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Description of a new species of *Catamachilis* (Insecta: Microcoryphia) from Spain

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Abstract

Stach (1930) described several new species of Microcoryphia from Spain, among them two belonging to the genus *Catamachilis*, namely *C. clipeata* and *C. ancorata*, the latter with specimens from two localities (Flix in Tarragona and La Pobla de Segur in Lleida), more than 160 km far away one of each other. Bach de Roca (1982) provided new data of both species with fresh specimens from several localities from Spain including La Pobla de Segur. Fanciulli et al., (1990) made a molecular study with gene-enzyme technique of genus *Catamachilis* including specimens from La Pobla de Segur and Monte Caro (Tarragona), this latter relatively close to Flix, resulting that the two populations having important genomic differences. So, now we have collected specimens in the two localities from where Stach described *C. ancorata* and have performed a morphometric and morphological study concluding that they belong to different species. The main differences in the morphometric study of males are found in most articles of maxillary palp, the femur and tibia of foreleg, the coxites and styli V and VIII and the opening of the penis. For females the length of the articles 3 and 6 of the maxillary palp, also of the articles 2 and 3 of labial palp, some variables on the urosternites V to IX and the number of divisions of gonapophysis VIII and IX show significant differences between both populations. The most relevant morphological differences between males are the quetotaxy of maxillary palp, and the penis opening; in females, the hardiness of maxillary palp, the number of spines on the tibia of hind leg and the number of divisions and chaetotaxy of gonapophysis. Because Stach named Flix as the type locality for *C. ancorata*, the specimens from La Pobla de Segur are here described as a new species, named *C. ilerdensis* sp. n.

Keywords Archaeognatha | Machilidae | Catamachilis | new species | Spain

1 Introduction

Stach (1930) published a study on the Microcoryphia fauna from Spain with material collected by Dr. Haas between 1914 and 1919. Among the new species described in that work, two of them belong to the genus *Catamachilis*, endemic to the Iberian Peninsula. Only two species were previously known: *C. constricta* (Navás, 1905) described with males and females and *C. torquata* (Navás, 1905), described only with females; this latter was assigned posteriorly to the genus *Pseudocatamachilis* Gaju & Bach de Roca

1991 when the male was described. The two species established by Stach were *C. clipeata* Stach, 1930 and *C. ancorata* Stach, 1930, both with specimens from several localities and, specifically for *C. ancorata*, a male and a female from Flix (Tarragona) and only one female from La Pobla de Segur (Lleida), more than 160 km apart. Stach designated Flix as the type locality. The consideration of the *C. ancorata* specimens as a new species was clear, due to the ovipositor, since it had characteristics that clearly differentiated it from the other three species. The ovipositor of *C. torquata*, now *Pseudocatamachilis torquata* (Navás, 1905), is considered to be of the primary type (now tertiary type sensu Sturm & Bach de Roca, 1993), while those of the other species were considered to be of the secondary type; the ovipositor of *C. ancorata* being much longer than that of *C. constricta* and *C. clipeata*. Bach (1976) cited *C. ancorata* for the first time after its original description in Marganell and Rocamora (Barcelona) where she found 2 females and several juveniles; later Bach de Roca (1982) studied specimens from La Pobla de Segur and surrounding areas (Talarn and Monte Claverol) and completed the description of the male of *C. ancorata* with the description of the scale pattern, the male maxillary palp (only known by three articles in the Stach's description) and other morphological and morphometric characteristics. *C. ancorata* was studied under scanning electron microscopy by Bach et al. (1986) but there is no reference to the place where the specimens were collected. In 1990, through a collaboration with the University of Siena (Italy), a molecular study was carried out using the gene-enzyme technique on several populations of *Catamachilis* from Spain (Fanciulli et al., 1990); two populations of *C. ancorata* were studied, one from La Pobla de Segur and the other from Monte Caro (Tarragona), the latter 40 km from Flix (type locality for *C. ancorata*). The study found that the two populations presented great genetic variability, since 45% of the genetic loci in common alleles were different, so they must correspond to two different taxonomic entities. Therefore, the present study is carried out to corroborate the morphological differences between the two populations previously attributed to *C. ancorata*. We have sampled the localities from which Stach described *C. ancorata*: Flix (Tarragona) and La Pobla de Segur (Lleida). In addition, we have reviewed all the samples that we had identified as *C. ancorata* from the provinces of Barcelona and Tarragona and a morphometric and morphological study has been carried out to analyze the differences between these populations and those of Lleida (surroundings of La Pobla de Segur).

