

Unionicola species (Acari: Hydrachnidia: Unionicolidae) from Madagascar

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Abstract

From the material of a limnological expedition to Madagascar in 2001, and the MILLOT collection conserved at the Muséum national d'Histoire naturelle in Paris six new *Unionicola* species are described: *U. (Pentatax) ankaranaensis* **n. sp.**, *U. (Pentatax) concava* **n. sp.**, *U. (Pentatax) gereckeï* **n. sp.**, *U. (Pentatax) goldschmidtii* **n. sp.**, *U. (Pentatax) milloti* **n. sp.**, and *U. (Pentatax) rubromarginata* **n. sp.**; *U. (Pentatax) megalopsis* Viets, 1925 is recorded for the first time for Madagascar.

Lectotypes are designated for *U. (Pentatax) lyncea* (Koenike, 1895), and *U. (Unionicola) harpax* (Koenike, 1898). Additional morphological information is given for these two species and – based on type material – the following African species: *U. (Pentatax) digitata* (Koenike, 1898), *U. (Pentatax) postmarginata* Viets, 1925, and *U. (Unionicola) cyclophora* Viets, 1913. *U. (Pentatax) uncata* Viets, 1916 **n. syn.** is a junior synonym of *U. (Pentatax) lyncea*.

Key words: Acari, Hydrachnidia, *Unionicola*, Madagascar, taxonomy, new records, new species, new synonym, redescriptions, lectotypes.

Zusammenfassung

Aus dem Material einer limnologischen Madagaskar-Expedition 2001 und der Sammlung MILLOT des Muséum national d'Histoire naturelle in Paris werden sechs neue *Unionicola*-Arten beschrieben: *U. (Pentatax) ankaranaensis* **n. sp.**, *U. (Pentatax) concava* **n. sp.**, *U. (Pentatax) gereckeï* **n. sp.**, *U. (Pentatax) goldschmidtii* **n. sp.**, *U. (Pentatax) milloti* **n. sp.** und *U. (Pentatax) rubromarginata* **n. sp.**; *U. (Pentatax) megalopsis* Viets, 1925 wird erstmals für Madagaskar nachgewiesen.

Für *U. (Pentatax) lyncea* (Koenike, 1895) und *U. (Unionicola) harpax* (Koenike, 1898) werden Lectotypen festgelegt. Die Beschreibungen dieser beiden Arten werden ergänzt und das Typusmaterial der folgenden afrikanischen Arten behandelt: *U. (Pentatax) digitata* (Koenike, 1898), *U. (Pentatax) postmarginata* Viets, 1925 und *U. (Unionicola) cyclophora* Viets, 1913. *U. (Pentatax) uncata* Viets, 1916 **n. syn.** ist ein jüngeres Synonym von *U. (Pentatax) lyncea*.

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1 Introduction

Madagascar became an island about 100 million years ago, after it was first separated from the supercontinent Gondwana (and thus from Africa) together with India in the Early Cretaceous and then also separated from India in

the Late Cretaceous. Because of this long geological isolation flora and fauna are especially interesting, since many taxa are endemic, particularly those in the limnology field (ELOUARD & GIBON 2001).

Nevertheless, relatively little research has been done on water mites from Madagascar so far (K. VIETS 1953,

K. O. VIETS 1970), in fact GOLDSCHMIDT & GERECKE (2003) recorded only 53 species and one subspecies from there.

In this situation Prof. Dr. REINHARD GERECKE (Tübingen) and Dr. TOM GOLDSCHMIDT (Munich) organized a limnological expedition to Madagascar focused especially on freshwater mites. From July to December 2001 they collected over 14,000 water mites and in addition the material from 65 interstitial excavations (GOLDSCHMIDT & GERECKE 2003). Parts of this material has been investigated and published already: GERECKE (2004b, 2006, 2009), GOLDSCHMIDT (2008), TUZOVSKY & GERECKE (2009), TUZOVSKY et al. (2007). The collections of GERECKE & GOLDSCHMIDT had their main ecological focus on running waters and springs, not on the habitats that most of *Unionicola* species prefer. All 19 *Unionicola* specimens which were collected during this expedition (see Material and methods) in fact originated from pool-like stillwater reaches with nearly stagnant waters.

Furthermore, in MNHN there are also water mites preserved in the large collections from Madagascar which was a French colony from 1896 until 1960. Most of them had been collected 1945–1955 by Prof. Dr. JACQUES MILLOT (1897–1980) from stagnant waters (GERECKE 2004a). J. MILLOT was a French arachnologist with a broad scientific spectrum, who also worked on the fauna of Madagascar and was a merited science organizer (LEGENDRE 1980, PAULIAN 1980). I received seven specimens for study as a loan from this MILLOT collection (see Material and methods).

For the genus *Unionicola* Haldeman, 1842, which is spread worldwide, only three species were known before from Madagascar: *U. (Pentatax) digitata* (Koenike, 1898), *U. (Pentatax) curtispalpis* Bader, 1978, and *U. (Unionicola) harpax* (Koenike, 1898) (see KOENIKE 1898 and BADER 1978). In the uninvestigated MILLOT collection of the MNHN, GERECKE (2004a) identified a male of *U. harpax* and named a female of the subgenus *Polyatax*, which in the course of this revision turned out to belong to the genus *Neumania*. Now more specimens of *U. harpax* and another seven *Unionicola* species from Madagascar have been discovered, out of which six are new for science and described below.

Acknowledgments

My special thanks are due to Prof. Dr. REINHARD GERECKE (Tübingen) and Dr. TOM GOLDSCHMIDT (Munich) for the *Unionicola* specimens of their Madagascar expedition in 2001 and for diverse information on this. Dr. MARK JUDSON (MNHN) I thank for loan and preparation permission of the *Unionicola* specimens of the MILLOT collection.

Material for comparison and especially type material have been loaned by Dr. PETER JÄGER and JULIA ALTMANN (SMF, K. VIETS and K. O. VIETS collections) and Dr. JASON DUNLOP and Dipl.-Biol. ANJA FRIEDERICH (ZMB, KOENIKE collection). Without these loans the revisions would not have been possible, therefore for these my special thanks.

Many thanks are also due to TERENCE GLEDHILL (Freshwater Biological Association, UK) who improved the text as a native speaker, and to REINHARD GERECKE (Tübingen) and an anonymous reviewer for their valuable comments and advice.

2 Material and methods

In total 26 adults of the genus *Unionicola* from Madagascar have been investigated. The 19 specimens from the Madagascar expedition of GERECKE & GOLDSCHMIDT in 2001 are: *U. (Pentatax) concava* n. sp. (1 ♂, 1 ♀), *U. (Pentatax) gereckei* n. sp. (3 ♂♂, 2 ♀♀), *U. (Pentatax) goldschmidtii* n. sp. (2 ♂♂, 2 ♀♀), *U. (Pentatax) megalopsis* Viets, 1925 (1 ♂, 3 ♀♀), *U. (Pentatax) rubromarginata* n. sp. (2 ♀♀), and *U. (Unionicola) harpax* (Koenike,

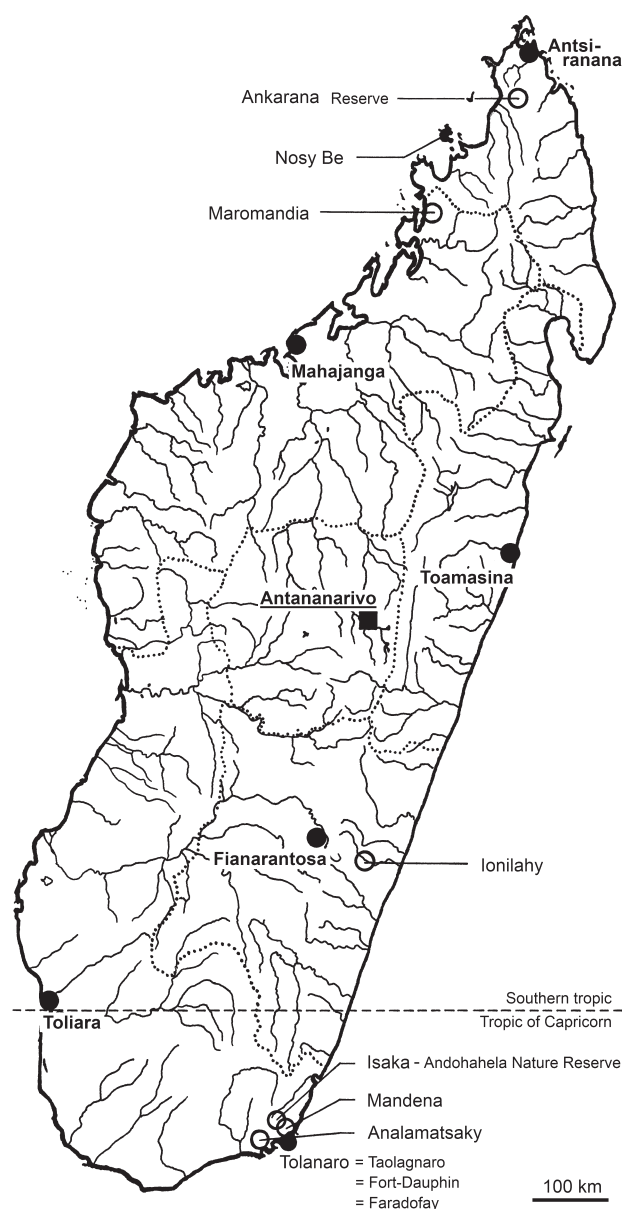


Fig. 1. Collecting sites (open circles) in Madagascar.

1898) (2 ♀♀). From the MILLOT collection in MNHN the following seven specimens were investigated: *U. (Pentatax) ankara-naensis* n. sp. (1 ♂, 1 ♀), *U. (Pentatax) milloti* n. sp. (4 ♀♀), and *U. (Unionicola) harpax* (Koenike, 1898) (1 ♂). The MILLOT material was collected in September 1946 in the area of the Ankarana Reserve in the north of Madagascar (Fig. 1).

Furthermore, material of related continental African species was borrowed from museums for comparison and revision; this material is treated below under "Reference species".

The mites were dissected, slide-mounted in glycerine jelly (HEVERS 1985), measured, and drawn. For the publication of GERECKE (2004a) the specimens from MNHN were prepared and provisionally embedded in Hoyer's fluid (KRAUS 1984); after an additional dissection they were moved to glycerine jelly.

For comparison of extremity measurements ratio diagrams are provided in some cases (Figs. 31, 60, 86). In these diagrams ratio curves of specimens and specimen groups are compared with each other. The curves show the percentaged deviations of the length of the extremity segments from those of the analogous segments of a zero-group (0-group).

From comparison of the curves conclusions can be drawn on membership to the same or different species. Males and females must be compared in separate curves because of possible sexual dimorphism. Curves of specimens or specimen groups of the same species should run approximately parallel, because the ratios of the extremity segments to each other should be approximately the same (HEVERS 1977, 2010).

The investigated species within the subgenus *Pentatax* are dealt with in alphabetic order, except the three species *U. megalopsis*, *U. concava*, and *U. rubromarginata* which belong to the *U. (Pentatax) borgerti* group.

The figures in this paper have the same magnification, except all legs and two coxal plates (Figs. 6, 45), which are figured exactly half as large as the remaining parts.

Abbreviations

I-[II-, III-, IV-]Cx	1 st [2 nd , 3 rd , 4 th] coxa
III-IV-Cx	3 rd and 4 th fused coxae
I-[II-, III-, IV-]L	1 st [2 nd , 3 rd , 4 th] leg
I-L-1[-2, -3, etc.]	1 st [2 nd , 3 rd , etc.] segment of the 1 st leg
L	length
P	pedipalp
P-1[-2, -3, etc.]	1 st [2 nd , 3 rd , etc.] segment of the pedipalp
Prep.	Preparation
W	width

Acronyms of depositories

MNHN	Muséum national d'Histoire naturelle, Paris, France
SMF	Forschungsinstitut und Naturmuseum Senckenberg, Frankfurt a. M., Germany
ZMB	Zoologisches Museum (= Museum für Naturkunde), Berlin, Germany

3 Taxonomy

3.1 Subgeneric classification of *Unionicola*

For the classification of the genus *Unionicola* into subgenera I follow the conventional system of COOK (1974)

and K. O. VIETS (1987) instead of the system of more than 50 subgenera proposed by VIDRINE in many papers. VIDRINE's subgeneric concept (see VIDRINE 1996, with additions of GLEDHILL & VIDRINE 2002, VIDRINE et al. 2005, VIDRINE et al. 2006, VIDRINE et al. 2007 a and b, SMIT 2008, and WEN et al. 2008) is impracticable and the subgenera are usually very poorly defined. A detailed statement on this problem was already given by HEVERS (2010: 41). I am convinced that VIDRINE's subgeneric classification of *Unionicola* is an unjustified splintering. It cannot replace the urgently needed phylogenetic revision of this genus.

