



## AQUATIC DANCE FLIES (DIPTERA, EMPIDIDAE: CLINOCERINAE, HEMERODROMIINAE) OF THE RIVER CETINA

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The aquatic dance fly fauna on the Cetina River was investigated between May and September 2005 and during March and April 2006. Samples were collected with an aspirator and by hand netting at 8 different locations through the whole stream flow of the Cetina River and at the springs of three tributaries (Sveti Spas spring, spring of Ruda River and spring of Grab River). The purpose of the research was to investigate the diversity of the aquatic dance flies (Diptera, Empididae) and to determine which locality had the greatest species richness. Twenty species of aquatic dance flies from 6 different genera were recorded. Four genera belong to the subfamily Clinocerinae (*Clinocera*, *Dolichocephala*, *Kowarzia*, *Wiedemannia*) and two genera to the subfamily Hemerodromiinae (*Hemerodromia*, *Chelifera*). Radmanove mlinice, near the mouth of the river Cetina into the Adriatic Sea was the most species-rich site.

**Key words:** aquatic Empididae, fauna, Cetina River, Croatia

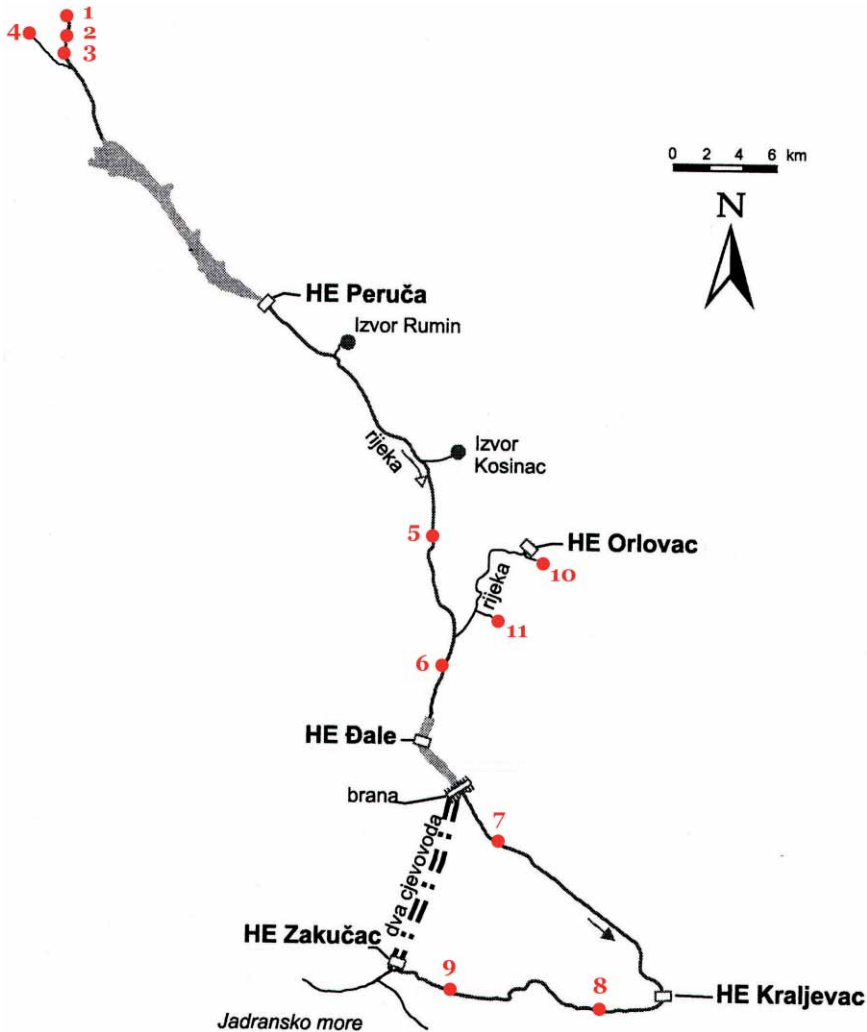
**Ivković, M. & Horvat, B.: Vodene muhe plesačice (Diptera, Empididae: Clinocerinae, Hemerodromiinae) rijeke Cetine. Nat. Croat., Vol. 16, No. 3., 171–179, 2007, Zagreb.**