2 Materials and Methods

Catamachilis specimens were captured using an entomological aspirator. Some specimens were fixed in ethanol, and others were preserved alive for laboratory study. They were raised in boxes with shelter, lichens for food, and humidity provided by water-filled vials with cotton plugs. The cephalic and thoracic appendages and abdominal urosternites were dissected using fine forceps and mounted in microscope slides with Tendeiro's fluid; finally, they were dried in an oven for at least a week. The dissections were performed using a Leica EZ4W stereomicroscope, equipped with LAS 4.13 photography equipment and software. The microscope slides were studied using a NIKON Labophot microscope equipped with a DS-Fi1 camera and NIS-Elements F2.20 software. The morphometric study was performed using

Table 1. Specimens studied in morphometric analysis.

	Locality	Province	Date	UCO-Ref.	Length mm
Males	Talarn	Lleida	14/05/1978	M0202-1	8
	La Pobla de Segur	Lleida	14/05/1978	M0207-1	8
				M0207-2	7
	La Pobla de Segur	Lleida	28/05/1986	M0569	9.0
	La Pobla de Segur	Lleida	28/05/1986	M0570-1	9.0
				M0570-2	8.2
				M0570-3	8.1
				M0570-4	8.0
	Conca de Dalt	Lleida	04/09/1992	M1316	9.0
	La Pobla de Segur	Lleida	05/04/2023	M1947-1	8.5
				M1947-2	9.5
	La Bisbal del Penedés	Tarragona	15/04/1987	M0594-2	10.0
				M0594-6	10.0
				M0594-7	10.0
	Alfara de Carles (M.	Tarragon	28/05/1982	M0595	10.5
	Falset	Tarragon	15/04/1987	M0596	10.0
	Alfara de Carles (M.	Tarragon	20/02/1990	M0601	10.5
	Alfara de Carles (M.	Tarragon	20/02/1990	M0602	8.5

	Locality	Province	Date	UCO-Ref.	Length mm
Females	Talarn	Lleida	14/05/1978	M0202-2	8
	La Pobla de Segur	Lleida	14/05/1978	M0207-3	8
	La Pobla de Segur	Lleida	17/02/1990	M0568	9.5
	La Pobla de Segur	Lleida	28/05/1986	M0570-5	10
				M0570-6	10.5
				M0570-7	11
				M0570-8	13
	La Pobla de Segur	Lleida	05/04/2023	M1947-3	10.5
	Marganell	Barcelon	31/08/1973	M0052	10
	La Bisbal del Penedés	Tarragona	15/04/1987	M0594-1	11.5
				M0594-3	12
				M0594-4	11
				M0594-5	9
	Alfara de Carles (M.	a	28/05/1982	M0595-1	11
	Falset	Tarragon	15/04/1987	M0596	11.5

Table 2. Comparison of means between the variables measured in males and females of *C. ancorata* and *C.* cf *ancorata*. Examples of abbreviations: L: length; W: width; PMX-7: seventh article of maxillary palp; PLB-2: second article of labial palp; P-1,2,3: first to third legs; Urost.: Urosternite; Op Penis: penis opening.

