

Annotated Checklist of Rotifers of Tehran Province, Iran, with Notes on New Records

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ABSTRACT

Despite rapid growth of our knowledge on the phylum Rotifera, only few studies on Iranian rotifers have been carried out. In this paper, we present a checklist of rotifers from the province of Tehran in Iran. In total, 45 species of rotifers (class Eurotatoria) are reported. Most of the recorded species are cosmopolitan in distribution. *Cephalodella ventripes*, *Dicranophorus forcipatus*, *D. luetkeni*, *Encentrum cf. putorius*, *Filinia terminalis*, *Notommata glyphura*, *Proales minima*, *Trichocerca tenuior* and *Trichotria pocillum* are new to Iran's fauna. Of the rotifer families found, Brachionidae, Lecanidae and Notommatidae were the most diverse. This study can be considered a starting point for rotifer biodiversity research in Iran. More comprehensive studies are required to achieve a reliable understanding of rotifer diversity patterns in the province of Tehran.

Keywords: biodiversity, rotifer, Tehran, Iran.

Introduction

The Phylum Rotifera includes a group of microscopic planktons, and is one of the most important elements of all freshwater ecosystems. The phylum is classically divided into three subclasses, Seisonidea, Bdelloidea, and Monogononta. A new classification, however, recognizes two classes, Eurotatoria and Pararotatoria (Wallace *et al.*, 2006). Although different aspects of rotifer biology including autecology (Berzin & Pejler 1989, May & Bass 1998, Arora & Mehra 2003) are and have been under intensive investigation worldwide, little research has been done in Iran. Even the most basic aspects of rotifer biology, such as their diversity, have not been extensively addressed in Iran. Löffler (1961) recorded eight species of rotifers from Iran and later on Brishtain *et al.* (1968) recorded 21 species from the Caspian Sea.

Additionally, there are some reports from governmental organizations which have not published. Hakimzadeh (2007) was the first local researcher who studied rotifers of Iran, and he recorded 36 species from various freshwater aquatic systems in the province of Tehran. Shayestehfar *et al.* (2008) carried out an ecological study in the river Kor, Iran. Later, Kordbacheh (2010) reported 25 species from Karaj River and Karaj Dam Lake, again from the province of Tehran. Khaleqsefat *et al.* (2011) and Hakimzadeh *et al.* (2011) were among other researchers who studied Iran's fauna. The present article presents a checklist of the Rotifera of Tehran, with a focus on new records for Iran's fauna found in Karaj River and Karaj Dam Lake.

Materials and Methods

The checklist presented here is based on the species reported by Hakimzadeh *et al.*

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(2011) from the province of Tehran, and the study of Kordbacheh (2010) carried out at the University of Tehran. Sampling was carried out twice a month, from October 2008 to September 2009 in Karaj River and the lake behind the Karaj Dam, in the mountainous area of Alborz mountain chain, 60 km west of Tehran. To collect planktonic specimens, from surface waters a plankton net with 30 cm mouth diameter and 20 μm mesh size was used. Samples were collected from three sites, two in the Karaj River (sites I and IV) and one in Karaj Dam Lake (site II). Sampling sites from which the new records are collated are listed in Table 1.

A closing plankton net was applied to collect specimens from site III located at depth of 5-10 m of Karaj Dam Lake. Different species were identified and documented, using an Axioplan 2 imaging compound microscope. The specimens are deposited at the Zoological Museum of the University of Tehran (ZUTC) as whole mounts and trophi in permanent glycerine slides.

Results And Discussion

In total, 113 species of monogonont rotifers were found in Tehran province (Table 2), all belonging to the class Eurotatoria, orders Ploima, Flosculariaceae and Collothocacea. Of these, nine species were new to Iran's fauna. All newly recorded species exhibit cosmopolitan in distribution according to Segers (2007).

Order Ploima

Based on the number of families and species, the order Ploima had the highest diversity, Ploima contains 21 families (Wallace *et al.*, 2006), and 14 of these were found in Tehran province, including two genera and eight species not previously reported from Iran (Tables 2 & 3).

Family Dicranophoridae

Members of the family Dicranophoridae are generally considered to be cosmopolitan, living in a diverse range of habitats, from freshwater to marine environments (De Smet, 1997). The family contains 17 genera, of which three were found in Tehran. Three species and two genera are new records for Iran's fauna.