COOK (1974) differentiated eight subgenera in *Unionicola*, to which K. O. VIETS (1987) added another two ones. The largest subgenera by far are *Unionicola* Haldeman, 1842 s. str. and *Pentatax* Thor, 1922, which differ in the number of acetabula on the acetabular plates surrounding the gonopore (*Unionicola* s. str. with six pairs of acetabula, *Pentatax* with five pairs of acetabula). Despite of the fact that this classification does not fully correlate with evolutionary relationships, it is nevertheless a practicable one.

3.2 *Unionicola (Pentatax) ankara-naensis* n. sp. (Figs. 2–10, Tab. 1)

Holotype: ♀, Madagascar, Province Antsiranana, Ankarana, swamp, September 1946, leg. JACQUES MILLOT, MNHN, Prep.-No. A 01 D (3).

Paratype: ♂, same collecting site and date as holotype, MNHN, Prep.-No. A 20 J (4).

Etymology

The new species is named after the type locality, Ankarana.

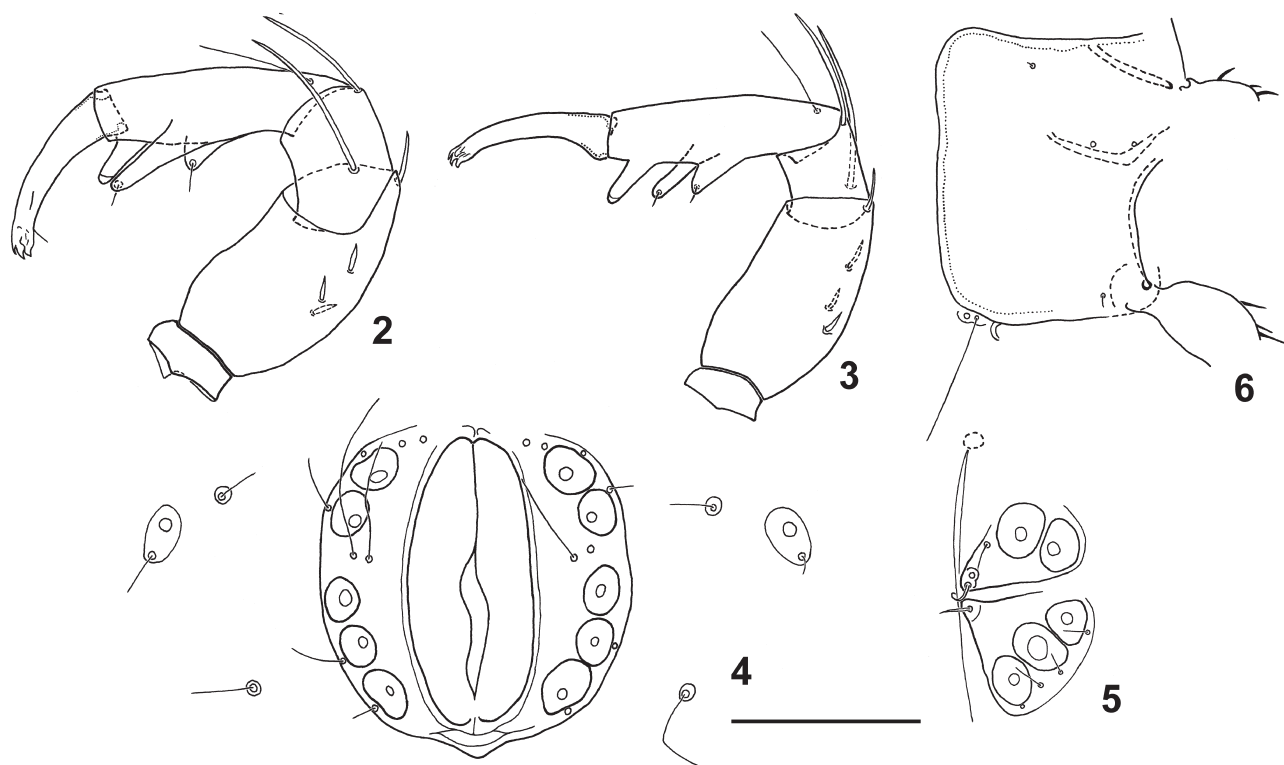
Diagnosis

Large species with 3 small distal teeth on the P-5. P-4 with 3 elongate tubercles, especially the distal peg-tubercle and the lateral hair-tubercle are long and finger-like. The distal peg-tubercle is inserted away from the distal margin of P-4 (Figs. 2, 3), similar to that in the much smaller *U. lyncea* (Figs. 38, 39).

Description

The acetabular plates of both ♂ and ♀ are only weakly sclerotized, so that the margins are difficult to be seen. The ♀ is fully developed with more than 50 eggs of 120 × 80 µm size. The IV-Cx has no comb-like pattern as is mostly common with *Unionicola* (see Figs. 16, 26, 45, 54, 65, 85). Idiosoma size of the ♂: 807 × 656 µm; that of the ♀ is not measurable.

I-L is the strongest of the legs with long, moveable inserted setae on I-L-2-5 for capturing prey (Fig. 7). III-L



Figs. 2–6. *Unionicola (Pentatax) ankaranaensis* n. sp. – 2. Holotype, ♀, left pedipalp, lateral view, MNHN Prep. A 01 D (3). 3. Paratype, ♂, right pedipalp, medial view, MNHN Prep. A 20 J (4). 4. Paratype, ♂, acetabular plates, MNHN Prep. A 20 J (4). 5. Holotype, ♀, left acetabular plates, MNHN Prep. A 01 D (3). 6. Holotype, ♀, left III+IV-Cx, MNHN Prep. A 01 D (3). – Scale: 100 µm (2–5), 200 µm (6).

Tab. 1. *Unionicola (Pentatax) ankaranaensis* n. sp., measurements of the extremity segments in µm. – Abbreviations see chapter 2.

<i>Unionicola ankaranaensis</i> n. sp.	P		I-L				II-L				III-L				IV-L				III+IV-Cx	
	4	5	3	4	5	6	3	4	5	6	3	4	5	6	3	4	5	6	L	W
Holotype, ♀, Madagascar, IX.1946, MNHN, Prep. A 01 D (3)	135	94	278	413	302	268	430	558	593	440	322	382	438	359	322	432	578	497	265	220
Paratype, ♂, Madagascar, IX.1946, MNHN, Prep. A 20 J (4)	120	90	253	377	278	255	396	541	561	413	295	352	400	319	292	425	546	450	288	213

and especially IV-L are well equipped with long swimming setae. Outspread they act like a parachute and raise the sinking drag of the mite (Figs. 9, 10). *U. ankaranaensis* is therefore recognizable as a free swimming species of stagnant waters, where it likely belongs to the plankton.

Differential diagnosis

Among the African *Pentatax* species with only 3 small distal teeth on the P-5 *U. ankaranaensis* is by far the largest with definitely the longest legs (Tab. 1). In pedipalp size only *U. digitata* reaches similar lengths. Also the ratios of the extremity segments are clearly different between *U. ankaranaensis* and all comparable species (see also Fig. 31).

3.3 *Unionicola (Pentatax) gerecke* n. sp. (Figs. 11–20, Tab. 2)

Holotype: ♀, Madagascar, Province Mahajunga, Maro-mandia, pool section near cliff in River Andranamalza, 21.X.2001, leg. REINHARD GERECKE & TOM GOLDSCHMIDT, Prep.-No. 1189, SMF.

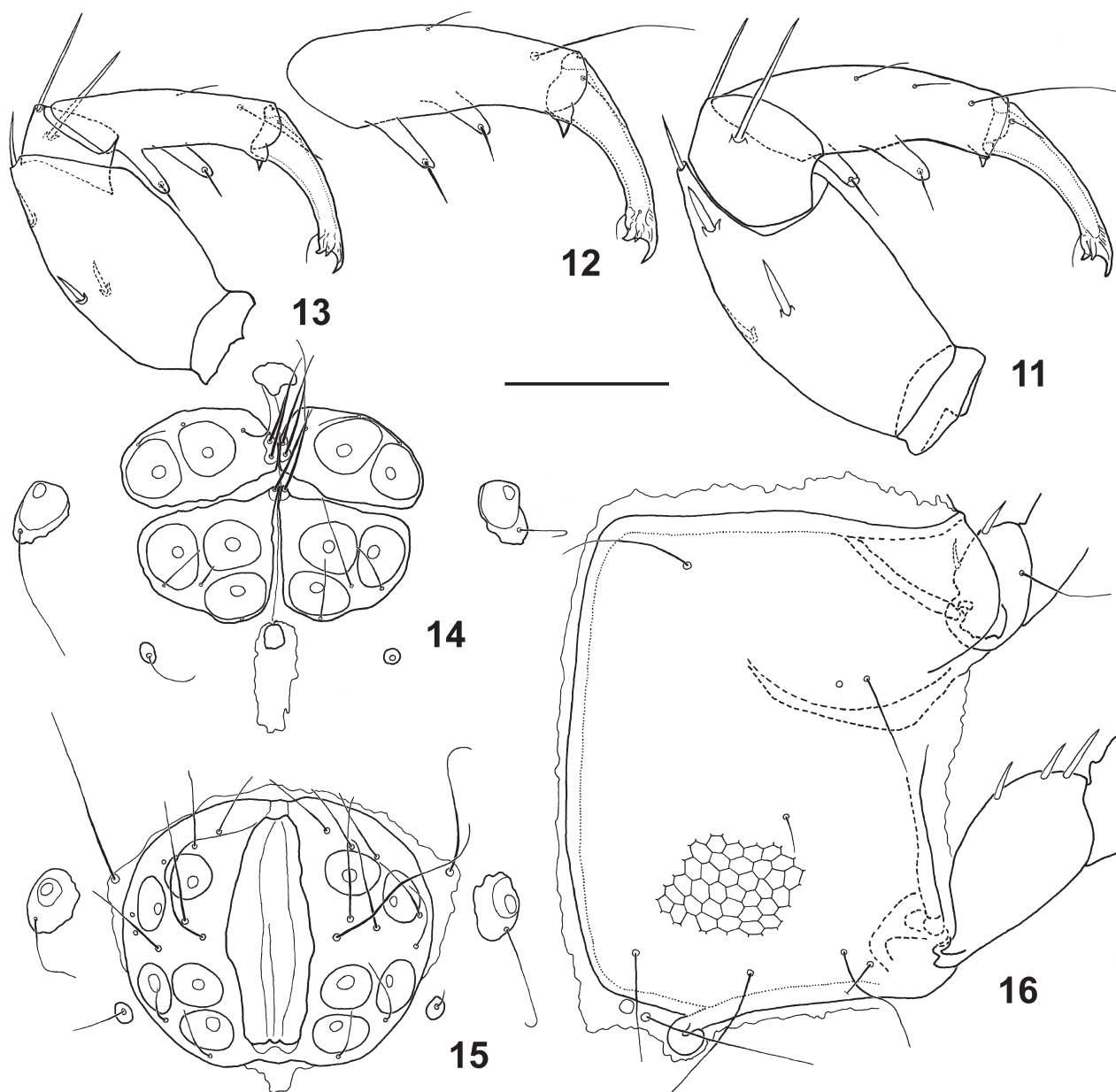
Paratypes: 3 ♂♂, 1 ♀, all same collecting site and date as holotype, Prep.-Nos. 1186–1188, 1190, SMF.

Etymology

The new species is named after Prof. Dr. REINHARD GERECKE (Tübingen), who together with Dr. TOM GOLDSCHMIDT projected, organized, and carried out the limnological expedition to Madagascar in 2001, on which the species was captured.



Figs. 7–10. *Unionicola (Pentatax) ankarananaensis* n. sp., holotype, ♀. – 7. Right 1st leg, anterior view, MNHN Prep. A 01 D (3). 8. Right 2nd leg, anterior view, MNHN Prep. A 01 D (3). 9. Left 3rd leg, posterior view, MNHN Prep. A 01 D (3). 10. Right 4th leg, anterior view, MNHN Prep. A 01 D (3). – Scale: 200 μm.



Figs. 11–16. *Unionicola (Pentatax) gereckei* n. sp. – 11. Paratype, ♀, right pedipalp, lateral view, Prep. 1190. 12. Holotype, ♀, left P-4 and P-5, medial view, Prep. 1189. 13. Paratype, ♂, left pedipalp, medial view, Prep. 1187. 14. Holotype, ♀, acetabular plates, Prep. 1189. 15. Paratype, ♂, acetabular plates, Prep. 1188. 16. Holotype, ♀, left III+IV-Cx, Prep. 1189. – Scale: 100 µm.

Diagnosis

Species with a long terminal tooth on P-5. P-4 with 3 tubercles, of which the medial and the proximal hair-tubercles are long. Ventrodistally on the I-L-6 a heavy, characteristically curved seta is inserted.

Description

U. gereckei bears distally on P-5 besides the long terminal tooth another 2 small teeth. P-4 with 3 tubercles on

the ventral side: distally a short peg-tubercle, medially and proximally a relatively long hair-tubercle reaching over 40 µm in length (Figs. 11–13).

The long legs indicate *U. gereckei* as a good swimmer, especially the III-L and IV-L bear many long swimming setae (Figs. 17–20). The I-L, which acts to capture prey, is remarkable: the long distoventral seta is thickened and bowed in a characteristic manner, for both ♂♂ and ♀♀ (Fig. 17). In the holotype ♀ this seta is 9 µm thick and 121 µm long.