Females		Mean		P val.
		C. cf ancorat	*C. ancorata*	
Maxillary palp	PMX- 7 L	0.65	0.70	0.2 ns
	PMX- 6 L	0.79	0.89	0.04 *
	PMX- 5 L	0.92	1.04	0.09 ns
	PMX- 4 L	0.58	0.65	0.2 ns
	PMX- 3 L	0.52	0.62	0.001 ***
	PMX- 7 W	0.13	0.12	0.4 ns
	PMX- 6 W	0.17	0.18	0.5 ns
	PMX- 5 W	0.23	0.26	0.2 ns
	PMX- 4 W	0.28	0.31	0.3 ns
	PMX- 3 W	0.33	0.37	0.1 ns
Labial palp	PLB- 3 L	0.49	0.57	0.01 **
	PLB- 2 L	0.41	0.49	0.001 ***
	PLB- 3 W	0.37	0.41	0.1 ns
	PLB- 2 W	0.20	0.21	0.3 ns
Leg 1	P-1 Femur L	0.75	0.86	0.08 ns
	P-1 Tibia L	0.65	0.73	0.08 ns
	P-1 Femur W	0.49	0.50	0.8 ns
	P-1 Tibia W	0.38	0.39	0.6 ns
Leg 2	P-2 Tibia L	0.59	0.58	0.9 ns
	P-2 Tibia W	0.35	0.36	0.9 ns
Leg 3	P-3 Tibia L	0.79	0.80	0.8 ns
	P-3 Tibia W	0.34	0.34	1 ns
Urost. V	Coxite V	0.94	1.03	0.01 **
	Stylus V	0.46	0.48	0.2 ns
	Spine Stylus	0.14	0.16	0.005 **
Urost. VII	Coxite VII	0.99	1.13	0.004 **
	Stylus VII	0.56	0.57	0.6 ns
	Spine Stylus	0.15	0.17	0.03 *
Urost. VIII	Coxite VIII	1.06	0.97	0.1 ns
	Stylus VIII	0.76	0.84	0.4 ns
	Spine Stylus	0.17	0.20	0.02 *
	Gonapophysi	41.63	37.71	0.01 *
Urost. IX	Coxite IX	1.92	2.16	0.03 *
	Stylus IX	1.33	1.43	0.2 ns
	Spine Stylus	0.19	0.23	0.04 *
	Gonapophysi	41.75	35.00	0.001 ***

Males		Mean		P val.
		C. cf ancorat	*C. ancorata*	
Maxillary palp	PMX- 7 L	0.63	0.79	0.02 *
	PMX- 6 L	0.84	1.01	0.02
	PMX- 5 L	1.01	1.20	0.01 **
	PMX- 4 L	0.67	0.76	0.02 *
	PMX- 3 L	0.58	0.68	0.02 *
	PMX- 7 W	0.20	0.24	0.09 ns
	PMX- 6 W	0.22	0.30	0.005 **
	PMX- 5 W	0.28	0.36	0.01 **
	PMX- 4 W	0.33	0.40	0.01 **
	PMX- 3 W	0.35	0.42	0.008 **
Labial palp	PLB- 3 L	1.00	0.97	0.9 ns
	PLB- 2 L	0.55	0.61	0.08 ns
	PLB- 3 W	0.56	0.57	0.8 ns
	PLB- 2 W	0.26	0.29	0.2 ns
Leg 1	P-1 Fémur L	0.77	0.86	0.04 *
	P-1 Tibia L	0.70	0.78	0.02 *
	P-1 Fémur W	0.50	0.49	0.8 ns
	P-1 Tibia W	0.38	0.38	0.4 ns
Leg 2	P-2 Tibia L	0.66	0.66	0.6 ns
	P-2 Tibia W	0.35	0.35	0.7 ns
Leg 3	P-3 Tibia L	0.86	0.86	0.6 ns
	P-3 Tibia W	0.32	0.33	0.3 ns
Urost. V	Coxite V	0.85	0.94	0.001 ***
	Stylus V	0.45	0.49	0.05 *
	Spine Stylus	0.14	0.15	0.6 ns
	Stylus/Coxite	0.53	0.52	0.6 ns
	Spine/Stylus	0.32	0.30	0.3 ns
Urost. VIII	Coxite VIII	0.93	1.06	0.01 **
	Stylus VIII	0.66	0.74	0.03 *
	Spine Stylus	0.16	0.17	0.2 ns
	Stylus/Coxite	0.70	0.70	0.5 ns
	Spine/Stylus	0.25	0.24	0.7 ns
Urost. IX	Coxite IX	1.46	1.55	0.2 ns
	Stylus IX	1.21	1.35	0.1 ns
	Spine Stylus	0.20	0.19	0.9 ns
	Stylus/Coxite	0.83	0.87	0.4 ns
	Spine/Stylus	0.16	0.15	0.3 ns
Penis	Penis W	0.31	0.29	0.5 ns
	L/W Op Penis	1.09	1.37	0.001 ***

