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SHORT COMMUNICATION KISA MAKALE

A new oligochaeta record for Türkiye, *Rhyacodrilus falciformis* Bretscher, 1901 (Annelida: Naididae: Rhyacodrilinae)

Türkiye Oligochaeta faunası için yeni kayıt, *Rhyacodrilus falciformis* Bretscher, 1901 (Annelida: Naididae: Rhyacodrilinae)

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Abstract: The aim of this paper is to contribute to the aquatic Oligochaeta fauna of Türkiye. The study area selected for this research is Karasu Stream, located in the Black Sea Region of Türkiye, in the province of Sinop. Benthic macroinvertebrate samples were collected on a monthly basis between February 2013 and January 2014 from 10 selected stations in the study area. As a result of the study, *Rhyacodrilus falciformis* Bretscher, 1901 is reported as a new record for the Oligochaeta fauna of Türkiye. Besides being recognized as a new record species, this record also extends the species' distribution area to the Asian part of Türkiye. Additionally, this study provides detailed information on the biological, ecological, and morphometric characteristics, as well as the distribution of *R. falciformis*, identified as a new record for the fauna of Türkiye.

Keywords: Oligochaeta, Rhyacodrilinae, new record, Karasu Stream, Sinop, Türkiye

Öz: Bu makalenin amacı, Türkiye'nin sucul Oligochaeta faunasına katkıda bulunmaktır. Bu araştırma için seçilen çalışma alanı, Türkiye'nin Karadeniz Bölgesi'nde, Sinop ilinde bulunan Karasu Çayı'dır. Bentik makroomurgasız örnekleri, Karasu Çayı'nda 10 istasyondan Şubat 2013 ile Ocak 2014 arasında aylık olarak toplanmıştır. Araştırma alanında tespit edilen, *Rhyacodrilus falciformis* Bretscher, 1901, Türkiye'den ilk kez bildirilmektedir. Türkiye Oligochaeta faunası için yeni kayıt olarak tanınmasının yanı sıra, bu araştırma ile türün dağılım alanı Türkiye'nin Asya kısmına kadar genişlemektedir. Ayrıca, bu çalışma, Türkiye faunası için yeni bir kayıt olarak tanımlanan *R. falciformis*'in biyolojik, ekolojik ve morfometrik özellikleri ile dağılımı hakkında detaylı bilgiler de sağlamaktadır.

Anahtar kelimeler: Oligochaeta, Rhyacodrilinae, yeni kayıt, Karasu Çayı, Sinop, Türkiye

INTRODUCTION

The Oligochaeta order in freshwater ecosystems comprises approximately 1100 known species (Martin et al., 2008). The family Naididae is one of the most significant groups of aquatic Oligochaeta. Rhyacodrilinae is a subfamily within the family Naididae, and its representatives are commonly found in rivers and marine environments. The genus Rhyacodrilus, now placed in the family Naididae from Tubificidae, is a cosmopolitan and large genus (Ohtaka, 1995). There have been 54 valid species of *Rhyacodrilus* identified worldwide (Martin et al., 2023). Globally, 20 genera are recognized within this subfamily (Martin et al., 2023).

However, from Türkiye, only five species belonging to this subfamily have been reported so far: *R. coccineus* (Vejdovsky 1876) in Gümüş River by Öntürk and Arslan (2003); in Tunca River by Çamur-Elipek et al. (2006); in Balıkdamı Wetland by Arslan et al. (2007); in Lake Uluabat by Kökmen et al. (2007); in Porsuk River and in the Trace Region by Arslan and İlhan (2010); in Trace Region-Taş et al. (2012); in Tuzla Stream by Odabaşı et al. (2018); *Branchiura sowerbyi* Beddard, 1892 in Buldan Dam Lake by Balık et al. (2004); *Monopylephorus irroratus* (Verrill, 1873) in Hazar Lake by Şahin and Baysal (1972); *Epirodrilus moubayedi* Giani and Martinez-Ansemil (1981) in Balıkdamı Wetland by Arslan et al. (2007); and *Bothrioneurum vejdovskyanum* Stolc, 1886 in Karamenderes Stream by Odabaşı et al. (2017) have been reported from different parts of Türkiye.

The objective of this study is to report *R. falciformis* Bretscher, 1901 as a new record for the Oligochaeta fauna of Türkiye. In addition, this record also contributes to the knowledge of the species distribution by extending its range to the Asian part of Türkiye.

MATERIALS AND METHODS

Between February 2013 and January 2014, samples were collected from 10 stations in Karasu Stream, located in the Black Sea Region of Türkiye, at monthly intervals (Figure 1).