Encentrum cf. putorius Wulfert, 1936

Specimens of *Encentrum cf. putorius* were found in benthic habitats in Karaj River. Trophi forcipate, uncus with trifid tip due to expanded shafts (Fig. 1 a). Measurements (μm): body length 430.7, toe length 38.25, ramus 13.4, manubrium 44.2, fulcrum 11. Despite being considered as a cold stenothermal species by De Smet (1997), we found *E. cf. putorius* even during summer when the water temperature was around 14 °C.

Dicranophorus forcipatus (Müller, 1786)

Specimens of *Dicranophorus forcipatus* with fusiform body (Fig. 1 b), forcipate trophi, each ramus with five teeth (Fig. 1 c) were sampled from muddy and also sandy habitats of Karaj River, when the water temperature was between 7.2 and 9.1 °C. Measurements (μm): body length 347-351.25, ramus 40.28, manubrium 52.44 and fulcrum 16.72. *D. forcipatus* is a cosmopolitan species and is found in fresh and brackish waters worldwide (De Smet, 1997).

Dicranophorus luetkeni (Bergendal, 1892)

Specimens of *D. luetkeni* were sampled from muddy and sandy parts of Karaj River, with water temperature of 8.2 °C. Forcipate trophi, each ramus with two shearing teeth, and each uncus with one tooth (Fig. 1 d). Measurements (μm): body length 100, toe 20-22, ramus 15.96, manubrium 25.08,

uncus 7.6 and fulcrum 7.6. *D. luetkeni* is cosmopolitan in distribution, in muddy habitat of freshwater habitats (De Smet, 1997).

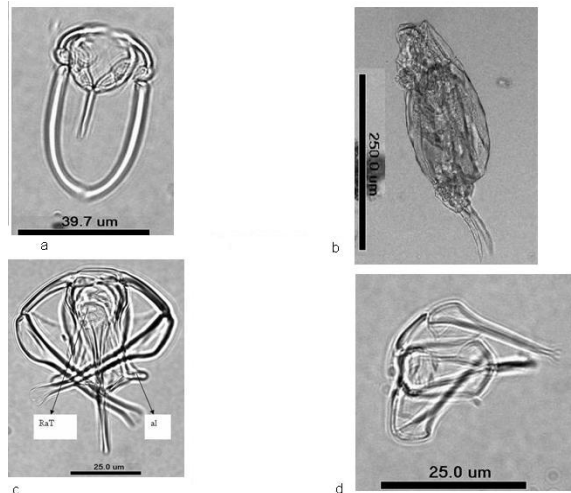


Figure 1. (a) *Encentrum cf. putorius* forcipate trophus. B-C) *Dicranophorus forcipatus*: b) lateral view c) forcipate trophus. al, alulae; RaT, ramus tooth. (d) *Dicranophorus luetkeni* forcipate trophus.

Family: Notommatidae

Notommatidae is the most difficult family for classification among monogononts. To avoid misidentification, it is necessary to observe the animals while still alive. In some cases, trophi examination is sufficient for classification. In this study identifications are mostly based on trophi and also fixed specimens as it was impossible to transfer live animals to the laboratory. This family includes 21 genera, and four of these were recorded from Tehran (Table 2).

Cephalodella ventripes (Dixon-Nuttall, 1901)

Specimens of *C. ventripes* were found in Karaj River at water temperatures between 4.3 and 13.3 °C. Body short, oval dorsally (Fig. 2 a). Trophi virgate, type A (Fig. 2 b). Measurements (µm): body length 80.75-

96.52, width 71.44, toe 34-37.24. This species is cosmopolitan (Nogrady and Pourriot, 1995) and has previously been found at temperatures below 25 °C (Berzins and Pejler, 1989).