a graduated scale adapted to the microscope eyepiece, and metric equivalences were established using a 1-cm micrometer scale graduated in 100 divisions. The length and width of the maxillary palp articles, femur, and tibia of the legs were measured. In the abdominal urosternites, the length of the coxites, styli, and terminal spine, as well as the length and width of the penis opening, were measured. The divisions of the distal antennal chains and the gonapophyses were counted. Photographs were used to create morphological drawings of the appendages and for specific chaetotaxy, using the GIMP (2019) version 2.10.12 package. The statistical study was performed using the PAST version 5.1 program (Hammer et al., 2001). Due to the small number of samples studied (between 7 and 11 for males and females from each population), the difference in means of the measured variables was analyzed using the nonparametric Mann-Whitney U test. Variables showing significant differences were standardized, and a Principal Components and Discriminant Analysis were performed.

Supplementary material is online included with tables and figures.

3 Results

3.1 Morphometric study

The study conducted by Fanciulli et al. (1990) was carried out with specimens from two localities, one for each population: Monte Caro for *C. ancorata* and La Pobla de Segur for the population that Bach de Roca used to complete Stach's description. We conducted a morphometric study comparing specimens from several localities for each population (see Table 1 and Fig. S1), identifying as *C. ancorata* the specimens of the localities close to the type locality, Flix, located in the provinces of Tarragona and Barcelona, and *C.* cf *ancorata* for the localities close to La Pobla de Segur in the province of Lleida.

Tables with all the measured variables (mm) for males and females are provided as supplementary material Table S1 and S2.

The results of the comparison of means between the variables are shown in Table 2. Those that have shown significant differences have been highlighted with a grey background, indicating the level of significance by (*). The three variables that have shown high significant differences for females PMX-3L, PLB-2L and gonapophysis IX) and the two more significant variables for distinguishing males are coxite V and Op Penis.

Using all variables that showed significant differences, a Principal Components Analysis (Fig. 1) was performed. Males and females from the two populations were clearly separated. Although the groups of males are better grouped than those of females.

To corroborate this result, a Discriminant Analysis (Fig. 2) was performed using the same variables, showing a better separation of males and females from the two populations.

All individuals assigned to males or females for each population were confirmed in their respective groups (Table 3).

Both analyses confirm that the two populations analyzed correspond to two different species. Therefore, the specimens we analyzed as *C.* cf. *ancorata* correspond to a new species that we will name *Catamachilis ilerdensis* sp. n., which we describe below. Stach (1930) used the specimens of Flix to describe *C. ancorata* and Bach de Roca (1982) completed Stach's description with specimens from La Pobla de Segur, which means that the data published by Bach de Roca correspond to the new species. Firstly, an update of Stach's description with the characters not supplied by Stach and widening the variability of some characters with the data of all specimens studied now; further the description of the new species, updating the Bach de Roca description of specimens from Lleida.

Catamachilis ancorata Stach, 1930

Updated description. Stach's description of *C. ancorata* was quite complete; however, the distal articles of the maxillary palp were undescribed, as the only male available only had articles 1 to 3. This work completes this description and expands the species' variability by studying specimens from several locations in the provinces of Tarragona and Barcelona (Table 1 and Fig. S1 and S2).