The kick sampling method was used to collect zoobenthic

samples from a 1 m² area at each station, with a 5-minute collection standard (kick-net mesh size: 180 µm) (Letovsky et al., 2012). After fixing the samples with 4% formaldehyde in the study area, they were transported to the laboratory and washed again through a 180 µm sieve. Oligochaeta samples separated from the debris were preserved in 70% alcohol with CMCP 10 solution for identification. Species identification was carried out using Timm's (1999 and 2009) keys.

Digital photos of the species were taken using a digital camera (Camedia, C-7070, Olympus) connected to compound and stereo microscopes. The specimens are housed in the Museum of the Faculty of Fisheries, Ege University. All measurements are given in parentheses.

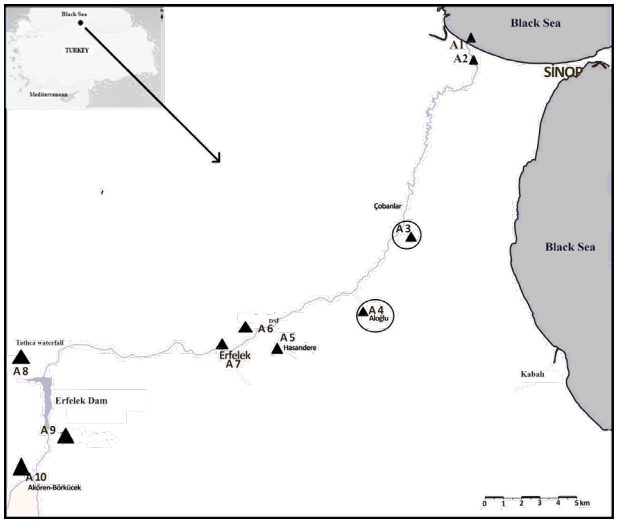

Figure 1. Sampling stations and map of the study area (Çil et al., 2021)

RESULTS

As a result of the samplings, *R. falciformis* was found at only two stations (Stations A3 and A4) (Figure 2, Figure 3).

Figure 2. Station 3 (A3)

Figure 3. Station 4 (A4)

The ecological, biological, and morphometric characteristics, as well as the distribution, of the Oligochaeta species determined as a new record for the fauna of Türkiye are explained in detail below.

Rhyacodrilus falciformis Bretscher, 1901 (Figure 4 and 5)

Material

A total of 15 specimens were obtained, and they were found only at two stations in the study area (Station 3=A3: Karasu Stream 41°57'59.24"N, 35°01'26.45"E, and Station 4=A4: Tributary of Karasu 41°54'45.10"N, 34°59'33.17"E) (Figure 1). One individual was obtained from Station 3 in February, while 11 were collected from Station 4 in February and 1 in March.

Description

Total length = 8-10 mm, Number of segments = 38-48

The anterior and posterior locomotory chaetae are similar, with upper teeth 2-6 in anterior bundles and 1-2 in posterior bundles, measuring 72-81 µm in length. Near the male pores (XI), single large sickle-shaped penial chaetae are usually hidden inside the body with a simple tip, measuring 94-148 µm in length and 12-14 µm in thickness. The presence of abundant large coelomocytes in the body cavity gives the living worm a white color, similar to enchytraeids (Timm, 1999).

Diagnosis

Total length = 5.75-9.25 mm, Number of segments = 31-45

The anterior and posterior locomotory chaetae are similar, with upper teeth 2-6 in anterior bundles and 1-2 in posterior bundles, measuring 57.5 µm-61 µm in length. Near the male pores (XI), single large sickle-shaped penial chaetae are usually hidden inside the body with a simple tip, measuring 96-117 µm in length and 18.5 µm-22.5 µm in thickness.

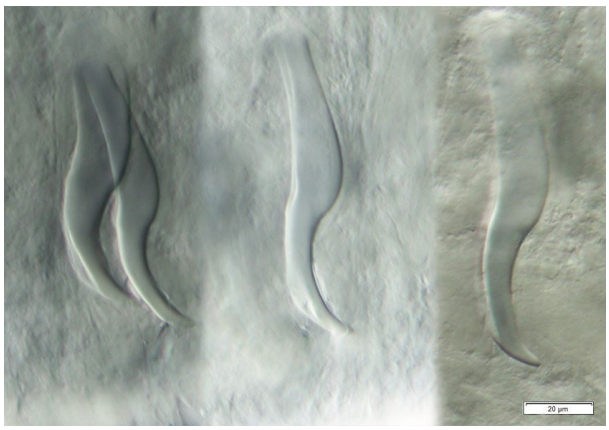

Figure 4. *Rhyacodrilus falciformis*, genital area (XI. ventral segment) showing large modified penial setae