Figs. 17–20. *Unionicola (Pentatax) gereckei* n. sp., holotype, ♀, Prep. 1189 (except detail 17b) – **17.** Right 1st leg, anterior view, [details: **(a)** curved stout distoventral seta of the right I-L-5, anterior view; **(b)** same, but paratype, ♂, Prep. 1186]. **18.** Right 2nd leg, anterior view. **19.** Right 3rd leg, anterior view. **20.** Right 4th leg, anterior view. – Scale: 100 µm (details 17a, b), 200 µm (17–20).

Tab. 2. *Unionicola (Pentatax) gerecke* n. sp. and, for comparison, *U. crassipalpis*, measurements of the extremity segments in μm . – Abbreviations see chapter 2.

<i>Unionicola gerecke</i> n. sp.	P		I-L				II-L				III-L				IV-L				III+IV-Cx	
	4	5	3	4	5	6	3	4	5	6	3	4	5	6	3	4	5	6	L	W
Holotype, ♀, Madagascar, 21.X.2001, HEVERS-Prep. 1189	173	128	209	337	330	292	327	463	498	407	251	336	416	358	278	390	520	474	306	237
Paratype, ♀, Madagascar, 21.X.2001, HEVERS-Prep. 1190	177	126	204	325	305	267	303	437	459	403	245	321	402	347	270	376	502	443	297	210
Paratype, ♂, Madagascar, 21.X.2001, HEVERS-Prep. 1186	150	107	178	282	277	237	288	420	451	364	217	296	377	308	248	340	453	417	295	213
Paratype, ♂, Madagascar, 21.X.2001, HEVERS-Prep. 1187	147	106	166	266	269	230	274	399	424	344	220	288	363	306	235	327	436	391	291	210
Paratype, ♂, Madagascar, 21.X.2001, HEVERS-Prep. 1188	145	106	170	276	270	241	278	404	439	347	215	284	364	308	239	337	437	399	301	206
<i>U. crassipalpis</i> , ♀, Australia, 28.IV.1981, from COOK (1986)	146	89	170	226	251	242									288	380	358			

Idiosoma size: ♂♂: $690 \times 622, 663 \times 523, 682 \times 496 \mu\text{m}$; ♀♀: $996 \times 708 \mu\text{m}$ (holotype without eggs), $813 \times 677 \mu\text{m}$ (paratype with 16 eggs); size of eggs: $138 \times 105 \mu\text{m}$ on average.

Differential diagnosis

Several other African *Unionicola* species possess a long terminal tooth on P-5 like *U. gerecke*: *U. (Armatax) cooki* Bader, 1981, *U. (Armatax) dentifera* Cook, 1966, *U. expansipalpis* Tuzovsky, 2010, *U. (Armatax) koenikei* Viets, 1913, as well as both species discussed in chapter 3.9, *U. (Unionicola) harpax* (Koenike, 1898), and *U. (Unionicola) cyclophora* Viets, 1913. An additional species from Asia is *U. (Armatax) armata* Walter, 1929 and from the Australian region *U. (Pentatax) crassipalpis* Walter, 1915.

A long terminal tooth on the P-5 thus occurs independently in different subgenera. But in the subgenus *Pentatax* such a tooth is only known from *U. crassipalpis*, a widespread species in the Australian region (SMIT 2008). According to K. O. VIETS (1980) and COOK (1986) it is, however, about 20 % smaller than in *U. gerecke* (P-5 even about 30 % shorter) (see Tab. 2).

Of the 3 tubercles on P-4 the medial and proximal hair-tubercles are relatively long in *U. gerecke* (over $40 \mu\text{m}$). The compared species do not have such long hair-tubercles, with the exception of *U. (Armatax) koenikei*, where the medial tubercle may be even longer (HEVERS 2010: p. 71, figs. 184, 186).

Within the compared species a long stout distoventral seta on I-L-5 as in *U. gerecke*, was only observed in *U. (Armatax) cooki*.

3.4 *Unionicola (Pentatax) goldschmidt* n. sp. (Figs. 21–30, Tab. 3)

Holotype: ♂, Madagascar, Province Toliara, Mandena near Fort-Dauphin, pool section in River Amendano, 13.IX.2001, leg. REINHARD GERECKE & TOM GOLDSCHMIDT, Prep.-No. 1182, SMF.

Paratypes: 1 ♂, 2 ♀♀, all from the same collecting site and date as holotype, Prep.-Nos. 1183–1185, SMF.

Etymology

The new species is named after Dr. TOM GOLDSCHMIDT (Munich), who together with Prof. Dr. REINHARD GERECKE projected, organized, and carried out the limnological expedition to Madagascar in 2001, during which the species was captured.

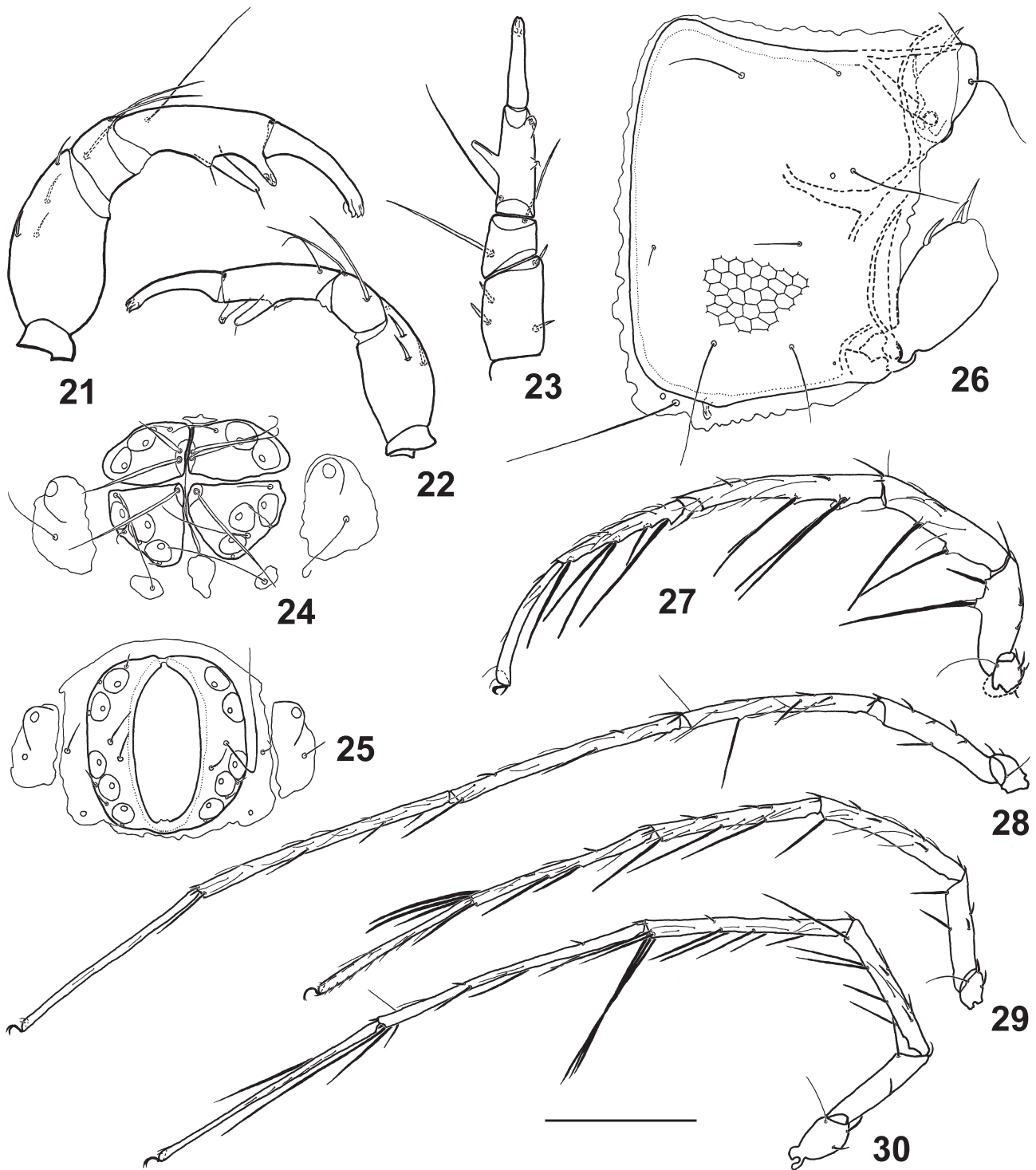
Diagnosis

A species whose P-5 bears 3 small distal teeth, and which is large in relation to the compared species. Of the 3 tubercles on the ventral side of P-4, the distal peg-tubercle is elongated and inserted at its distal margin.

Description

U. goldschmidt has only 3 small distal teeth on P-5. P-4 bears 3 tubercles on the ventral side as mostly usual in *Unionicola*: in the middle of the exterior side a long hair-tubercle, on the interior side a distal peg-tubercle and approximately in the middle a small stocky-coniform hair-tubercle (Figs. 21–23).

The 2 anterior acetabular plates of the ♀ bear 2 long stout piercing setae each and the posterior plates one such seta each as in most *Pentatax* species (Fig. 24). The I-L



Figs. 21–30. *Unionicola (Pentatax) goldschmidtii* n. sp. – 21. Paratype, ♀, left pedipalp, medial view, Prep. 1184. 22. Holotype, ♂, left pedipalp, lateral view, Prep. 1182. 23. Paratype, ♂, right pedipalp, ventral view, Prep. 1183. 24. Paratype, ♀, acetabular plates, Prep. 1184. 25. Holotype, ♂, acetabular plates, Prep. 1182. 26. Paratype, ♀, left III+IV-Cx, Prep. 1184. 27. Holotype, ♂, right 1st leg, anterior view, Prep. 1182. 28. Holotype, ♂, right 2nd leg, anterior view, Prep. 1182. 29. Holotype, ♂, right 3rd leg, anterior view, Prep. 1182. 30. Holotype, ♂, right 4th leg, anterior view, Prep. 1182. – Scale: 100 µm (21–26), 200 µm (27–30).

Tab. 3. *Unionicola (Pentatax) goldschmidtii* n. sp. and, for comparison, the four most closely related African species [*U. digitata*, *U. fimbriata*, *U. postmarginata*, *U. lyncea* (syn. *U. uncata*)], measurements of the extremity segments in μm . – Abbreviations see chapter 2.

<i>Unionicola goldschmidtii</i> n. sp.	P		I-L				II-L				III-L				IV-L				III+IV-Cx	
	4	5	3	4	5	6	3	4	5	6	3	4	5	6	3	4	5	6	L	W
Holotype, ♂, <i>U. goldschmidtii</i> , Madagascar, 13.9.2001, HEVERS-Prep. 1182	79	69	197	270	182	185	258	318	355	300	210	228	250	236	197	277	370	340	208	148
Paratype, ♂, <i>U. goldschmidtii</i> , Madagascar, 13.IX.2001, HEVERS-Prep. 1183	76	69	190	270	182	185	256	324	359	294	205	225	252	228	195	275	365	342	213	139
Paratype, ♀, <i>U. goldschmidtii</i> , Madagascar, 13.IX.2001, HEVERS-Prep. 1184	105	87	256	349	223	219	302	386	438	350	241	274	303	270	240	322	454	419	248	177
Paratype, ♀, <i>U. goldschmidtii</i> , Madagascar, 13.IX.2001, HEVERS-Prep. 1185	101	82	232	317	204	201	275	347	388	310	217	243	266	244	216	289	399	374	228	153
Holotype, ♀, <i>U. digitata</i> , Madagascar, 27.VIII.1895, KOENIKE-Prep. 183	113	111	211	266	201	220	259	301	323	300	203	235	268	258	236	281	354	346	245	190
<i>U. fimbriata</i> , average of 13 ♀♀, Ivory Coast, 1977–1978, from HEVERS (2010: tab. 5)	84	68	169	225	161	165	186	226	238	215	151	174	197	181	172	205	268	249	190	144
Holotype, ♀, <i>U. postmarginata</i> , Cameroon, 1.IX.1915, K. VIETS-Prep. 3163	81	66	113	148	110	116	130	170	177	–	111	137	151	–	127	158	–	–	185	126
Lectotype, ♀, <i>U. lyncea</i> , Congo (Lake Edward), 25.V.1891, KOENIKE-Prep. 332	98	74	185	252	167	183	216	276	298	242	168	205	245	202	178	237	–	–	214	151
Holotype, ♀, <i>U. uncata</i> [= <i>U. lyncea</i>], Cameroon, 30.III.1913, K. VIETS-Prep. 1719	85	64	179	252	166	162	207	248	–	–	165	188	–	–	179	225	307	252	192	127
<i>U. uncata</i> [= <i>U. lyncea</i>], average of 3 ♂♂, Congo, 1972, K. O. VIETS-Prep. 4643–4645	88	71	170	233	164	179	215	275	293	242	169	201	237	196	179	232	318	274	198	141
<i>U. uncata</i> [= <i>U. lyncea</i>], average of 3 ♀♀, Congo, 1972, K. O. VIETS-Prep. 4641, 4642, 4645	101	81	198	267	176	194	228	292	308	248	174	212	255	214	193	248	339	287	205	156

are bearing long setae for prey capturing, the II-L possess almost no longer setae, and the III-L and IV-L have a moderate number of swimming setae (Figs. 27–30).