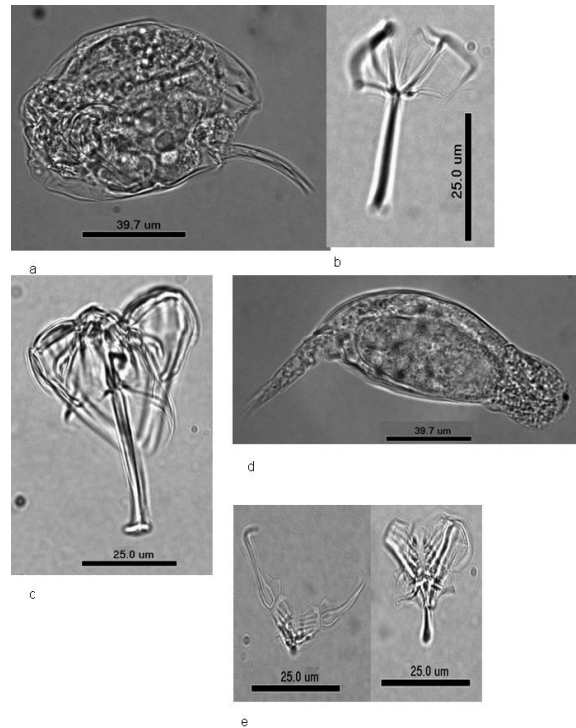


Figure 2. a-b *Cephalodella ventripes*: a) Lateral view b) virgate Trophus. c) *Notommata glyphura*, virgate trophus. d-e *Proales minima*: d) lateral view e) Virgate trophus.

Notommata glyphura (Wulfert, 1935)

A specimen of *N. glyphura* was reported once from Karaj River, at a temperature of 4.7 °C, and was identified solely based on trophi as the specimen was contracted after fixation. Trophi virgate, asymmetrical (Fig. 2c). Measurements (µm): manubrium 38.76-41.8, ramus 29.64, fulcrum 35.72-37.24 and uncus 12.16-15.96.

Family: Proalidae

The Family Proalidae has a cosmopolitan distribution and exists in a diverse range of aquatic systems (De Smet 1996). It contains

four genera, one of which is reported from Tehran. This is a new record for Iran's fauna.

***Proales minima* (Montet, 1915)**

P. minima was observed in the muddy and sandy habitats of Karaj lake at temperatures between 10.2 and 16.5 °C. Body transparent (Fig. 2 d). Trophi between virgate and malleate, uncus with five teeth (Fig. 2 d, e).

Measurements (µm): body length 114.76-144.5, neck width 25.5-31.16, body width 34-44.84, toe 25.5-47.88, ramus 5.32, manubrium 15.96 and uncus 3.04.

Family: Notommatidae

Notommatidae is the most difficult family for classification among monogononts. To avoid misidentification, it is necessary to observe the animals while still alive. In some cases, trophi examination is suffices for classification. In this study identifications are mostly based on trophi and also fixed specimens as it was impossible to transfer live animals to the laboratory. This family includes 21 genera, and four of these were recorded from Tehran (Table 2).

This species is cosmopolitan (Nogrady and Pourriot, 1995) and has previously been found at temperatures below 25 °C (Berzins and Pejler, 1989).

Family: Trichotriidae

***Trichotria pocillum* (Müller, 1776)**

This species, with a spindle-shaped lorica (Fig. 3 c), one cerebral eyespot, and malleate trophi with round alulae (Fig. 3 d) was reported from muddy habitats of Karaj River.

Measurements (µm): body length 210, lorica length 102, foot spine 32, median spine 25 and foot 85. Berzin and Pejler (1989)

reported this species at temperatures of 3-26 °C.

Order: Flosculariaceae

This order, characterized with malleoramate trophi, contains six families (Wallace *et al.*, 2006), five of which are being reported from Tehran. One species being reported is new for Iran's fauna (Table 2).