Istraživanje faune vodenih muha plesačica rijeke Cetine rađeno je tijekom svibnja, lipnja, srpnja, kolovoza i rujna 2005. godine i tijekom ožujka i travnja 2006. godine. Uzorci su sakupljeni aspiratorom i entomološkom mrežicom na 8 različitim lokacija na cijelom toku rijeke Cetine te na izvorima triju pritoka, Izvor Sveti Spas, te izvori rijeka Rude i Grab. Cilj istraživanja je bio ustanoviti raznolikost skupine vodenih muha plesačica (Diptera, Empididae) i utvrditi koja od istraživanih lokacija ima najveći broj zabilježenih vrsta. Unutar dvije potporodice zabilježeno je 20 vrsta iz 6 različitih rodova, 4 roda pripadaju potporodici Clinocerinae (*Clinocera*, *Dolichocephala*, *Kowarzia*, *Wiedemannia*) i 2 roda pripadaju potporodici Hemerodromiinae (*Hemerodromia*, *Chelifera*). Lokacija sa najvećim brojem vrsta je lokacija Radmanove mlinice blizu samoga ušća rijeke Cetine u Jadransko more.

**Ključne riječi:** vodene Empididae, fauna, rijeka Cetina, Hrvatska

## INTRODUCTION

The Cetina is the longest river in middle Dalmatia. From the spring to its mouth into the Adriatic Sea the river is 105 km long. The spring Glavaš of the Cetina River is situated at 375 meters above mean sea level. On the river there are 5 hydro-electric power stations (Peruča, Zakučac, Đale, Kraljevac and Orlovac on the River Ruda).



**Fig. 1.** Map of the researched area; localities are marked with spots and numbers beside them. (1) The main spring Glavaš; (2) Preočki most; (3) Crveni most; (4) Spring Sveti Spas; (5) Sinjski Obrovac; (6) Trilj; (7) Čikotina lađa; (8) Pavića most; (9) Radmanove mlinice; (10) Spring of the River Ruda; (11) Spring of the River Grab.

The climate in the upper flow is Continental and in lower flow is Mediterranean, with a mean yearly temperature of 6.9 °C in the northeast upper flow and 12.4 °C in the southwest lower flow. The underlying geology largely comprises carbonate beds from the Triassic, Jurassic and Cretaceous (CRA/PPA 2000).

Aquatic dance flies (Empididae: Clinocerinae, Hemerodromiinae) are taxonomically heterogeneous but share common ecological features. The larvae of both subfamilies live and feed in water while the adults live and feed above the water. Larvae and adults are both predators (WAGNER, 1997).

This research was conducted because very little is known about the aquatic dance flies of the Cetina River (HORVAT, 1990). The objective of our work was to determine which species of aquatic dance flies are found there.

## MATERIAL AND METHODS

Aquatic empidids were collected during May, June, July, August, September of 2005, and during March and April 2006, once a month. Altogether 11 locations were studied, 8 of them are situated on the Cetina River, and 3 of them are the springs of tributary rivers of the Cetina: the main spring Glavaš (1) of the Cetina River, Preočki most (2), Crveni most (3) and the small spring Sveti Spas (4) which is situated near the main spring Glavaš of the Cetina River. These locations are all approximately 3 km from each other in the upper flow of the Cetina River. Locations Sinjski Obrovac (5), Trilj (6) are situated in the middle flow and locations Čikotina lađa (7), Pavića most (8) and Radmanove mlinice (9) are situated in the lower flow of the Cetina River, as well as the Spring of Ruda River (10) and the Spring of its tributary, the Grab River (11) (Fig. 1). Locations Sinjski Obrovac (5), Trilj (6) and Pavića most (8) were visited only once during the study.

Adult flies were collected with an aspirator or by using a sweeping net and preserved in 80% alcohol. Genitalia were dissected for the purpose of determination. The abdomens with the genitalia were removed and boiled in potassium hydroxide then transferred to a mixture of acetic acid and clove oil and finally placed in a small dish with glycerin for examination with a Zeiss Semi 2000-C microscope. Identification and nomenclature followed that of ENGEL (1938–1946), COLLIN (1961), HORVAT (1993b), MANDARON (1964), CHVÁLA & WAGNER (1989).

Cluster analysis was conducted using Primer 5.

## RESULTS

A total of 3357 specimens (1585 ♂♂, 1772 ♀♀) were collected and 20 species were determined. The species were classified in 2 subfamilies, 6 genera and 5 subgenera. Among the species determined 7 belong to the subfamily Hemerodromiinae and 13 to the subfamily Clinocerinae.

