</i> (Wiszniewski, 1929)
Family Lecanidae	
11.	<i>Lecane arcula</i> Harring, 1914
12.	<i>Lecane bulla</i> (Gosse, 1851)
13.	<i>Lecane furcata</i> (Murray, 1913)
14.	<i>Lecane haliclysta</i> Harring & Myers, 1926
15.	<i>Lecane hamata</i> (Stokes, 1896)
16.	<i>Lecane hastata</i> (Murray, 1913)
17.	<i>Lecane hornemanni</i> (Ehrenberg, 1834)
18.	<i>Lecane inermis</i> (Bryce, 1892)
19.	<i>Lecane luna</i> (Müller, 1776)
20.	<i>Lecane lunaris</i> (Ehrenberg, 1832)
21.	<i>Lecane papuana</i> (Murray, 1913)
22.	<i>Lecane signifera</i> (Jennings, 1896)
23.	<i>Lecane undulata</i> Hauer, 1938
24.	<i>Lecane unguitata</i> (Fadeev, 1925)
Family Lepadellidae	
25.	<i>Colurella obtusa</i> (Gosse, 1886)
26.	<i>Colurella uncinata</i> (Müller, 1773)
27.	<i>Lepadella rhomboides</i> (Gosse, 1886)
Family Mytilinidae	
28.	<i>Lophocharis salpina</i> (Ehrenberg, 1834)*
Family Notommatidae	
29.	<i>Cephalodella forficula</i> (Ehrenberg, 1830)
Family Scardiidae	
30.	<i>Scardium longicaudum</i> (Müller, 1786)
Family Synchaetidae	
31.	<i>Polyarthra dolichoptera</i> Idelson, 1925
Family Trichocercidae	
32.	<i>Trichocerca dixonnutalli</i> (Jennings, 1903)
33.	<i>Trichocerca elongata</i> (Gosse, 1886)
34.	<i>Trichocerca iernis</i> (Gosse, 1887)
35.	<i>Trichocerca pusilla</i> (Jennings, 1903)
36.	<i>Trichocerca tenuior</i> (Gosse, 1886)

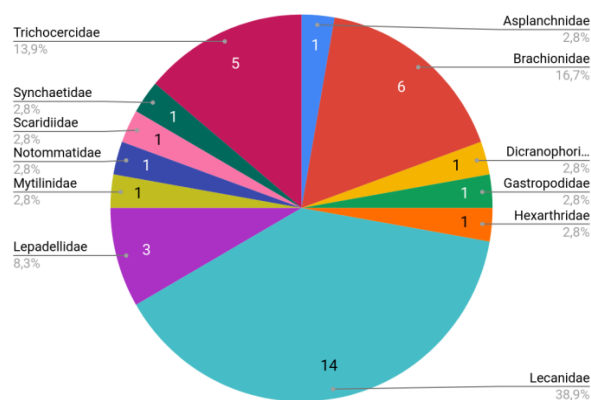


Figure 2. Percentage of species in each family of Rotifera from Ly Son Island

Among the recorded species in Ly Son Island, one

species was recorded new to Vietnam rotifera fauna, *Lophocharis salpina* (Ehrenberg, 1834) (Figure 3). This species was found only in Thoi Loi Lake, Ly Son Island. *L. salpina* can be recognized by its anterior margin always serrated and keel with transverse folds mostly over caudal part of lorica. Besides, most of the species recorded in Ly Son are tropical species, with some typical species such as *Anuraeopsis coelata*, *Keratella tropica* và *Lecane hamata*.

To identify the species richness, we constructed species accumulation curves based on the rarefaction method and fitted with a logarithmic model in each study site (Figure 4). The result showed that the average species number at each locality was 14 taxa, and the observed number of species in the pooled samples series was 36 taxa. Besides, the number of species increased with the increase of sample size, following the equation $y = 14.02 + 13.34 \log(x)$ ($R^2 = 0.99$). Based on the estimators, the expected number of taxa in Ly Son Island could be up to 68 ± 28 taxa (according to the Chao index), 59 taxa (according to the Jackknife 2 index), and 42 ± 5 taxa (according to Bootstrap index) (Figure 4).

The species composition of the rotifer fauna of Ly Son Island (36 taxa observed, Chao2 = 68, Jack = 59 taxa estimated) was quite similar to that of the island Cozumel, Quintana Roo, México, where 36 monogonont rotifers species belong to 11 families were recorded and the most species-rich genera of the fauna were *Lecane* and *Brachionus* (Arroyo-Castro, 2019).

The diversity of rotifer in Ly Son Island was higher than that in Heard Island (17 taxa recorded) (Dartnall, 1995), but lower than that in 31 lakes in North Island, New Zealand (78 species recorded) (Duggan, 2002). However, the result shows that the number of species recorded in the islands depends on the number of lakes and samples.

Moreover, geographical properties and environmental conditions were also recognised as important factors to affect the difference in the rotifer diversity. The species number of rotifers in Ly Son Island was rather lower than that from inland lakes in Viet Nam such as Bau Thiem Lake (89 taxa), Nhu Y river (98 taxa), and rivers in the Southern area (49 taxa).