Idiosoma size: ♂♂: 457×320 and $450 \times 330 \mu\text{m}$; ♀♀: 595×419 and $528 \times 388 \mu\text{m}$. Both ♀♀ contain 4 eggs of $123 \times 73 \mu\text{m}$ size on average.

Differential diagnosis

Eight of the African species of the subgenus *Pentatax* have P-5 with 3 small distal teeth like *U. goldschmidtii* n. sp.: *U. ankaranaensis* n. sp. (see above), *U. digitata* (Koenike, 1898), *U. fimbriata* Viets, 1913, *U. latilaminata* Viets, 1911, *U. lyncea* (Koenike, 1895) (syn. *U. uncata* Viets, 1916, see below), *U. milloti* n. sp. (see above), *U. minuta* Viets, 1916, and *U. postmarginata* Viets, 1925.

Four species are relatively easy to distinguish from *U. goldschmidtii*: *U. ankaranaensis* is much bigger than all compared species (e. g. I-L-5 and I-L-6 are over $230 \mu\text{m}$ long, see Tab. 1), *U. latilaminata* ♀♀ possess overlong stout piercing setae on the acetabular plates, *U. milloti* has considerably more swimming setae on the shorter II-IV-L (Figs. 47–49), and *U. minuta* has no tubercles on P-4.

The remaining four species are more difficult to distinguish from *U. goldschmidtii*. The best characters are in

the form and position of the distal peg-tubercle on P-4. In *U. lyncea* the peg-tubercle is elongated as in *U. goldschmidtii*, while it is stocky-coniform in *U. digitata*, *U. fimbriata*, and *U. postmarginata*. In *U. lyncea* this peg-tubercle inserts distinctly away from the distal margin of P-4, but in *U. goldschmidtii*, as well as in the 3 species *U. digitata*, *U. fimbriata*, and *U. postmarginata*, it inserts at the distal margin. Furthermore, *U. postmarginata* lacks the hair-tubercle of the medial side of P-4 (Figs. 35, 36).

Thus the combination elongated peg-tubercle at the distal margin of P-4 only appears within the compared species in *U. goldschmidtii*.

In the ratio diagram of Fig. 31 the ratio curves show the differences between *U. goldschmidtii* and the compared species, especially *U. digitata*, which also occurs in Madagascar and has a comparable size. In *U. digitata* P-4 and P-5 are amazingly long in proportion to the leg segments and I-L-4, II-L-5, and IV-L-5 are relatively short. Furthermore, Figs. 32–34 of the *U. digitata* holotype show the overlong eponymous hair-tubercle on P-4 and the longer setae on II-L compared to those of *U. goldschmidtii*.

The curves of *U. lyncea* and *U. uncata* lie close together in Fig. 31; they are arranged separately to keep the figure readable. The curves show that there are no significant ratio differences between the two ‘species’ (see also below under *U. lyncea*).

Reference species

Unionicola (Pentatax) lyncea (Koenike, 1895)
(Figs. 37–39, Tab. 3)

Unionicola (Pentatax) uncata Viets, 1916 **n. syn.**

KOENIKE described *U. lyncea* based on several ♀♀ and 1 ♂ from the NW lakeshore of Lake Edward in East Africa, which today belongs to the Democratic Republic of the Congo. Of these specimens 4 preparations are preserved in the ZMB: KOENIKE-Prep. 332–334 of ♀♀, each marked with the inscription “Type”, and the KOENIKE-Prep. 7142 of a ♂, which was apparently pre-

pared later. They are all marked with the same collecting site and date: Kirima, 25.V.1891, just as published by KOENIKE (1898).

KOENIKE (1895: 17) already noted that in contrast to the ♀♀, the ♂ has no tubercles on P-4 and no heightened inserted sword-setae on I-L; he considered this as a individual aberration. In fact the ♂ belongs, in contrast to the ♀♀, to the *Unionicola borgerti* group with characteristically broadened, outstandingly large, but stump-like claws on I-L-6 (see HEVERS 2010: 71). Therefore the ♂ can not be a syntype of *U. lyncea*.

This ♂ of the KOENIKE-Prep. 7142 is, with the exception of one removed pedipalp, mounted undissected. Nevertheless it could be measured successfully. Based on the size of the extrem-

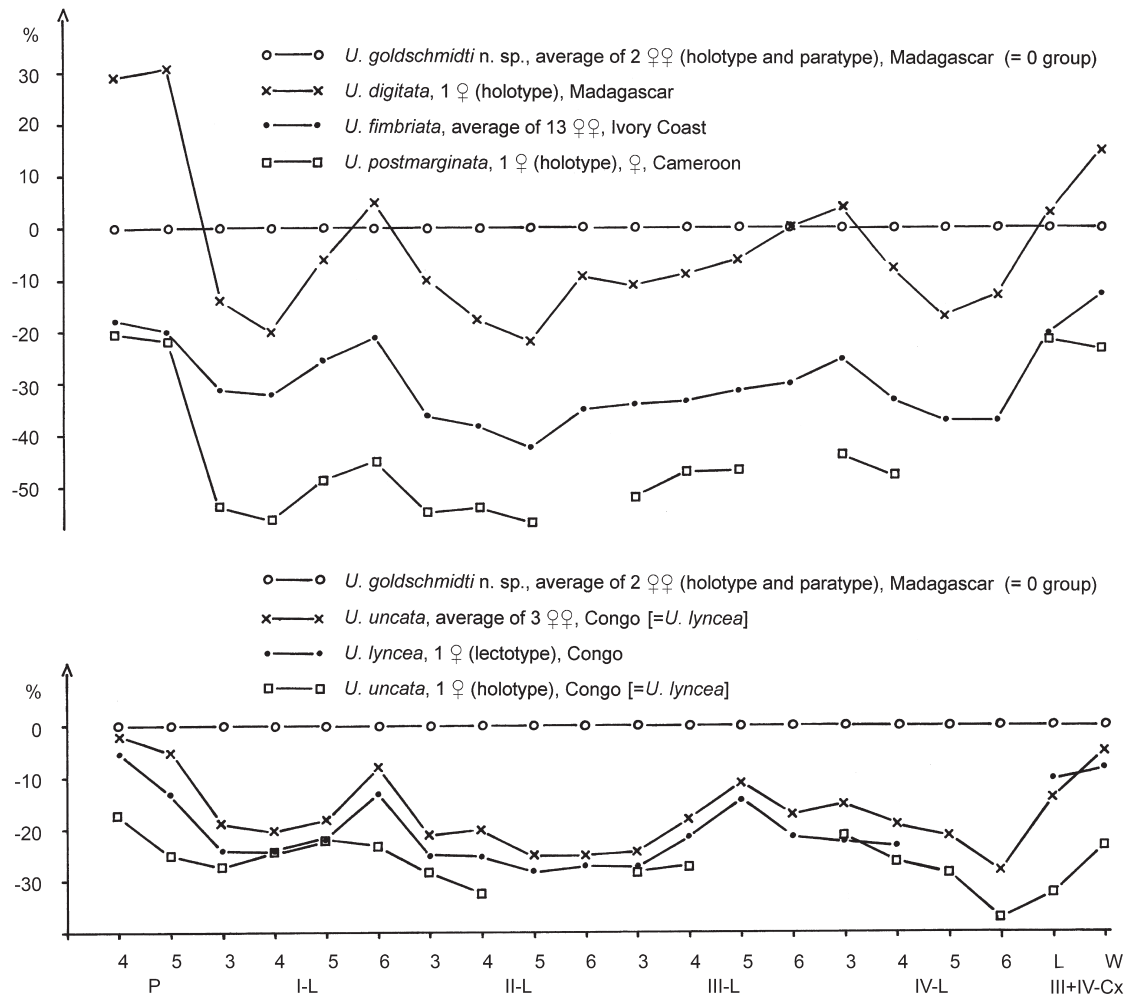
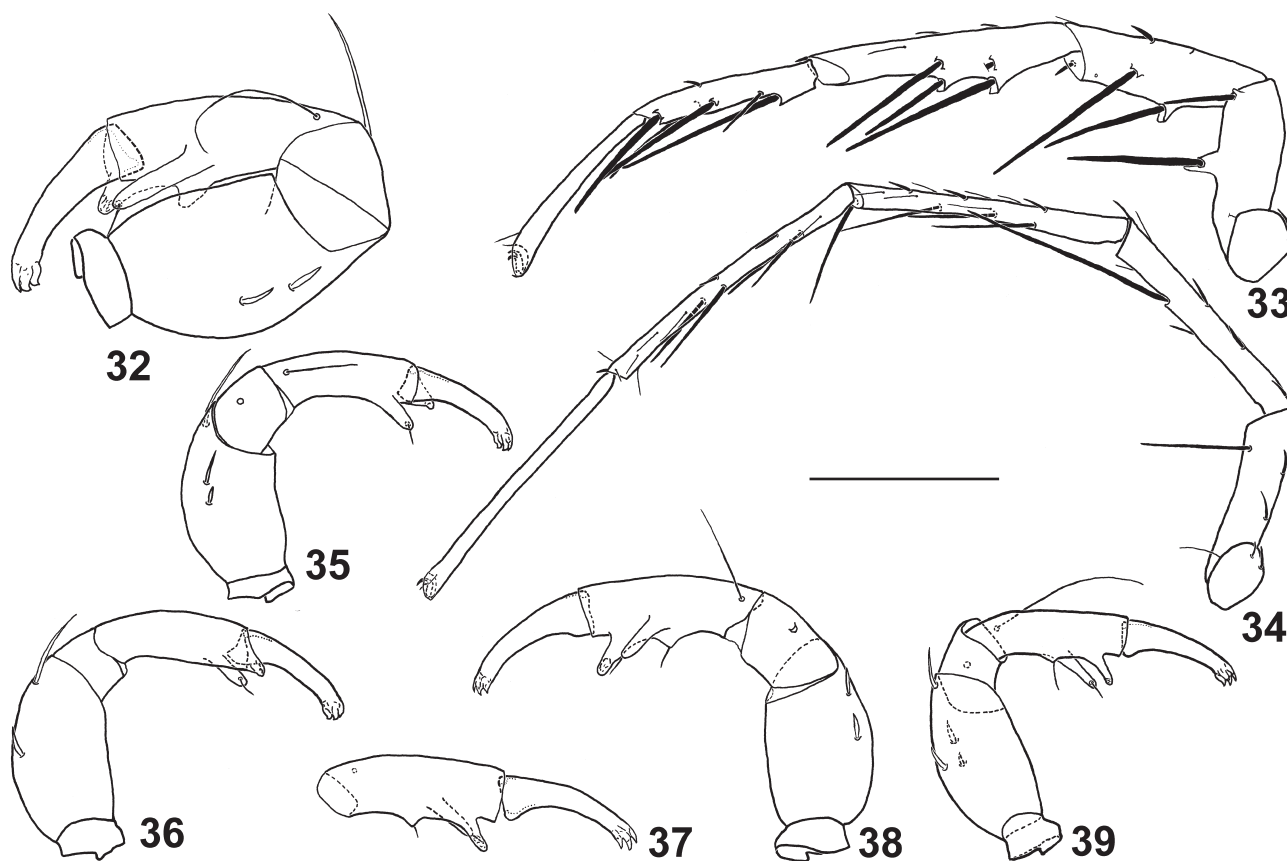


Fig. 31. Ratio diagram of *Unionicola (Pentatax) goldschmidtii* n. sp. and its four most closely related African species. For clearness only the curves of the ♀♀ are shown, the holotypes and lectotypes are ♀♀ anyway. *U. lyncea* and *U. uncata* are proved to be synonyms (see text), their curves are shown separate from the others to keep the figure readable. – Underlying measurements see Tab. 3.

ity segments and their ratios the ♂ belongs to *Unionicola (Pentatax) megalopsis* Viets, 1925.