## HEMERODROMIINAE

Genus *Chelifera*

*Chelifera precabunda* Collin, 1961

*Chelifera precatorea* (Fallén, 1816)

*Chelifera siveci* Wagner, 1984

*Chelifera stigmatica* (Schiner, 1862)

Genus *Hemerodromia*

*Hemerodromia melangyna* Collin, 1927

*Hemerodromia oratoria* (Fallén, 1816)

*Hemerodromia unilineata* Zetterstedt, 1842

## CLINOCERINAE

Genus *Clinocera*

*Clinocera stagnalis* (Haliday, 1833)

Genus *Kowarzia*

*Kowarzia barbatula* Mik, 1880

*Kowarzia bipunctata* (Haliday, 1833)

Genus *Dolichocephala*

*Dolichocephala guttata* (Haliday, 1833)

*Dolichocephala irrorata* (Fallén, 1815)

*Dolichocephala ocellata* (Costa, 1854)

Genus *Wiedemannia*

*Wiedemannia (Chamaedipsia) ariadne* Wagner, 1981

*Wiedemannia (Chamaedipsia) aequilobata* Mandaron, 1964

*Wiedemannia (Eucelidia) zetterstedti* (Fallén, 1826)

*Wiedemannia (Philolutra) kacanskae* Horvat, 1993

*Wiedemannia (Pseudowiedemannia) lamellata* (Loew, 1869)

*Wiedemannia (Wiedemannia) bistigma* (Curtis, 1834)

*Wiedemannia (Wiedemannia) tricuspudata* (Bezzi, 1905)

The highest species richness was recorded at Radmanove mlinice (9) where 10 species were recorded (Tab. 1). Some of the localities which had the lowest number of species (Sinjski Obrovac (5), Trilj (6) and Pavića most (8)) were only visited once, so their species richness is likely to have been under-recorded.

A cluster analysis was acquired by calculating Bray-Curtis similarity and group average linkage method was used. Cluster analysis revealed similarities and differences in the faunistic composition of the assemblages between sampling sites (Fig. 2). It is very obvious that the sites from the upper flow of the Cetina River clustered

**Tab. 1.** Presents of aquatic dance flies at the studied sites.

Species / Location	1	2	3	4	5	6	7	8	9	10	11
<i>Chelifera precabunda</i> Collin, 1961	•	•	•	•							
<i>Chelifera preclatoria</i> (Fallén, 1816)		•	•	•						•	
<i>Chelifera siveci</i> Wagner, 1984	•		•								•
<i>Chelifera stigmatica</i> (Schiner, 1862)				•							
<i>Hemerodromia melangyna</i> Collin, 1927							•				
<i>Hemerodromia oratoria</i> (Fallén, 1816)							•				
<i>Hemerodromia unilineata</i> Zetterstedt, 1842							•	•	•		
<i>Clinocera (Hydrodromia) stagnalis</i> (Haliday, 1833)	•			•	•	•		•	•	•	•
<i>Kowarzia barbatula</i> Mik, 1880									•	•	
<i>Kowarzia bipunctata</i> (Haliday, 1833)		•								•	•
<i>Dolichocephala guttata</i> (Haliday, 1833)		•					•	•	•		
<i>Dolichocephala irrorata</i> (Fallén, 1815)									•		
<i>Dolichocephala ocellata</i> (Costa, 1854)									•		
<i>Wiedemannia (Chamaedipsia) ariadne</i> Wagner, 1981		•	•							•	
<i>Wiedemannia (Chamaedipsia) aequilobata</i> Mandaron, 1964	•	•	•	•							
<i>Wiedemannia (Eucelidia) zetterstedti</i> (Fallén, 1826)	•	•	•				•		•	•	•
<i>Wiedemannia (Philolutra) kacanskae</i> Horvat, 1993	•	•	•							•	
<i>Wiedemannia (Pseudowiedemannia) lamellata</i> (Loew, 1869)									•	•	
<i>Wiedemannia (Wiedemannia) bistigma</i> (Curtis, 1834)	•	•	•		•		•		•	•	•
<i>Wiedemannia (Wiedemannia) tricuspadata</i> (Bezzi, 1905)								•	•		

with the springs of Ruda River (10) and Grab River (11). This was an expected result because the physical and chemical characteristics, especially temperature, are relatively the same during the year at the different sites. The only clustering that differed slightly from expectation is at Pavića most (8) which is on the lower flow of Cetina River and was expected to cluster with locations from lower flow, Čikotina lađa (7) and Radmanove mlinice (9). The reason that it does not cluster is most likely sampling bias as that location was sampled only once, in September, while the other locations in the lower flow were sampled during all the sampling months.