Table 2. The Similarity index of rotifera communities among freshwater habitats

	Phu Ninh Lake	Nhu Y River	Thuy Tien Lake	Bau Thiem Lake
Nhu Y River	0.61			
Thuy Tien Lake	0.59	0.61		
Bau Thiem Lake	0.72	0.80	0.67	
Ly Son	0.76	0.67	0.78	0.86

Moreover, the similarity index of rotifera species composition among water bodies from previous studies in central Vietnam showed that rotifers species composition in Ly Son island was similar to that in inland water bodies (similarity index ranges from 0.67 to 0.86). In particular, the highest similarity was found between Ly Son and Bau Thiem Lake - an oligotrophic lake in Thua Thien Hue province (similarity index of 0.86). The largest difference in species composition was observed between Ly Son and

Nhu Y river, a eutrophic river in Thua Thien Hue province (similarity index of 0.67). This difference may be due to the difference of water body characteristics.

Ly Son is an oligotrophic habitat which was indicated by the QB/T index = 0.8 (Brachionus: Trichocerca index - Sládeček, 1983).

Figure 3. *Lophocharis salpina* (Ehrenberg, 1834), habitus. a) dorsal view, b) lateral view, and c) frontal view

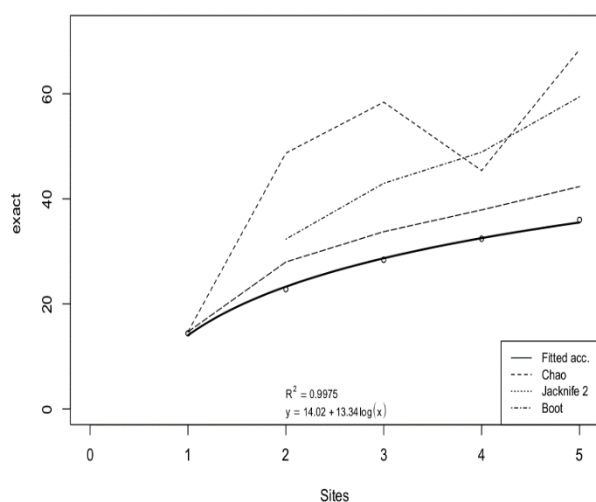
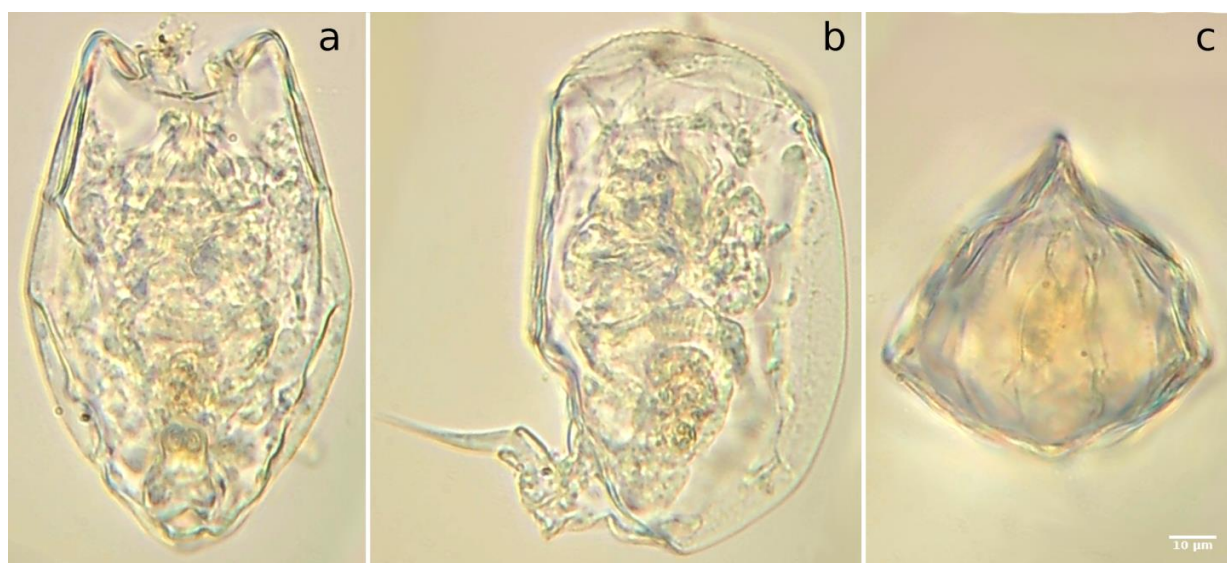


Figure 4. Species accumulator of species richness at study sites, with the fitted curve and estimator curve

4. Conclusions

The study has contributed to the knowledge of rotifers diversity from Ly Son Island, with thirty-six species-level taxa identified, and *Lophocharis salpina* is recorded new to Vietnamese rotifer fauna.

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