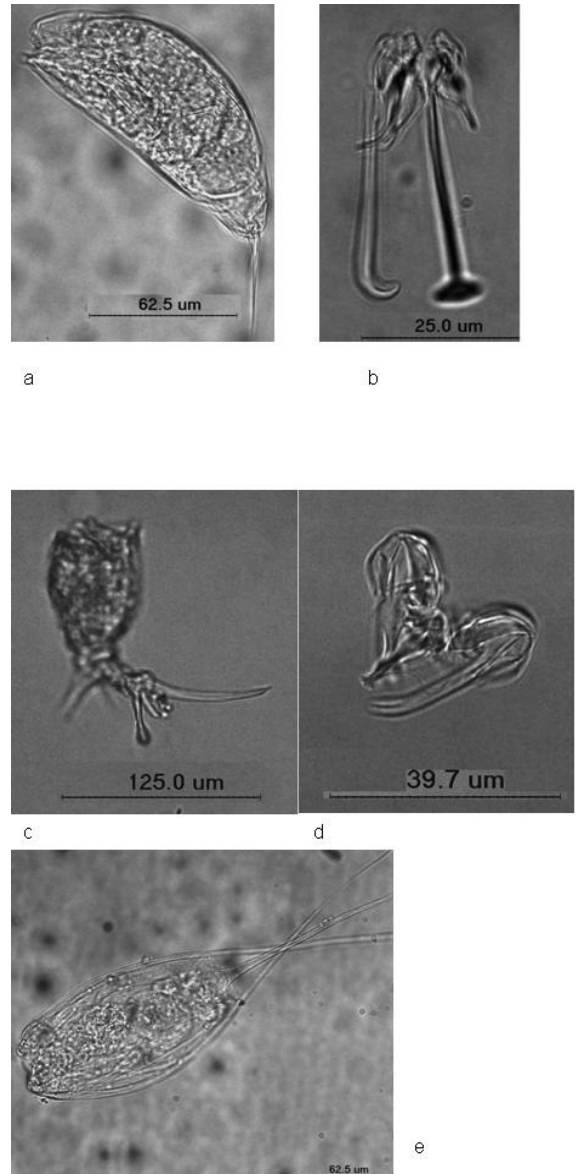


Figure 3. a-b) *Trichocera tenuior*: a) lateral view b) virgate Trophusi. c-d) *Trichotria pocillum*: c) ventral view d) Malleate trophus. e) *Filinia terminalis* ventral view.

Family: Trochosphaeridae

This family contains three genera among which *filinia* is being reported from Tehran. It is a new record for Iran's fauna.

Filinia terminalis (Plate, 1886)

F. terminalis was reported from both Karaj Dam Lake and Karaj River at temperatures of 6.1-12.7 °C. Bodysaccate, caudal seta

inserted few microns from posterior end of body. (Fig. 3 e).

Measurements: body length 144.5 µm, caudal seta 142 µm, lateral seta 238 µm.

Filinia terminalis is considered a cold stenothermal species (Sanoamuang, 2002). Berzins and Pejler (1989) reported this species at temperatures of 8-14.5 °C.

Table 1. Coordinates of sampling sites with new records

Station Nam	Station coordinates		Altitude (m)	Habitat
Bilaghan	N 53° 49' 5. 2"	E 51° 02' 38. 1"	1364	Muddy
Karaj dam lake	N 53° 58' 25. 4"	E 51° 05' 58. 2"	1725	Surface water
Karaj dam lake,	N 53° 58' 25. 4"	E 51° 05' 58. 2"	1725	5-10 m depth
Lake entrance	N 36° 00' 41. 4"	E 51° 08' 24. 9"	1749	Sandy

Distributions

There are slight differences between the thermal range in which some of the rotifer species occurred in our study and temperature ranges that Berzins and Pejler (1989) had recorded for the same species. It seems that factors other than temperature might be more important in determining the geographical distribution of these species. Moreover, Berzins and Pejler (1989) presented thermal ranges for Swedish populations and the thermal ranges may be different for populations of the species in other areas of the world.

Families Brachionidae with 20 recorded species from Tehran represented 17.6% of total monogonont rotifers of Tehran. In terms of frequencies, it was followed by families Lecanidae (13.27%) and Notommatidae (12.38%). In Southeast Asia, Lecanidae is the most diverse family followed by Brachionidae (Segers, 2001).

In studies carried out in Turkey (Altindag and Yigit, 1999; Altindag, 2000; Yigit 2002) with a climate similar to that of Karaj Dam Lake and river, Brachionidae represented the most diverse family. In our study, however, Brachionidae was the most diverse. Apparently, we do not yet have sufficient data to opine on rotifer diversity in Tehran province.

Among 113 species found in Tehran province, 103 were cosmopolitan. *Cephalodella stenroosi*, *Lecane elsa*, *Lecane lamellate* and *Synchaeta vorax* have been previously recorded from both Neotropic and Palearctic (Segers, 2007). *Lepadella (Lepadella) costata* has only been recorded from Palearctic. *Cephalodella maior* and *Lecane sympoda* have been recorded from Africa and Palearctic. *Lepadella (Lepadella) punctata* has been recorded from Orientalis and Palearctic.

The taxonomy of *Colurella obtusa* is uncertain (Segers, 2007), so its report from

Tehran needs confirmation. Also, the identity of *Lecane rugosa* needs confirmation.