U. lyncea has not been found again since the description of KOENIKE (1895), thus his figures of pedipalp and acetabular plates

of the ♀ are the only ones of the species. The 3 ♀♀ preparations in the ZMB are the only syntypes of the species: In Prep. 332 a ♀ is mounted whole and still measurable; in Prep. 333 a mainly destroyed ♀ is mounted and only partially examinable; Prep. 334



Figs. 32–39. *Unionicola* spp. related to *U. (Pentatax) goldschmidtii* n. sp. – **32–34.** *U. digitata*. **32.** Holotype, ♀, left pedipalp, lateral view, KOENIKE-Prep. 183. **33.** Holotype, ♀, right 1st leg, anterior view, KOENIKE-Prep. 183. **34.** Holotype, ♀, right 2nd leg, anterior view, KOENIKE-Prep. 183. – **35–36.** *U. postmarginata*. **35.** Holotype, ♀, right pedipalp, lateral view, K. VIETS-Prep. 3163. **36.** Holotype, ♀, left pedipalp, medial view, K. VIETS-Prep. 3163. – **37–39.** *U. lyncea*. **37.** Paralectotype of *U. lyncea*, ♀, left P-4 and P-5, medial view, KOENIKE-Prep. 333. **38.** Paralectotype of *U. lyncea*, ♀, left pedipalp, lateral view, KOENIKE-Prep. 334. **39.** Holotype of *U. uncata* (= *U. lyncea*), ♀, left pedipalp, medial view, K. VIETS-Prep. 1719. – Scale: 100 µm (32, 35–39), 200 µm (33–34).

only contains one left pedipalp. Based on these preparations the pedipalps of Figs. 37–38 could be drawn and the extremity measures of Tab. 3 could be made. Because the ♀ in Prep. 332 is the specimen conserved best, it is designated as lectotype of *U. lyncea*; the other 2 ♀♀ therefore now are paralectotypes.

Unionicola (Pentatax) uncata was described by K. VIETS (1916) based on 1 ♀ from Cameroon. The holotype-Prep. 1719 is preserved in the SMF; the partly dissected ♀ could be measured (Tab. 3), and the left pedipalp could be drawn anew (Fig. 39). Additionally K. VIETS (1925) described the ♂, also from Cameroon; the corresponding Prep. 3171 is also preserved in the SMF and contains 2 ♂♂, which are partly measurable.

In his original description K. VIETS (1916) compared his new species *U. uncata* with *U. fimbriata* and *U. latilaminata*, but astonishingly not with the East African *U. lyncea*, which his mentor KOENIKE had described. *U. uncata* and *U. lyncea* show no significant morphological differences. In both, the elongated peg-tubercle of P-4 is inserted distinctly away from the lateral margin – a criterion that exists within none of the compared species. Also in the ratio diagram of Fig. 31 there are no significant differences in the curve progression of the two ‘species’. Therefore, based on

the current state of knowledge, *U. uncata* is a junior synonym of *U. lyncea*.

LUNDBLAD (1949) placed a ♂ from Eastern Congo near Lake Edward among *U. uncata* and pictured it; this figure also shows no significant differences to *U. lyncea*. K. O. VIETS (1973) mentioned many specimens from the west bank of Lake Kivu in the Congo. Of these specimens 5 preparations (K. O. VIETS-Prep. 4641–4645), containing 3 ♂♂ and 3 ♀♀, are preserved in the SMF. They could be measured (Tab. 3) and neither their morphology nor their ratios (Fig. 31) show significant differences to *U. lyncea*. All these specimens originate from the Eastern Congo like *U. lyncea*.

Unionicola (Pentatax) digitata (Koenike, 1898)
(Figs. 32–34, Tab. 3)

KOENIKE described the species based on a ♀ from the Island of Nosy Be off the NW coast of Madagascar. With the name he indicated the finger-like, extremely long hair-tubercle (54 µm) on the ventral side of P-4 as a specific attribute. The species has not been found again since then.

The holotype, marked as “Type”, is preserved in the ZMB as KOENIKE-Prep. 183. This mostly undissected holotype ♀ could be measured (Tab. 3) and the removed left pedipalp as well as I-L and II-L drawn (Figs. 32–34). KOENIKE stated the size of the ♀ as 700 × 500 µm; it contains 11 eggs.

Unionicola (Pentatax) postmarginata Viets, 1925
(Figs. 35–36, Tab. 3)

K. VIETS described the species based on a ♀ from Cameroon and figured it. The holotype-Prep. 3163 is preserved in the SMF; the partly dissected ♀ could be measured (Tab. 3) and both pedipalps drawn (Figs. 35, 36). The species has not been found since then.

Based on the leg segments, *U. postmarginata* is a very small species, but its pedipalps and coxal plates are considerably larger in relation (Fig. 31). On P-4 the stocky-coniform peg-tubercle inserts directly at the distal margin, as in *U. fimbriata* and also in *U. digitata*, which are much larger however. Moreover, *U. postmarginata* completely lacks the small hair-tubercle on P-4.

3.5 *Unionicola (Pentatax) milloti* n. sp.
(Figs. 40–49, Tab. 4)

Holotype: ♀, Madagascar, Province Antsiranana, Ankarana, September 1946, leg. JACQUES MILLOT, MNHN, Prep.-No. A 20 J (7).

Paratypes: 3 ♀♀, same data as holotype, MNHN, Prep.-Nos. A 01 B (2), A 20 J (5), A 20 J (6).

Etymology

The new species is named after the collector Prof. Dr. JACQUES MILLOT (1897–1980).

Diagnosis

Relatively small species with 3 small distal teeth on the P-5. P-4 with 3 tubercles, of which the elongated peg-tubercle inserts directly at the distal margin. The legs bear an unusually large number of long setae. Relative to the leg segments, the III+IV-Cx are very large.

Description

U. milloti is only known in the female sex. It belongs to the species with 3 small distal teeth on the P-5 and 3 tubercles on the ventral side of P-4. Altogether the acetabular plates bear 3 pairs of stout long piercing setae: 2 pairs on the anterior and 1 pair on the posterior upwards bent medial boundary areas. The acetabular plates of all 4 investigated ♀♀ are hardly sclerotized, except for the upwards bent medial boundary areas, so that the acetabula are lying free in the integument; all 4 ♀♀ are without eggs.

The legs are relatively short, but strong and bear a considerable number of long setae. Already I-L, which acts to capture prey, has especially stout long setae and also II-L, which is usually only slightly equipped with setae, bears a number of long setae in this case. The III-L and IV-L, which usually already bear the most swimming setae, possess in *U. milloti* an unusual high number of closely-packed, partly extraordinarily long swimming setae. This can be observed in particular on IV-L-4-6: the holotype ♀ bears 13 swimming setae on IV-L-4, 10 swimming setae on IV-L-5, and 5 swimming setae stand in a row on IV-L-6 (Figs. 46–49).

In length and especially in width the III+IV-Cx are relatively large in proportion to the length of the extremity segments (Fig. 45, Tab. 4).

Differential diagnosis

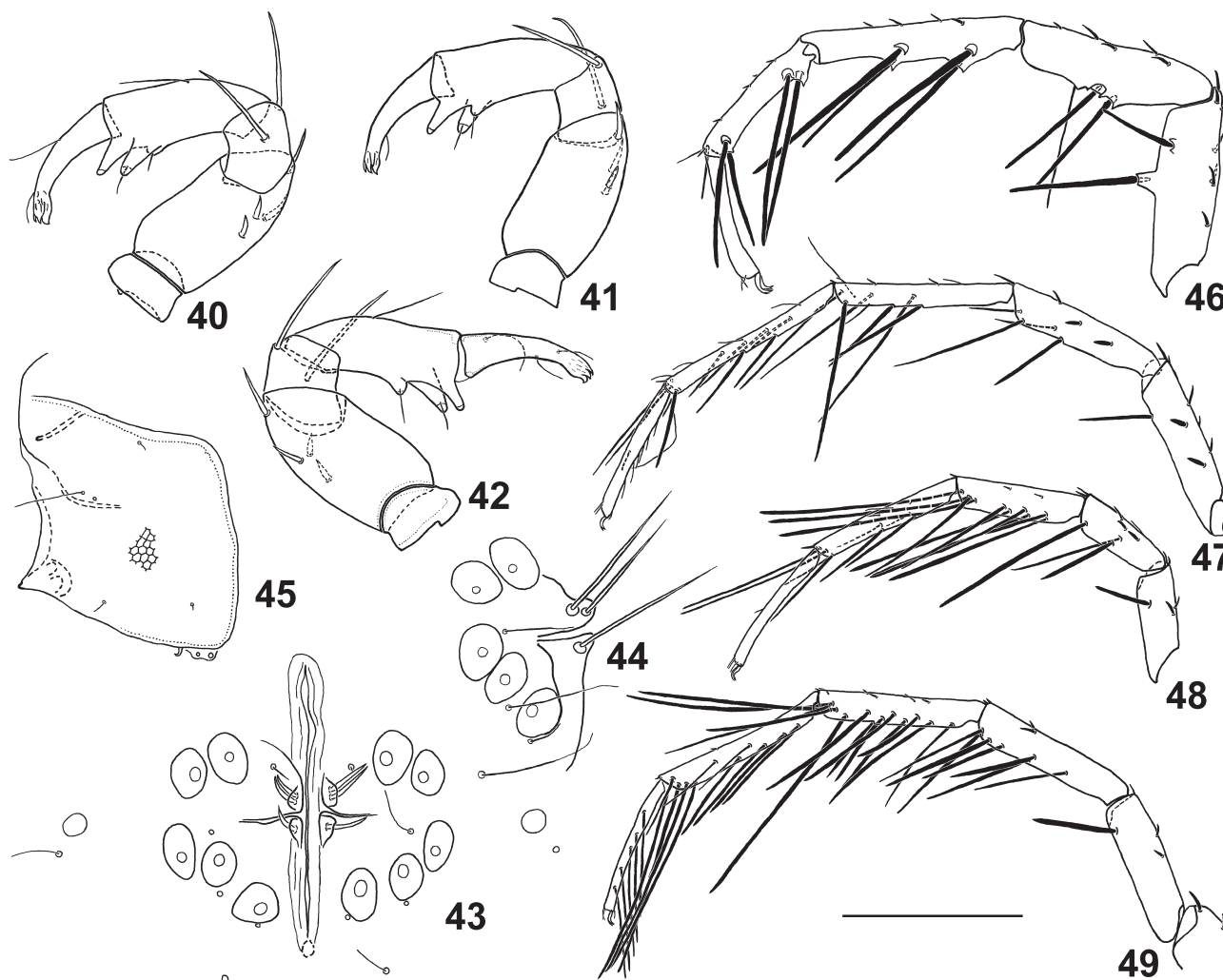
Within the African *Pentatax* species *U. milloti* is characterized by the uniquely large number of swimming setae on II–IV-L. Only this species bears 5 heavy swimming setae on IV-L-6. Therefore *U. milloti* must be an exceptionally good swimmer, although it is relatively small.

3.6 *Unionicola (Pentatax) megalopsis* Viets, 1925

The present material from Madagascar contains 1 ♂ and 3 ♀♀ of *U. megalopsis*, a Malagasy first record with the following collecting dates: 1 ♂, Province Fianarantosa, Ionilahy, pool section of River Ionilahy, 11./13.VIII.2001, Prep.-No. 1174,

Tab. 4. *Unionicola (Pentatax) milloti* n. sp., measurements of the extremity segments in µm. – Abbreviations see chapter 2.

<i>Unionicola milloti</i> n. sp.	P		I-L				II-L				III-L				IV-L				III+IV-Cx	
	4	5	3	4	5	6	3	4	5	6	3	4	5	6	3	4	5	6	L	W
Holotype, ♀, Madagascar, IX.1946, MNHN, Prep. A 20 J (7)	94	77	212	240	171	143	183	206	243	167	119	155	189	154	195	193	203	158	251	250
Paratype, ♀, Madagascar, IX.1946, MNHN, Prep. A 01 B (2)	98	81	226	252	172	150	192	205	248	178	122	153	186	163	194	194	211	163	267	271
Paratype, ♀, Madagascar, IX.1946, MNHN, Prep. A 20 J (5)	96	80	233	159	176	155	195	213	247	185	121	154	188	164	202	197	210	166	266	272
Paratype, ♀, Madagascar, IX.1946, MNHN, Prep. A 20 J (6)	99	80	229	259	178	150	207	213	247	178	123	159	192	164	201	199	212	165	277	277



Figs. 40–49. *Unionicola (Pentatax) milloti* n. sp. – 40. Holotype, ♀, left pedipalp, lateral view, MNHN Prep. A 20 J (7). 41. Holotype, ♀, right pedipalp, medial view, MNHN Prep. A 20 J (7). 42. Paratype, ♀, left pedipalp, medial view, MNHN Prep. A 20 J (5). 43. Holotype, ♀, acetabular plates, MNHN Prep. A 20 J (7). 44. Paratype, ♀, right half of acetabular plates, oblique lateral view, MNHN Prep. A 20 J (2). 45. Holotype, ♀, right III+IV-Cx, MNHN Prep. A 20 J (7). 46. Paratype, ♀, right 1st leg, anterior view, MNHN Prep. A 20 J (5). 47. Holotype, ♀, right 2nd leg, anterior view, MNHN Prep. A 20 J (7). 48. Holotype, ♀, right 3rd leg, anterior view, MNHN Prep. A 20 J (7). 49. Holotype, ♀, right 4th leg, anterior view, MNHN Prep. A 20 J (7). – Scale: 100 µm (40–44), 200 µm (45–49).

SMF; 1 ♀, Province Toliara, Isaka near Andohahela Nature Reserve, stream W from the village, 12.IX.2001, Prep.-No. 1175, SMF; 1 ♀, Province Toliara, Mandena near Fort-Dauphin, ditch near River Amendano, 13.IX.2001, Prep.-No. 1176, SMF; 1 ♀, Province Toliara, Mandena near Fort-Dauphin, pool section of River Amendano, 13.IX.2001, Prep.-No. 1177, SMF.