Among 3357 collected specimens, the most-represented species was *Wiedemannia (Wiedemannia) bistigma* (accounting for 2131 (885 ♂♂, 1246 ♀♀) or 63,48% of the total sample). The species was recorded at almost every location from the spring Glavaš of the Cetina (1) to Radmanove mlinice (9) which is only 6 km from the mouth into the Adriatic Sea. The locality with the largest number of caught specimens, the

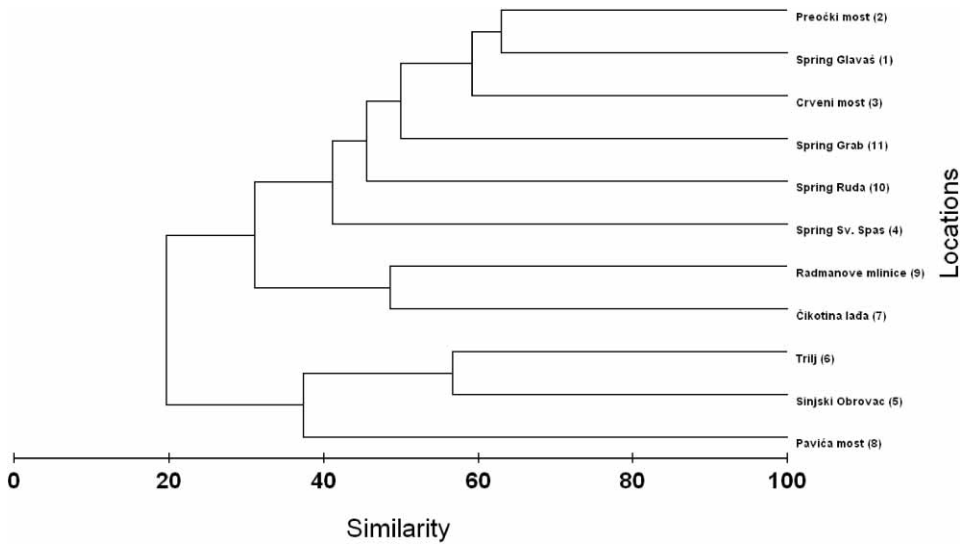


Fig. 2. Cluster analyses of the locations on the basis of fauna composition.

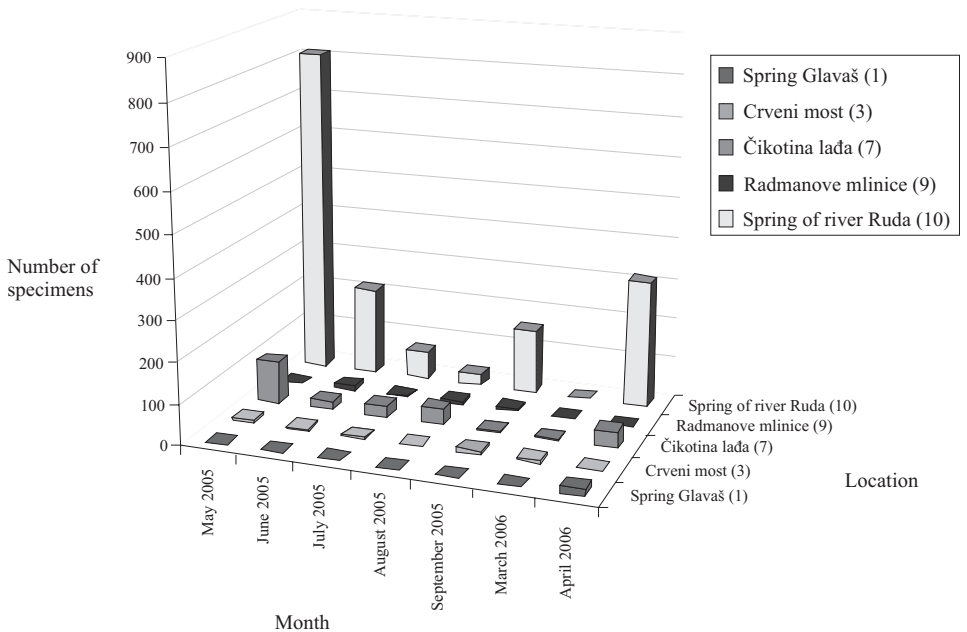


Fig. 3. Fluctuation in the number of the species *Wiedemannia (Wiedemannia) bistigma* at the localities investigated.