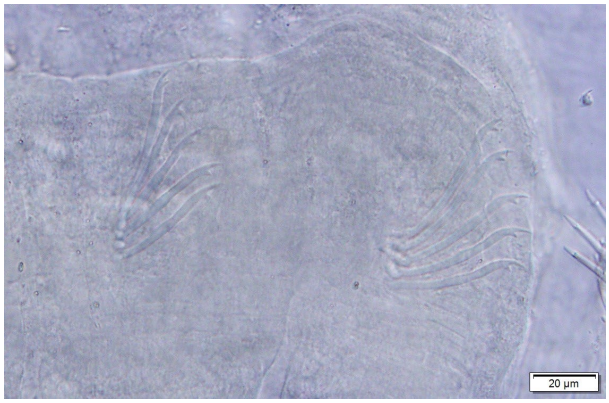

Figure 5. *Rhyacodrilus falciformis*, anterior dorsal setae III-IV with distinct longer distal tooth

Differential characteristics

R. falciformis shows similarities with *Bothrioneurum vejdovskyanum* Štolc, 1886, but *B. vejdovskyanum* bears sensory prostomial pits and only the foremost chaetae have considerably longer upper teeth, while the teeth become progressively equal in subsequent preclitellar segments.

The sickle-shaped penial setae of this species are a distinctive feature. A similar species described from France (*R. pigueti*) has larger penial chaetae of 150 µm and is more straight compared to the sickle-shaped penial chaetae of *R. falciformis* (Martinsson et al., 2013).

In this study, the penial setae of *R. falciformis* vary in length from 96-117 µm, which falls within the normal range for this species (100-140 µm: Martinsson et al., 2013).

Although penial setae are normally between 94-148 µm long (Kasprzak, 1979, 1981; Timm, 2009), Martin and Boughrous (2012) have shown penial setae of approximately 175 and 200 µm (Table 1).

Environment

This species can be found in groundwater, springs, clean lakes, and in soil (van Haaren, 2002).

Habitat

R. falciformis in habits freshwater. Karasu Stream originates in Boyabat district, passes along through Erfelek town (Sinop Province) and pours into the Black Sea (Figure 1). This approximately 80 km long stream provides drinking water to the surrounding settlement areas together with the Erfelek Dam.

Station 3 (A3): This stream, which passes through the middle of a village surrounded by forest, is closely associated with agricultural activities and animal husbandry. The water flow rate at this station shows significant changes throughout the year. The bottom structure of the stream consists of stones, gravel, and sand.

Station 4 (A4): This station has a rich riparian zone and merges with the Karasu Stream. The main source of pollution at this station is the domestic waste discharged from nearby settlement areas.

Distribution

Europe, possibly introduced in North America (Timm, 2009).

Table 1. Penial setae lengths according to literature

References	Region	Length penial chaetae (µm)
Piguet (1906) as *R. lemani*	Lake Geneva	124
Michaelsen (1908) as *Taupodrilus lemani*	Germany	116
Piguet and Bretscher (1913); Piguet (1913)	Switzerland	138
Hrabě (1935)	Bohemia and Moravia	117.6
Čhekanovskaya (1962); Brinkhurst (1963)	Europe	138
Hrabě (1981)	Czech Rep	128-140
Kasprzak (1979, 1981)	Poland	94-148
Timm et al. (1996)	Sweden	100-122
Martin and Boughrous (2012)	Maghreb	~175 (fig no 58C) and ~200um (fig no 58D)
Unpublished measurements (van Haaren, T.)	Netherlands	100-130 (n=7)
This study	Türkiye	(78-)96-117

DISCUSSION

The main distribution area of *R. falciformis* is in Central Europe (van Haaren, 2002) (Figure 6).

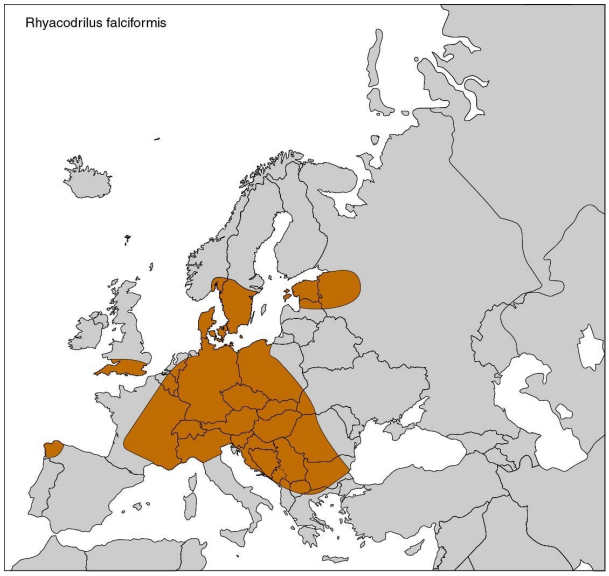

Figure 6. Distribution map of *Rhyacodrilus falciformis* Bretscher, 1901 in Europe (van Haaren, 2002).