Differential diagnosis

The extremity measurements of the specimens are within the variation limits of the species, and also the ratio curves do not show significant differences to those of the species (HEVERS 2010: tab. 7, fig. 88). Up to now *U. megalopsis* was found on the African continent in Cameroon (1 ♂, 1 ♀; K. VIETS 1925), in the Ivory Coast (38 ♂♂,

87 ♀♀; HEVERS 2010), and in the Democratic Republic of the Congo (1 ♂; KOENIKE 1895: mistakenly attributed to *U. lyncea* [see above under *U. lyncea*]). It is obviously a widespread species in Africa.

Remarks

Within the subgenus *Pentatax* the *Unionicola borgerti* group is characterized by peculiarly broadened, outstandingly large, but blunt claws on the I-L and by the last pedipalp segment without distal teeth, ending in a blunt tip.

According to HEVERS (2010), who revised the African species of this group, the following species are known from the continent: *U. dadayi* Cook, 1966, *U. megalopsis*

Viets, 1925, *U. nziensis* Hevers, 2010, and *U. vietsi* Walter, 1935; for *U. borgerti* (Daday, 1907) and *U. lineata* Viets, 1925 the existing material is too small for a clear species definition, and for *U. chappuisi* Walter, 1935 the qualification as a species is doubtful.

In the following, two species (*U. concava* n. sp. and *U. rubromarginata* n. sp.) from Madagascar belonging to this group are described as new for science.

3.7 *Unionicola (Pentatax) concava* n. sp. (Figs. 50–59, Tab. 5)

Holotype: ♀, Madagascar, Province Toliara, Mandena near Fort-Dauphin, pool section of River Amendano, 13.IX.2001, leg. REINHARD GERECKE & TOM GOLDSCHMIDT, Prep.-No. 1181, SMF.

Paratype: 1 ♂, same collecting site and date as holotype, Prep.-No. 1180, SMF.

Etymology

The new species is named after the concave bowed I-L-6 of ♂ and ♀.

Diagnosis

Within the subgenus *Pentatax* this species belongs to the *Unionicola borgerti* group (see under *U. megalopsis* above). I-L-6 of ♂ and ♀ are concave and distally bent

upwards; the stout seta on the outer side of P-3 is round and extraordinarily long; I-L-5 and I-L-6 are relatively long in proportion to the other extremity segments.

Description

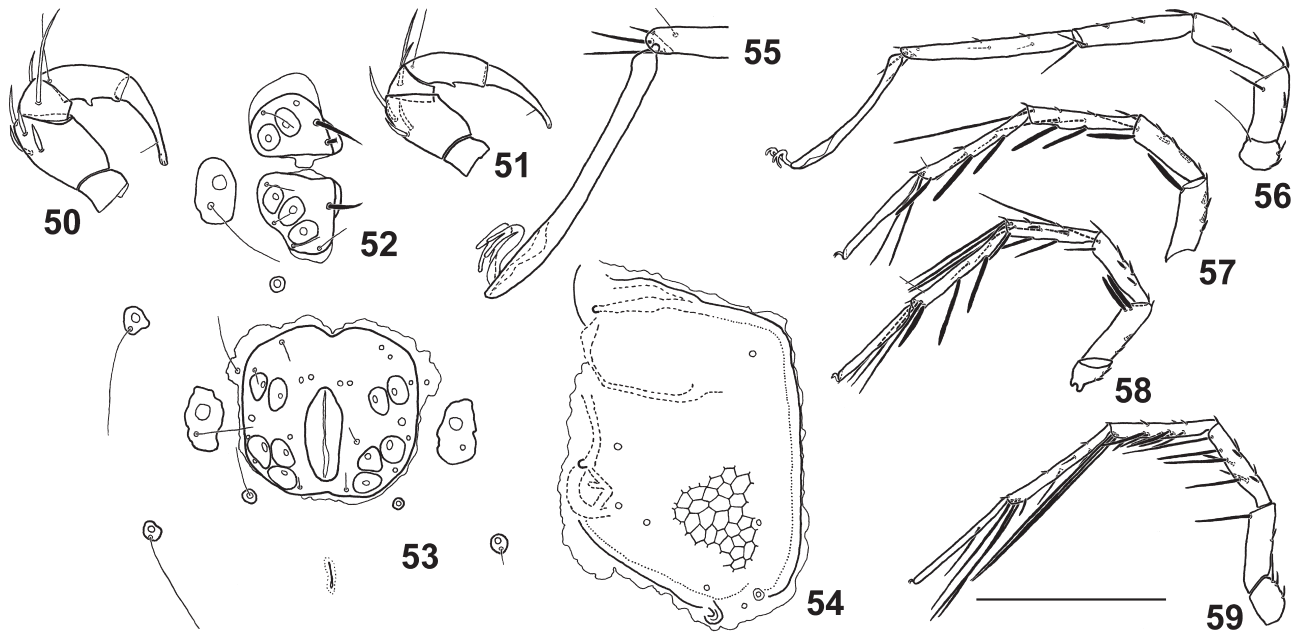
U. concava is relatively small like most species of the *U. borgerti* group. On the pedipalp the stout seta on the outside of P-3 is extraordinarily long with a round cross-section.

As common in the *U. borgerti* group, I-L is hardly setaceous. The II-L bears some longer setae, while III-L and IV-L possess many, some very long swimming setae. A specific characteristic of *U. concava* is I-L-6, which is distally bent upwards in both sexes. Thus it gets an overall concave form, not observed in any other species (Figs. 55, 56).

Idiosoma size: ♂ (paratype): 394 × 330 µm; ♀ (holotype): 470 × 370 µm. The holotype ♀ contains 9 eggs of 108 × 77 µm size on average.

Differential diagnosis

While P-4-5 are uniform without differentiating features within the species of the *U. borgerti* group, the stout seta on the outside of P-3 shows a high species-specific variety in shape and dimension. Long and round in cross-section as in *U. concava* (Figs. 50, 51) it is also in *U. dadayi*,



Figs. 50–59. *Unionicola (Pentatax) concava* n. sp. – 50. Holotype, ♀, right pedipalp, lateral view, Prep. 1181. 51. Paratype, ♂, left pedipalp, medial view, Prep. 1180. 52. Holotype, ♀, right acetabular plates, Prep. 1181. 53. Paratype, ♂, acetabular plates, Prep. 1180. 54. Paratype, ♂, right III+IV-Cx, Prep. 1180. 55. Paratype, ♂, right I-L-6, anterior view, Prep. 1180. 56. Holotype, ♀, right 1st leg, anterior view, Prep. 1181. 57. Holotype, ♀, right 2nd leg, anterior view, Prep. 1181. 58. Holotype, ♀, right 3rd leg, anterior view, Prep. 1181. 59. Holotype, ♀, right 4th leg, anterior view, Prep. 1181. – Scale: 100 µm (50–55), 200 µm (56–59).

Tab. 5. *Unionicola (Pentatax) concava* n. sp. and *U. (P.) rubromarginata* n. sp., in comparison with *U. dadayi* and *U. megalopsis*, measurements of the extremity segments in μm . – Abbreviations see chapter 2.

<i>Unionicola concava</i> n. sp. <i>Unionicola rubromarginata</i> n. sp.	P		I-L				II-L				III-L				IV-L				III+IV-Cx	
	4	5	3	4	5	6	3	4	5	6	3	4	5	6	3	4	5	6	L	W
Holotype, ♀, <i>U. concava</i> , Madagascar, 13.IX.2001, HEVERS-Prep. 1181	45	52	115	130	182	166	97	118	134	121	95	102	130	116	103	112	134	136	192	140
Paratype, ♂, <i>U. concava</i> , Madagascar, 13.IX.2001, HEVERS-Prep. 1180	42	47	99	115	166	160	91	105	122	112	81	93	120	106	90	102	119	117	164	120
Holotype, ♀, <i>U. rubromarginata</i> , Madagascar, 13.IX.2001, HEVERS-Prep. 1179	48	54	122	153	189	150	119	141	155	143	109	123	151	143	112	130	156	153	165	140
Paratype, ♀, <i>U. rubromarginata</i> , Madagascar, 13.IX.2001, HEVERS-Prep. 1178	44	52	120	145	177	150	115	127	142	132	100	117	143	130	107	121	141	143		139
<i>U. dadayi</i> , 1 ♀, Liberia, 8.XI.1957, from COOK (1966)	40	45	100	118	180	161														
<i>U. megalopsis</i> , average of 10 ♀♀, Ivory Coast, 1977–1978, from HEVERS (2010: tab. 7) [0-group in Fig. 60]	57	59	122	156	162	131	112	142	152	137	111	139	157	135	125	153	177	160	184	148

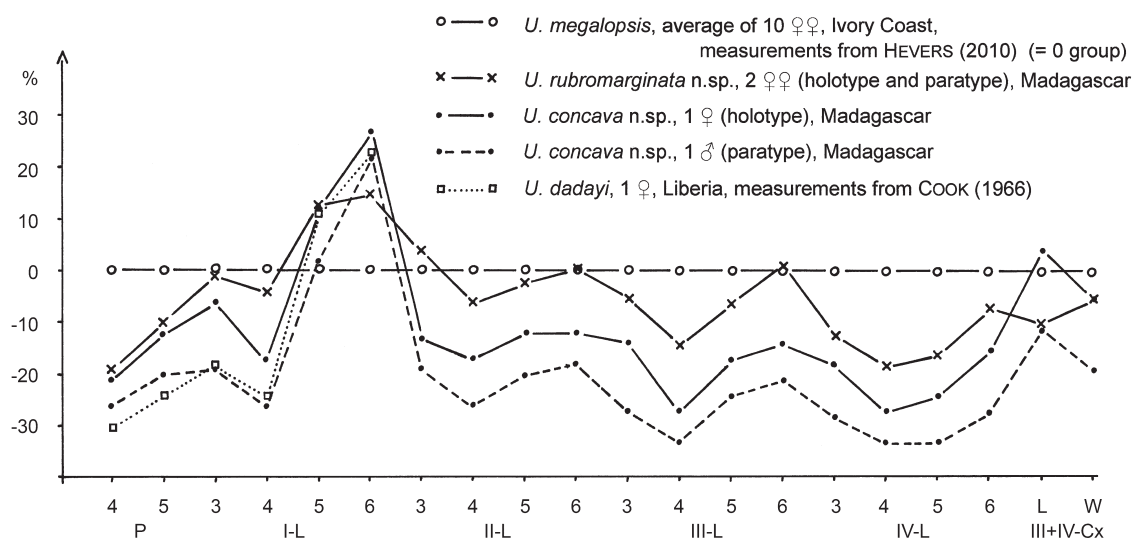


Fig. 60. Ratio diagram of *Unionicola (Pentatax) concava* n. sp. and *U. (P.) rubromarginata* n. sp., compared with *U. (P.) dadayi* and *U. (P.) megalopsis*. – Underlying measurements see Tab. 5.

U. lineata, and *U. vietsi*. Short and flattened in cross-section it is, in contrast, in *U. rubromarginata* (Figs. 61, 62), *U. megalopsis*, *U. nziensis*, and *U. chappuisi* (as far as can be seen in WALTER 1935: fig. 59).

The ratio diagram (Fig. 60) shows, that compared to *U. megalopsis*, *U. concava* has remarkably long I-L-5 and I-L-6. The species *U. rubromarginata* (described below) and *U. dadayi* both have relatively long distal segments of I-L as well. In contrast, as in *U. megalopsis*, these leg segments are relatively short in *U. vietsi* (see HEVERS 2010: fig. 209).