spring of River Ruda (10), where 1587 (670 ♂♂, 917 ♀♀) specimens were collected. The number of *Wiedemannia (Wiedemannia) bistigma* caught fluctuated throughout the study period (Fig. 3). Fluctuations in abundance were recorded during the sampling period but are difficult to interpret on account of uneven sampling effort. Despite this, two very clear peaks of abundance were evident and were interpreted as evidence of spring and autumn generations.

## DISCUSSION

Previously, only 13 species of aquatic dance flies were recorded in Croatia (BECKER, 1889; HORVAT, 1990, 1993a; SIVEC & HORVAT, 2002; WAGNER, 1981, 1995). Our research has found a further 11 species: *Kowarzia barbatula* Mik, 1880, *Kowarzia bipunctata* (Haliday, 1833), *Dolichocephala guttata* (Haliday, 1833), *Dolichocephala irrorata* (Fallén, 1815), *Dolichocephala ocellata* (Costa, 1854), *Wiedemannia (Chamaedipsia) ariadne* Wagner, 1981, *Wiedemannia (Chamaedipsia) aequilobata* Mandaron, 1964, *Wiedemannia (Eucelidia) zetterstedti* Fallén, 1826, *Wiedemannia (Philolutra) kacanskae* Horvat, 1993, *Wiedemannia (Wiedemannia) bistigma* (Curtis, 1834) and *Wiedemannia (Wiedemannia) tricuspida* (Bezzi, 1905).

*Wiedemannia (Wiedemannia) bistigma* was unequivocally the most abundant. Fluctuation in numerical abundance was demonstrated with two peaks associated with two generations during the year; the spring generation is numerically much greater than the autumn generation. *W. (W.) bistigma* was not recorded on Balkan Peninsula for 108 years (STROBL, 1898), and this is its second record for Balkan peninsula.

One more interesting finding was the species *Wiedemannia (Philolutra) kacanskae*, which was recorded only at locations in the upper flow of the river Cetina (spring Glavaš, Preočki most and Crveni most) and at the spring of Ruda River where the physical and chemical characteristics are relatively the same during the year. To date this species was known only from two locations in middle Bosnia (HORVAT, 1993b) and this is the first record from elsewhere.

In reviewing accessible references we have found few recorded data (HORVAT, 1990) on aquatic dance flies for the Cetina River. This is first list of aquatic dance flies for the Cetina River and the first such list for Croatia as well.