The first survey of the rotifer fauna of Tehran province, covering different habitats, resulted in identification of 104 species, and the second survey, focusing on only Karaj Dam Lake and river, in the western part of the province, uncovered an additional 9

species (from the total of 25 species found), all new for Iran's fauna. These results indicate that Tehran's aquatic systems could be home to a considerable diversity of rotifers. Thus, great diversity is expected to be reported from Tehran if different habitats are sampled regularly in different seasons, as seen in Karaj River which was sampled every two weeks, for about one year.

Table 2. Check list of recorded species from the province of Tehran new records

Phylum: Rotifera	<i>Dicranophorus forcipatus</i> (Müller, 1786)*
Class: Eurotatoria	<i>Dicranophorus luetkeni</i> (Bergendal, 1892)*
Subclass: Monogononta	
Order: Ploima	Family: Epiphanidae
Family: Asplanchnidae	<i>Epiphanes senta</i> (Müller, 1773)
<i>Asplanchna brightwellii</i> Gosse, 1850	Family: Euchlanidae
<i>Asplanchna girodi</i> de Guerne, 1888	<i>Euchlanis dilatata</i> Ehrenberg, 1832
<i>Asplanchna priodonta</i> Gosse, 1850	<i>Euchlanis incisa</i> Carlin, 1939
	<i>Beauchampiella eudactylota</i> (Gosse, 1886)
Family: Brachionidae	Family: Lecanidae
<i>Brachionus angularis</i> Gosse, 1851	<i>Lecane bulla</i> (Gosse, 1851)
<i>Brachionus bidentatus</i> Anderson, 1889	<i>Lecane closterocerca</i> (Schmarda, 1859)
<i>Brachionus calyciflorus</i> Pallas, 1766	<i>Lecane elsa</i> Hauer, 1931
<i>Brachionus diversicornis</i> (Daday, 1883)	<i>Lecane furcata</i> (Murray, 1913)
<i>Brachionus leydigii</i> Cohn, 1862	<i>Lecane grandis</i> (Murray, 1913)
<i>Brachionus plicatilis</i> Müller, 1786	<i>Lecane hamata</i> (Stokes, 1896)
<i>Brachionus quadridentatus</i> Hermann, 1783	<i>Lecane lamellata</i> (Daday, 1893)
<i>Brachionus rubens</i> Ehrenberg, 1838	<i>Lecane leontina</i> (Turner, 1892)
<i>Brachionus urceolaris</i> Müller, 1773	<i>Lecane luna</i> (Müller, 1776)
<i>Brachionus variabilis</i> Hempel, 1896	<i>Lecane lunaris</i> (Ehrenberg, 1832)
<i>Kellicottia longispina</i> (Kellicott, 1879)	<i>Lecane nana</i> (Murray, 1913)
<i>Keratella cochlearis</i> (Gosse, 1851)	<i>Lecane obtusa</i> (Murray, 1913)
<i>Keratella quadrata</i> (Müller, 1786)	<i>Lecane opias</i> (Harring & Myers, 1926)
<i>Keratella tropica</i> (Apstein, 1907)	<i>Lecane scutata</i> (Harring & Myers, 1926)
<i>Keratella valga</i> (Ehrenberg, 1834)	<i>Lecane sympoda</i> Hauer, 1929
<i>Notholca acuminata</i> (Ehrenberg, 1832)	
<i>Notholca labis</i> Gosse, 1887	Family: Lepadellidae
<i>Notholca squamula</i> (Müller, 1786)	<i>Colurella adriatica</i> Ehrenberg, 1831
<i>Notholca striata</i> (Müller, 1786)	<i>Colurella colurus</i> (Ehrenberg, 1830)
<i>Platyias quadricornis</i> (Ehrenberg, 1832)	<i>Colurella obtusa</i> (Gosse, 1886)
	<i>Colurella uncinata</i> (Müller, 1773)
Family: Dicranophoridae	<i>Lepadella (Lepadella) biloba</i> Hauer, 1958
<i>Encentrum cf. putorius</i> Wulfert, 1936*	<i>Lepadella (Lepadella) costata</i> Wulfert, 1940
<i>Dicranophoroides caudatus</i> (Ehrenberg, 1834)	<i>Lepadella (Lepadella) eurysterna</i> Myers, 1942

Lepadella (Lepadella) ovalis (Müller, 1786)
Lepadella (Lepadella) patella (Müller, 1773)
Lepadella (Lepadella) punctata Wulfert, 1939
Lepadella (Lepadella) quadricarinata
 (Stenroos, 1898)
Lepadella (Lepadella) triptera (Ehrenberg,
 1832)
Squatinella rostrum (Schmarda, 1846)