R. falciformis Bretscher, 1901, is a rarely encountered groundwater species. This genus was first described in 1900 from materials collected from the Swiss Alps (Bretscher, 1901). Subsequently, it was rediscovered from samples collected at Geneva Lake in France (Juget, 1967) and from the Pieniny Mountains in the southern part of Poland (Kasprzak, 1979). According to van Haaren (2002), the distribution of *R. falciformis* in Europe is as follows:

Records of *R. falciformis* are from the following locations: Holland (Verdonschot et al., 1992), Susaa River in Denmark (Berg, 1948), source of the Fulda River, and Schlei in Germany (Wachs, 1967; von Bülow, 1957), Vättern Lake in Sweden (Brinkhurst and Jamieson, 1971), Geneva Lake in Switzerland (Brinkhurst, 1964; Brinkhurst and Jamieson, 1971), South Dorset in England (Ladle and Bird, 1980), Jantra and Struma rivers in Bulgaria (Uzunov and Kapustina, 1993), Tambre River and Porto do Cabo in the Iberian Peninsula (Martínez-Ansemil and Giani, 1980; Martínez-Ansemil, 1984; Martínez-Ansemil and Collado, 1996), source of the Adige basin in Italy (Di Chiara Paoletti and Sambugar, 1996), Estonia (Timm, 1999), Dyje River in Czechoslovakia (Wolgemuth and Schenkova, 1999), Poland (Dumnicka, 2001), and various locations in France including Annecy Lake, Argens River (l'Eau Salée), Geneva Lake, and the (subterranean) underflow of the upper Rhône, as well as the southern and western foothills of the Carpathian mountains in caves along the Hungarian/Slovakian border (Brinkhurst and Jamieson, 1971; Giani and Martinez-Ansemil, 1981; Juget, 1984; IUCN, 1998; Dumnicka, 2001). There are also records from Scandinavia (Milbrink, 1978) and Norway (Bremnes and Sloreid, 1994) and in Magnesian Limestone Plateau of County Durham, UK (Standen et al., 2009). Recently, Martinsson et al. (2013) described a slightly different new species from France, *R. pigueti* sp. n., and successfully distinguished it from *R. falciformis* using DNA barcoding, based on the shape of the penial chaetae. In *R. falciformis,* the penial chaetae are sickle-shaped, while in the new species, they are straight and somewhat spoon-shaped.

In North America, *R. falciformis* is extremely rare. According to Timm (2009), this species was possibly introduced to North America. It was first recorded from Airport Creek in British Columbia (Brinkhurst, 1978), and since then, it has been documented from Cascade Cave (Vancouver Island), the Hudson River in New York, Fraction Run in Illinois, and Montana (Brinkhurst, 1986; Wetzel, 1992; Kathman and Brinkhurst, 1998). The collection of *R. falciformis* from Mystery Cave expands its range southward and is the second report of this species from a cave in North America (Wetzel and Taylor, 2001).

Apart from the distribution of *R. falciformis* in these continents, Martin and Boughrous (2012) reported that *R. falciformis* has also been collected in the upper courses of the Oued Aïssi River in Algeria by Lounaci (1987).

CONCLUSION

Numerous studies have been conducted on freshwater oligochaeta species in different regions of Türkiye, yet to date; there have been no verified records of the stygophilous species *R. falciformis*. With this study, it has been confirmed that the distribution of *R. falciformis* extends to the Asian part of Türkiye. Ongoing research on the oligochaeta fauna in Türkiye is expected to yield more records regarding the distribution of this species and other oligochaeta species that were previously unrecorded in the country's biodiversity records.

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AUTHOR'S CONTRIBUTION

Melek Zeybek Yünlü, Eylem Aydemir Çil and Seray Yıldız conceived the idea and developed the experimental protocol. Seray Yıldız and Ton van Haaren have organized the assignments and data related to the species. All authors contributed critically to the draft and gave the final approval for publication.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ETHICS APPROVAL

No specific ethical approval was necessary for this study.

DATA AVAILABILITY

The data supporting the conclusions of this paper are available in the main paper.

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