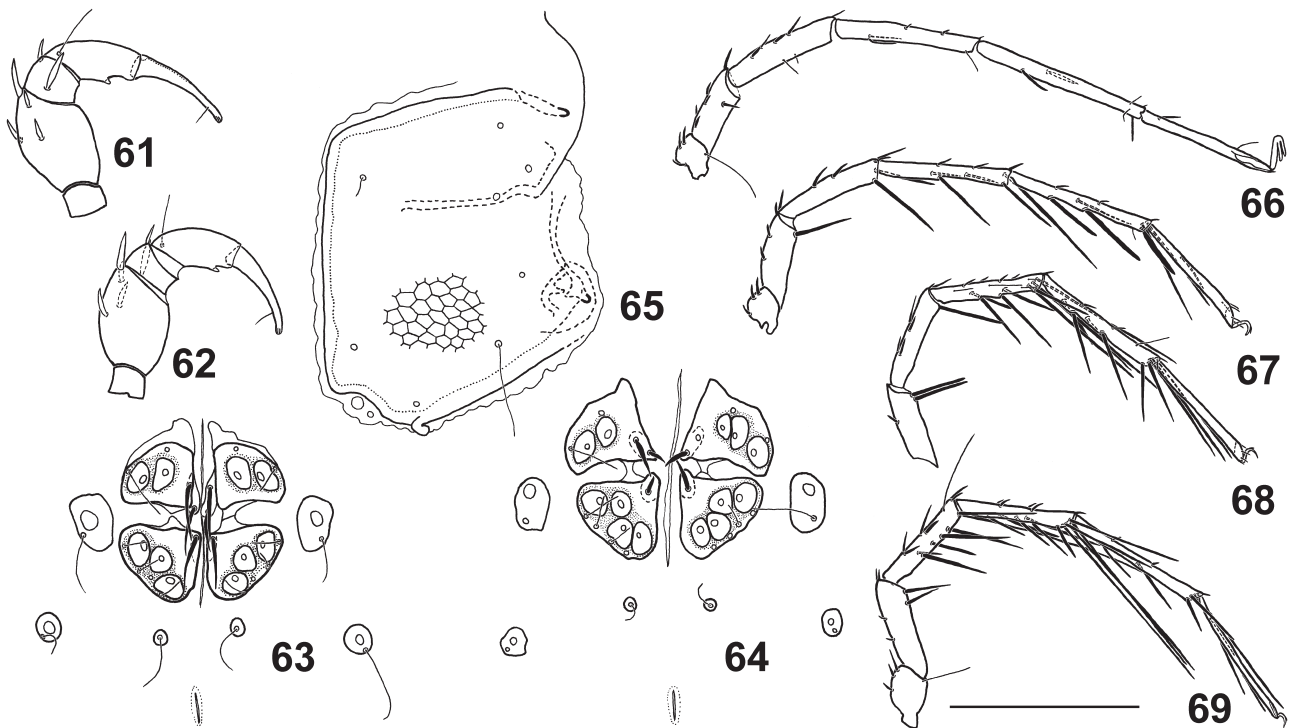
3.8 *Unionicola (Pentatax) rubromarginata* n. sp. (Figs. 61–69, Tab. 5)

Holotype: ♀, Madagascar, Province Toliara, Mandena near Fort-Dauphin, pool section in River Amendano, 13.IX.2001, leg. REINHARD GERECKE & TOM GOLDSCHMIDT, Prep.-No. 1179, SMF.

Paratype: 1 ♀, same collecting site and date as holotype, Prep.-No. 1178, SMF.

Etymology

The new species is named after the reddish coloured area around the acetabula on the acetabular plates.



Figs. 61–69. *Unionicola (Pentatax) rubromarginata* n. sp. – **61.** Holotype, ♀, right pedipalp, lateral view, Prep. 1179. **62.** Paratype, ♀, left pedipalp, medial view, Prep. 1178. **63.** Holotype, ♀, acetabular plates (reddish coloured areas dotted), Prep. 1179. **64.** Paratype, ♀, acetabular plates with 3 extra acetabula (reddish coloured areas dotted), Prep. 1178. **65.** Holotype, ♀, left III+IV-Cx, Prep. 1179. **66.** Holotype, ♀, left 1st leg, anterior view, Prep. 1179. **67.** Holotype, ♀, left 2nd leg, anterior view, Prep. 1179. **68.** Holotype, ♀, left 3rd leg, anterior view, Prep. 1179. **69.** Holotype, ♀, left 4th leg, anterior view, Prep. 1179. – Scale: 100 µm (61–65), 200 µm (66–69).

Diagnosis

Within the subgenus *Pentatax* the species belongs to the *Unionicola borgerti* group (see under *U. megalopsis* above). The areas around the acetabula on the acetabular plates are reddish; the stout seta on the outside of P-3 is flattened and relatively short; I-L-5 and I-L-6 are relatively long in proportion to the other extremity segments.

Description

U. rubromarginata is a relatively small species. The stout seta on the outer side of P-3 is flattened in cross-section and relatively short. The acetabular plates bear the usual 5 pairs of acetabula. The acetabular plates of the paratype ♀ have altogether 3 extra acetabula as a deformity (Fig. 64).

Similar to *U. concava* I-L bears only a few setae and II-L some long setae, while III-L and IV-L bear most of the partly very long swimming setae (Figs. 66–69).

Idiosoma size: holotype (♀ with 18 eggs): 436 × 344 µm, paratype (♀ with 3 eggs): 404 × 344 µm; egg size: 109 × 74 µm on average.

Differential diagnosis

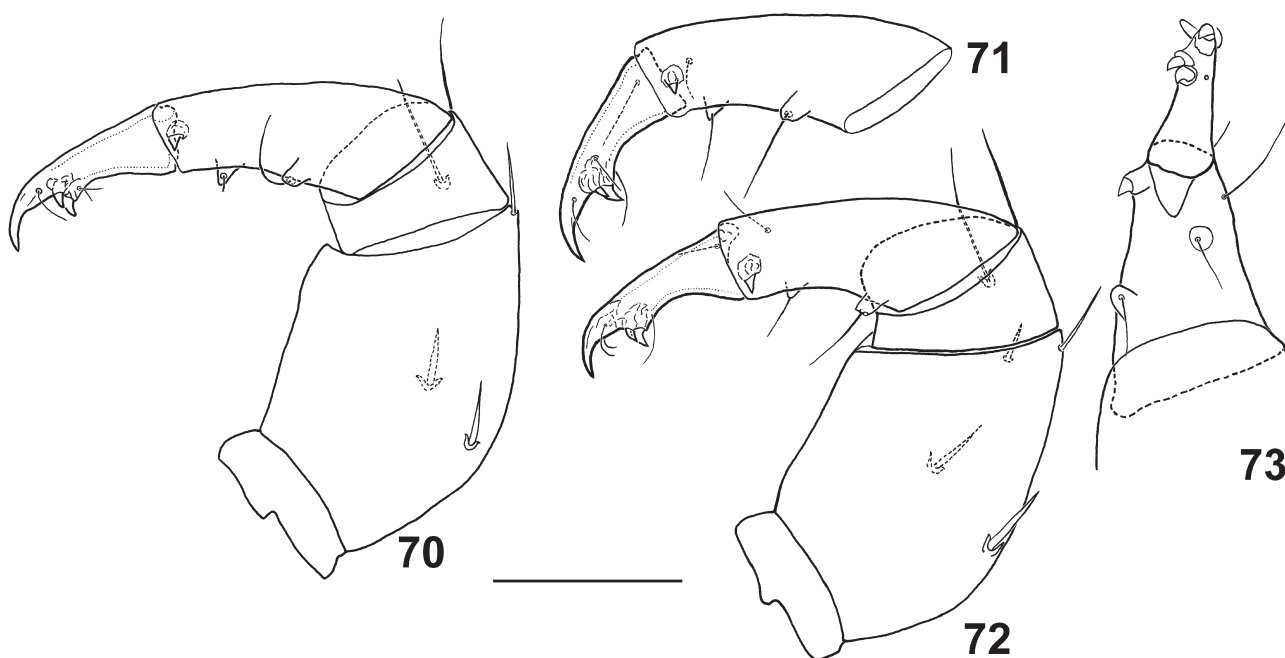
Unique in *U. rubromarginata* is the reddish colouration of the area around the acetabula on the acetabular plates, which has not been observed in any other species so far (Figs. 63, 64).

The variation of the stout seta on the outer side of P-3 within the *U. borgerti* group is discussed above under *U. concava*. Likewise the ratio diagram of Fig. 60 and the relative length of I-L-5 and I-L-6 are discussed there for some species of the *U. borgerti* group, to which *U. rubromarginata* also belongs.

3.9 *Unionicola (Unionicola) harpax* (Koenike, 1898) (Figs. 70–81, Tab. 6)

Material

1 ♀, 3 deutonymphs, syntypes of the KOENIKE collection in ZMB (Prep.-Nos. 1386–1388; ♀ in Prep.-No. 1386 is designated as lectotype, see below), Madagascar, Island of Nosy Be, Lake Djabala, October 1895; 2 ♀♀ from the Madagascar expedition in 2001 with the data: Madagascar, Province Toliara, Analamatsaky



Figs. 70–73. *Unionicola (Unionicola) harpax*. – **70.** Lectotype, ♀, right pedipalp, medial view, KOENIKE-Prep. 1386. **71.** ♀, right P-4 and P-5, medial view, Prep. 1173. **72.** ♀, right pedipalp, medial view, Prep. 1172. **73.** ♀, left P-4 and P-5, ventral view, Prep. 1172. – Scale: 100 µm.

near Tsimelahy, ditches near the village (dead branches of a small stream), 6.IX.2001, leg. REINHARD GERECKE & TOM GOLDSCHMIDT, Prep.-Nos. 1172–1173, SMF; 1 ♂, collection MILLOT in MNHN, Madagascar, Province Antsiranana, Ankarana, September 1946, leg. JACQUES MILLOT, MNHN, Prep.-No. A 20 J (1).

Redescription

Pedipalp with a huge terminal tooth and 2 small ventral teeth side by side. P-4 on the ventral side with 3 tubercles: 1 peg-tubercle distally on the inner side and 2 hair-tubercles medially on the outer side and proximally on the inner side. The medial hair-tubercle is short-coniform.

Acetabular plates with 6 pairs of acetabula in total. The 3 acetabula of the anterior plates lie nearly in a row in the lectotype ♀, as described by KOENIKE (1898) (Fig. 74), but not in the 2 ♀♀ found in 2001 (Fig. 75).

The I-L and II-L bear only relatively short and weak setae, especially on the I-L-4-5. In contrast III-L and IV-L possess long swimming setae (Figs. 78–81).

Idiosoma size of the females collected in 2001: ♀ without eggs: 754×628 µm, ♀ with 35 eggs: 1020×850 µm; egg size: 134×100 µm on average. KOENIKE (1898) stated his ♀ to be 0.8×0.64 mm large.

Differential diagnosis

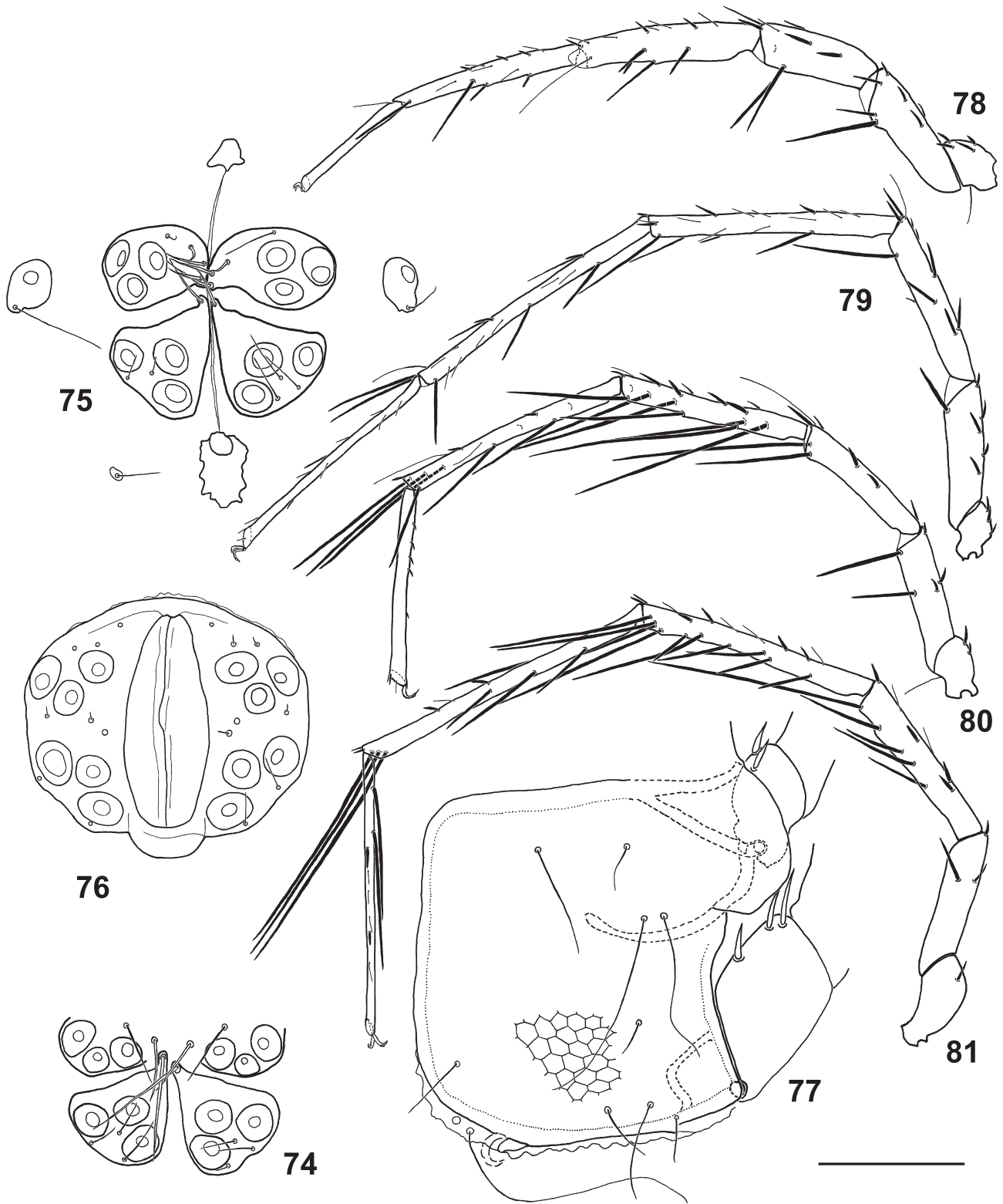
KOENIKE (1898) described *U. harpax* based on 1 ♀ and 14 deutonymphs from the Island of Nosy Be off the NW

coast of Madagascar. His figures of the pedipalp and the ventral view of the ♀ are the only ones of the species so far. The name refers to the great hooked terminal tooth on P-5. In the ZMB 3 KOENIKE-preparations of the type series are preserved: No. 1386 with the ♀ (undissected, only the left pedipalp removed), No. 1387 with 2 undissected deutonymphs, and No. 1388 with a partly dissected deutonymph, which is largely destroyed due to desiccation of the preparation. Prep. 1386 and Prep. 1388 are marked with the inscription “Type”.