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## REFERENCES

- BECKER, T., 1889: Neue Dipteren aus Dalmatien. *Berliner Entomologische Zeitschrift*, **33**, 335–346.
- CHVÁLA, M. & WAGNER, R., 1989: Empididae. In: SOOS, A. & PAPP, L. (eds.), *Catalogue of Palaearctic Diptera*, Bd 6. Akademiai Kiado and Elsevier Science publ., Budapest-Amsterdam, p. 313–314.
- COLLIN, J. E., 1961: British Flies: Empididae: Empidinae (Part) and Hemerodrominae. Part III., At the University Press, Cambridge, p. 713–724.
- CRA/PPA, 2000: Riječni sliv i pripadajuće obalno područje rijeke Cetine: Ekološki socio-ekonomski profil. Centar za regionalne aktivnosti Programa prioritetnih akcija, Split, p. 1–165.
- ENGEL, E. O., 1938–1946: 28. Empididae. In: LINDER, E. (eds.), *Die Fliegen der palaearktischen Region*, Bd 4(4), E. Schweizerbart'sche Verlagsbuchhandlung (Erwin Nägele), Stuttgart, p. 1–399.
- HORVAT, B., 1990: Aquatic Dance Flies of the Subfamily Hemerodrominae (Diptera: Empididae) in Yugoslavia. *Scopolia*, **20**, 1–27.
- HORVAT, B., 1993a: A New *Hemerodromia* Species from Submediterranean Slovenia and Croatia (Diptera, Empididae: Hemerodromiinae). *Aquatic Insects*, **15**(4), 229–231.
- HORVAT, B., 1993b: Aquatic Empididae Fauna (Diptera) in Bosnia and Herzegovina. *Scopolia*, **28**, 1–25.
- MANDARON, P., 1964: Un nouveau Diptère récolté en Dauphiné *Wiedemannia (Chamaedipsia) aequilobata* n. sp.. *Trav. Lab. Hydrobiol. Piscic. Univ. Grenoble.*, **56**, 81–84.
- SIVEC, I. & HORVAT, B., 2002: Vrbnice (Plecoptera) in vodne muhe poplesovalke (Diptera, Empididae) reke Dragonje. *Varstvo narave*, **19**, 53–58.
- STROBL, G., 1898: Fauna Diptera Bosne, Hercegovine i Dalmacije. *Glasnik Zemaljskog muzeja*, **14**, 461–517.
- WAGNER, R., 1981: Über einige Hemerodromiinae vom Balkan und aus der Ägäis. *Spixiana*, **4**(3), 297–304.
- WAGNER, R., 1995: Empididen aus dem Mittelmeerraum (Diptera, Empididae: Hemerodromiinae und Clinocerinae). *Acta Entomologica Slovenica*, **3**(1), 5–23.
- WAGNER, R., 1997: Diptera Empididae, Dance Flies In: NILSSON, A. (eds.), *Aquatic Insects of North Europe*. Stenstrup, p. 333–344.

## SAŽETAK

**Vodene muhe plesačice (Diptera, Empididae: Clinocerinae, Hemerodromiinae) rijeke Cetine**

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Istraživanje vodenih muha plesačica rijeke Cetine provedeno je tijekom svibnja, lipnja, srpnja i kolovoza 2005, i tijekom ožujka i travnja 2006. odrasle jedinke prikupljane su aspiratorom i entomološkom mrežicom na 8 različitih lokacija duž cijelog toka rijeke Cetine te na izvorima triju njenih pritoka, izvoru Sveti Spas, izvoru rijeke Rude te izvoru rijeke Grab. Postaje su bile: izvor Glavaš (1), Preočki most (2), Cr-



veni most (3), izvor Sveti Spas (4), Sinjski Obrovac (5), Trilj (6), Čikotina lađa (7), Pavića most (8), Radmanove mlinice (9), izvor rijeke Rude (10) i izvor rijeke Grab (11).

Svrha istraživanja bila je odrediti raznolikost faune vodenih muha plesačica (Diptera, Empididae: Clinocerinae, Hemerodromiinae) i ustanoviti na kojoj je od istraživanih postaja njihov broj najveći. Prikupljeno je ukupno 3357 primjeraka iz dvije potporodice te je ustanovljeno 20 vrsta iz 6 različitih rodova; 4 iz potporodice Clinocerinae (*Clinocera*, *Kowarzia*, *Wiedemannia*, *Dolichocephala*) i 2 iz potporodice Hemerodromiinae (*Hemerodromia*, *Chelifera*). Postaja s najvećim brojem vrsta su bile Radmanove mlinice (9) blizu ušća Cetine, gdje je zabilježeno 10 vrsta. Najbrojnija vrsta bila je *Wiedemannia (Wiedemannia) bistigma*, a najveći broj ulovljenih primjeraka bio je na izvoru rijeke Rude.

Od 20 ulovljenih vrsta, 11 ih je prvi puta zabilježeno za Hrvatsku: *Kowarzia barbatula* Mik, 1880, *Kowarzia bipunctata* (Haliday, 1833), *Dolichocephala guttata* (Haliday, 1833), *Dolichocephala irrorata* (Fallén, 1815), *Dolichocephala ocellata* (Costa, 1854), *Wiedemannia (Chamaedipsia) ariadne* Wagner, 1981, *Wiedemannia (Chamaedipsia) aequilobata* Mandaron, 1964, *Wiedemannia (Eucelidia) zetterstedti* Fallén, 1826, *Wiedemannia (Philotutra) kacanskae* Horvat, 1993, *Wiedemannia (Wiedemannia) bistigma* (Curtis, 1834) i *Wiedemannia (Wiedemannia) tricuspidata* (Bezzi, 1905).