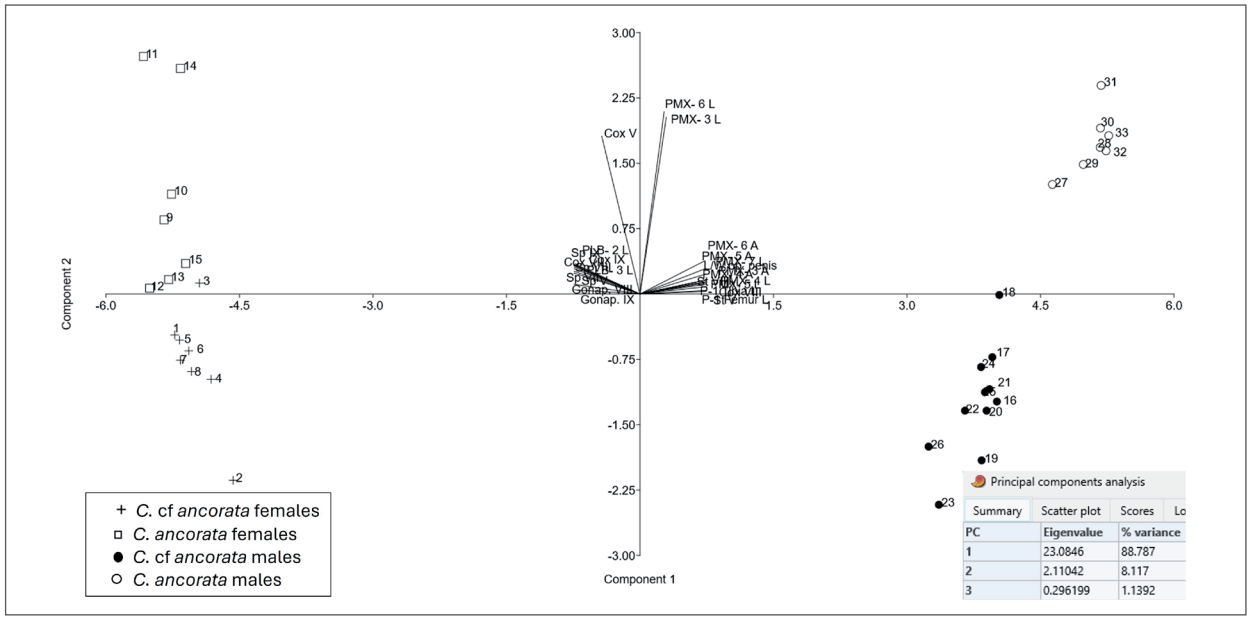


Figure 1. Principal Components analysis. Axis 1 accounts for 88.78% of variability.

General biometric values: body length without antennae and terminalia 9.5 mm (male), 11 mm (female) for specimens from Flix -Ref. M1962- (Type locality), but for studied specimens (tables S1 and S2) the body length ranges from 9 to 12 mm for females and 7 to 10.5 mm for males; antennae 9 mm (male), 6 mm -broken- (female) for Ref. M1962 (Type locality), but maximum measured 11.5 mm for a male Ref. M0595, slightly longer than body; terminalia frequently broken but for Type locality paracercus 9 mm (male),8 mm -broken- (female); cerci 3.4 mm (male) and 4 mm (female). Scales dorsal pattern as in Fig. 3 and Fig. S3 compared with that of *C. ilerdensis* n. sp (Fig. 4).

The head (Figs 5–8, 18–21 and Fig. S3) is like that described by Stach, but we provide data on the relationships between the head, eyes, and ocelli (Table 4).

Regarding the antennae (Fig. 9), Stach provides the number of divisions on the distal chains, which range from 12 to 18, values equivalent to ours.

Table 3. Group table with the results of the Discriminant Analysis. All specimen males or females proposed for each group have been confirmed in their respective groups.