The ♀ in Prep. 1386 is herewith designated as lectotype of *U. harpax*. Thus the 3 deutonymphs of Preps. 1387–1388 are paralectotypes. The lectotype ♀ was partly drawn anew (Figs. 70, 74), and the lectotype ♀ and both deutonymphs in Prep. 1387 were measured (Tab. 6).

U. harpax is probably closely related to *U. cyclophora*. Based on the literature the two species cannot be distinguished so far, because both possess a large terminal tooth on the P-5. Therefore type specimens of *U. cyclophora* were borrowed and the species was partly drawn anew and measured based on those specimens (see below).

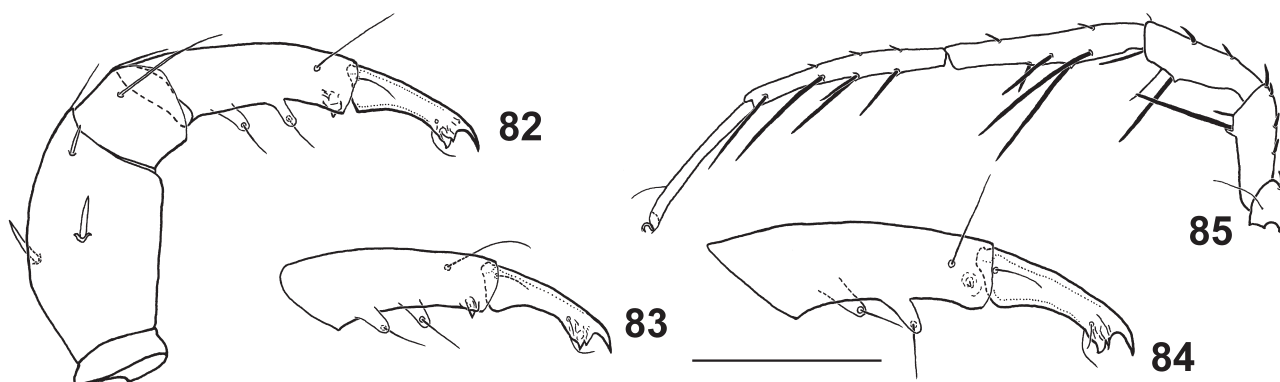
U. harpax has a considerably larger terminal tooth on P-5 than *U. cyclophora*, and the middle hair-tubercle of P-4 is short-coniform (Figs. 70–72) instead of being finger-like as in *U. cyclophora* (Figs. 82, 83). The setae of the legs also show clear differences between the two species. I-L-4 and I-L-5 in *U. harpax* bear distinctly shorter and weaker setae (Fig. 78) than *U. cyclophora* (Fig. 85).



Figs. 74–81. *Unionicola (Unionicola) harpax*. – 74. Lectotype, ♀, acetabular plates (as far as visible), KOENIKE-Prep. 1386. 75. ♀, acetabular plates, Prep. 1172. 76. ♂, acetabular plates, MNHN Prep. A 20 J (1). 77. ♀, left III+IV-Cx, Prep. 1173. 78. ♀, right 1st leg, anterior view, Prep. 1173. 79. ♀, right 2nd leg, anterior view, Prep. 1173. 80. ♀, right 3rd leg, anterior view, Prep. 1172. 81. ♀, right 4th leg, anterior view, Prep. 1173. – Scale: 100 µm (74–77), 200 µm (78–81).

Tab. 6. *Unionicola (Unionicola) harpax* and, for comparison, *U. cyclophora*, measurements of the extremity segments in μm . – Abbreviations see chapter 2.

<i>Unionicola harpax</i>	P		I-L				II-L				III-L				IV-L				III+IV-Cx	
	4	5	3	4	5	6	3	4	5	6	3	4	5	6	3	4	5	6	L	W
Lectotype, ♀, <i>U. harpax</i> , Madagascar, X.1895, KOENIKE-Prep 1386	155	111	164	244	243	179	241	335	357	311	205	278	326	289	243	323	422	408	253	230
Paralectotype, deutonymph, <i>U. harpax</i> , Madagascar, X.1895, KOENIKE-Prep. 1387 (larger specimen)	87	63	89	121	123	102	122	171	184	173	102	138	178	162	118	174	216	212	135	117
<i>U. harpax</i> , average of 2 ♀♀, Madagascar, 6.IX.2001, HEVERS-Prep. 1172–1173	163	112	165	238	252	173	234	325	362	318	203	265	323	279	245	320	410	362	251	227
<i>U. harpax</i> , ♂, Madagascar, IX.1946, MNHN, Prep. A 20 J (1)	165	110	167	241	247	184	242	326	354	300	199	266	313	273	250	321	420	378	266	227
Syntypes, <i>U. cyclophora</i> , average of 3 ♀♀, Cameroon, 4.I.1912, K. VIETS-Prep. 1306, 1308, 1310	150	93	156	243	252	194	234	313	345	307	187	253	319	271	226	301	393	378	223	186
Syntypes, <i>U. cyclophora</i> , average of 3 ♂♂, Cameroon, 4.I.1912, K. VIETS-Prep. 1307, 1309, 1311	128	83	142	214	219	168	218	296	316	295	176	229	285	245	203	271	357	336	209	164
Syntype, <i>U. cyclophora</i> , deutonymph, Cameroon, 4.I.1912, K. VIETS-Prep. 1312	78	52	85	121	133	104	122	161	187	174	100	128	177	153	110	156	207	208	115	92
<i>U. cyclophora</i> , average of 2 ♀♀, Liberia, 9.XII.1956, from COOK (1966)	142	87	165	240	251	182														

**Figs. 82–85.** *Unionicola (Unionicola) cyclophora*. – **82.** Syntype, ♂, right pedipalp, lateral view, K. VIETS-Prep. 1307. **83.** Syntype, ♂, left P-4 and P-5, medial view, K. VIETS-Prep. 1311. **84.** Syntype, ♀, right P-4 and P-5, lateral view, K. VIETS-Prep. 1306. **85.** Syntype, ♂, right 1st leg, anterior view, K. VIETS-Prep. 1307. – Scale: 100 μm (82–84), 200 μm (85).

The ratio diagram of Fig. 86 shows that the lectotype of *U. harpax*, the 2 ♀♀ captured in 2001, and the ♂ of 1946 coincide well. But compared with the extremity segments *U. harpax* has a longer P-5 than *U. cyclophora*, because the longer terminal tooth on P-5 is measured together with the segment.

U. harpax is only known from Madagascar, except for one deutonymph from Lake Muhazi in Rwanda, which K. VIETS (1921) placed in *U. harpax* because of its characteristic P-5.

Reference species

Unionicola (Unionicola) cyclophora Viets, 1913
(Figs. 82–85, Tab. 6)

K. VIETS (1913/14) described ♀, ♂, and a deutonymph based on an unstated number of specimens from Cameroon. The type series in the SMF contains 7 syntypes in 7 preparations: K. VIETS-Prep. 1306–1312 with 3 ♀♀, 3 ♂♂, and 1 deutonymph; all collecting data are identical: Cameroon, Manoka near Duala, 4.I.1912. Astonishingly K. VIETS did not compare his new species

with *U. harpax*, which his mentor KOENIKE had described from Madagascar.

Cook (1966) placed 2 ♀♀ from Liberia in *U. cyclophora* without discussion. His figures and measurements show the

shorter terminal tooth of P-5, the longish middle hair-tubercle on P-4, and the longer setae on I-L-4-5. The diagnosis is therefore unambiguous; see also the corresponding curve in Fig. 86. *U. cyclophora* has not been found again since then.

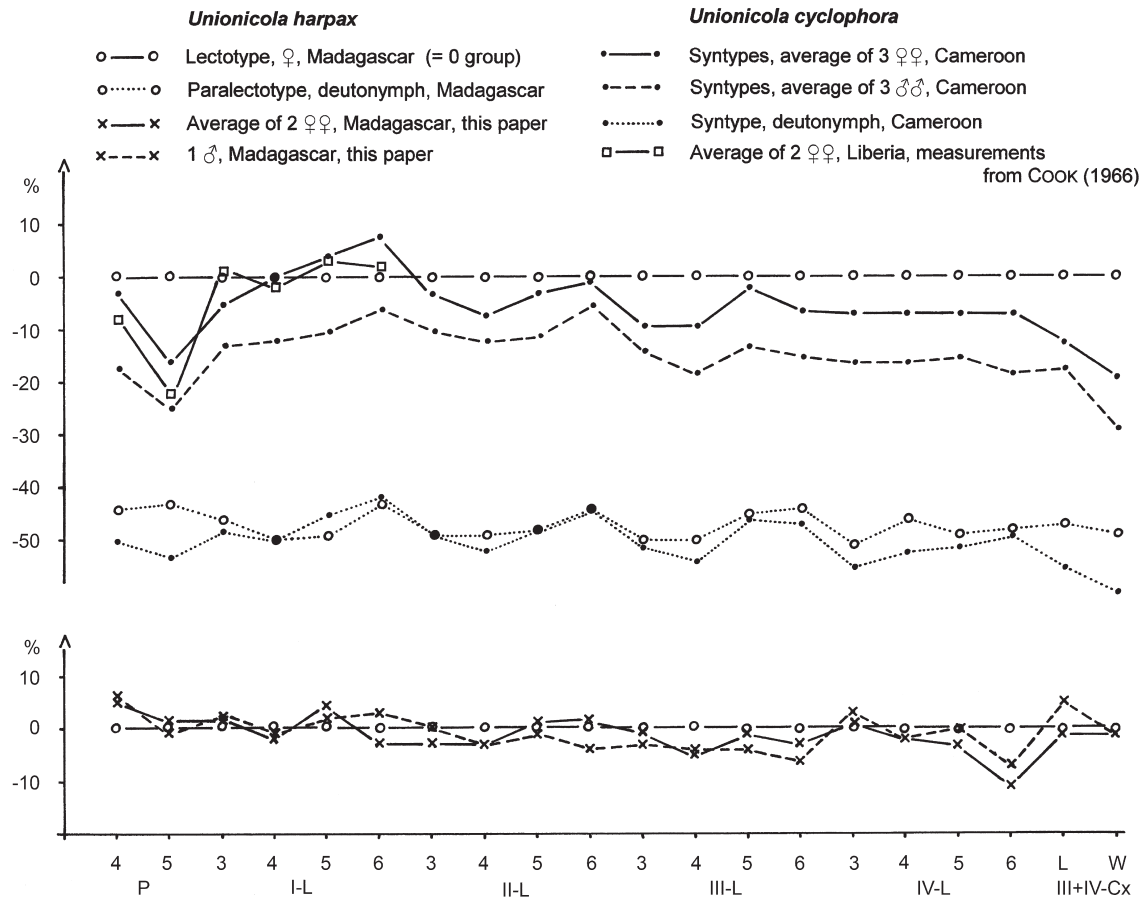


Fig. 86. Ratio diagram of *Unionicola* (*Unionicola*) *harpax* and *U. (U.) cyclophora*. The curves of the 3 newly discovered specimens of *U. harpax* are pictured in the lower part of the figure for clearness. – Underlying measurements see Tab. 6.

4 Conclusions

In total, including the specimens investigated here, 10 *Unionicola* species are now known from Madagascar. Eight of these species are only described from Madagascar, and *U. harpax* has one additional deutonymph mentioned from Rwanda. Only *U. megalopsis* is apparently widespread over the African continent.

The recorded species are probably only a small fraction of the *Unionicola* species of Madagascar. The collections so far must be seen as findings by chance, especially as the expedition in 2001 had its main focus on flowing waters and springs. *Unionicola*, however, mainly lives in mostly stagnant waters. Therefore it would not be helpful to pro-

vide already here a key to the few Malagasy *Unionicola* species.

Up to now the freshwater molluscs of Madagascar have not been searched systematically for parasitic or transient *Unionicola* species either. Only BADER (1978) described a Malagasy species from a gastropod: *U. (Pentatax) curtipalpis* from the ampullariid *Pila madagascariensis*. But especially the associations between *Unionicola* and Bivalvia are extremely diverse, as a worldwide overview of *Unionicola* and its hosts from the freshwater mussel order Unionoidea shows (VIDRINE 1996, GLEDHILL & VIDRINE 2002). Therefore especially in freshwater molluscs a considerable number of new species will likely be found, also in Madagascar.

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