Family: Mytilinidae

Lophocharis salpina (Ehrenberg, 1834)

Family: Notommatidae

Cephalodella catellina (Müller, 1786)
Cephalodella forfi cula (Ehrenberg, 1830)
Cephalodella gibba (Ehrenberg, 1830)
Cephalodella maior (Zawadovsky, 1926)
Cephalodella misgurnus Wulfert, 1937
Cephalodella plicata Myers, 1924
Cephalodella stenroosi Wulfert, 1937
Cephalodella ventripes (Dixon-Nuttall, 1901)*
Monommata actices Myers, 1930
Monommata longiseta (Müller, 1786)
Notommata aurita (Müller, 1786)
Notommata copeus Ehrenberg, 1834
Notommata glyphura Wulfert, 1935*
Pleurotrocha petromyzon (Ehrenberg, 1830)

Family: Proalidae

Proales minima (Montet, 1915)*
Proales theodora (Gosse, 1887)

Family: Scaridiidae

Scaridium longicaudum (Müller, 1786)

Family: Synchaetidae

Polyarthra dolichoptera Idelson, 1925
Polyarthra remata Skorikov, 1896
Polyarthra vulgaris Carlin, 1943
Synchaeta oblonga Ehrenberg, 1832
Synchaeta pectinata Ehrenberg, 1832
Synchaeta stylata Wierzejski, 1893
Synchaeta vorax Rousselet, 1902

Family: Trichocercidae

Trichocerca cylindrica (Imhof, 1891)
Trichocerca elongata (Gosse, 1851)
Trichocerca longiseta (Schrank, 1802)

Trichocerca myersi (Hauer, 1931)
Trichocerca porcellus (Gosse, 1851)
Trichocerca pusilla (Jennings, 1903)
Trichocerca stylata (Gosse, 1851)
Trichocerca tenuior (Gosse, 1886)*

Family: Trichotriidae

Trichotria pocillum (Müller, 1776)*
Trichotria tetractis (Ehrenberg, 1830)

Order: Flosculariaceae

Family: Conochilidae

Conochilus (Conochiloides) dossuarius
 Hudson, 1885
Conochilus (Conochilus) hippocrepis
 (Schrank, 1803)

Family: Flosculariidae

Floscularia ringens (Linnaeus, 1758)
Ptygura furcillata (Kellcott, 1889)
Sinantherina semibullata (Th orpe, 1893)

Family: Hexarthridae

Hexarthra intermedia (Wiszniewski, 1929)
Hexarthra mira (Hudson, 1871)
Hexarthra oxyuris (Sernov, 1903)
Hexarthra polyodonta (Hauer, 1957)

Family: Testudinellidae

Testudinella incisa (Ternetz, 1892)
Testudinella mucronata (Gosse, 1886)
Testudinella parva (Ternetz, 1892)
Testudinella patina (Hermann, 1783)

Family: Trochosphaeridae

Filinia limnetica (Zacharias, 1893)
Filinia terminalis (Plate, 1886)*

Order: Collothocacea

Family: Collothecidae

Collotheca heptabrachiata (Schoch, 1869)
Collotheca ornata (Ehrenberg, 1832)
Collotheca pelagica (Rousselet, 1893)
Stephanoceros fimbriatus (Goldfusz, 1820)

Table 3. List of new records, sites and temperature in which they are found, and Repository and Catalog Numbers.

	Site I	Site II	Site III	Site IV	Temp	Catalog Numbers
<i>Cephalodella ventripes</i>	+			+	4. 3-13. 3	ZUTC Rot 1011
<i>Dicranophorus forcipatus</i>	+			+	7. 2-9. 1	ZUTC Rot 1023-1024
<i>Dicranophorus. luetkeni</i>	+				8. 2	ZUTC Rot 1025
<i>Encentrum cf. putorius</i>	+			+	7. 8-13. 9	ZUTC Rot 1026
<i>Filinia terminalis</i>	+	+	+	+	6. 1-12. 7	
<i>Notommata glyphura</i>	+			+	4. 7	ZUTC Rot 1012-1013
<i>Proales minima</i>	+			+	10. 2-16. 5	ZUTC Rot 1021-1022
<i>Trichocerca tenuior</i>	+				7. 8-14. 4	
<i>Trichotria pocillum</i>				+	8. 9	ZUTC Rot 1045

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