Groups	1	2	3	4	Total
1	8	0	0	0	**8**
2	0	7	0	0	**7**
3	0	0	11	0	**11**
4	0	0	0	7	**7**
Total	**8**	**7**	**11**	**7**	**33**

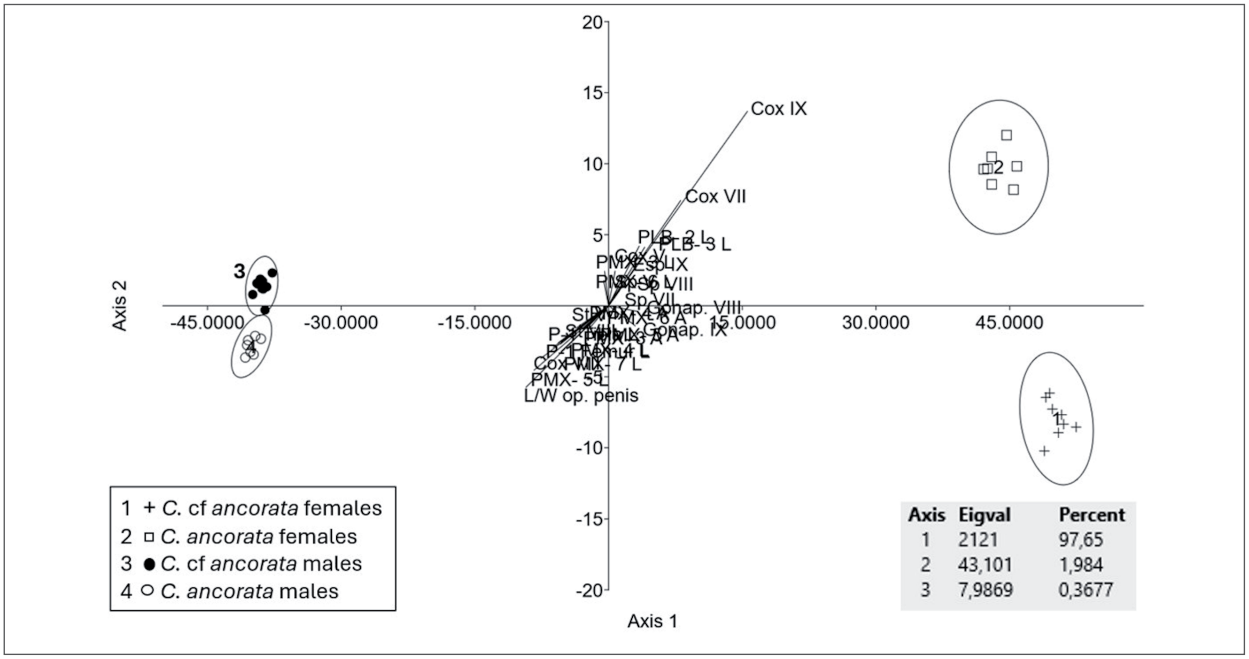


Figure 2. Discriminant analysis. Axis 1 accounts for more than 97% of variability.

Table 4. Head vs Eyes relationships. W: width; L: length; Icl: eyes contact line length; Oc: ocellus; Oc-Oc in/out: relation between inner and outer sides of ocelli; Oc-Oc-out/Eyes-W: relation between outer distance of ocelli related to the wide of both eyes. (Some values may be inaccurate because the measurements were made on the drawn heads and the limits of the ocelli and the eyes were sometimes not clear).

	C. ilerdensis sp. n.		*C. ancorata*	
	Female	**Male**	**Female**	**Male**
Eyes/Head-W	0.65	0.71	0.62	0.69
Eye-L/W	0.84	0.81	0.85	0.84
Eye-Icl/L	0.48	0.36	0.41	0.43
Oc-L/W	0.80	0.80	0.72	0.56
Oc/Eye-W	0.40	0.37	0.45	0.59
Oc-Oc in/out	0.31	0.53	0.47	0.41
Oc-Oc-out/Eyes-W	0.57	0.71	0.81	0.94

The maxillary palp (Figs 10 and 22) constitutes a secondary sexual character in the male, modifying its shape and chaetotaxy. Stach described the first three articles, since the only male he studied lacked four distal articles. The biometric study showed that the maxillary palp differs between *C. ancorata* and *C. ilerdensis* sp. n., furthermore, when observed under microscope, some differences in chaetotaxy had been found, mainly related to the small, strong, curved and spiralized setae found in the ventral region of the articles, which can be seen in Figure 9 of Stach's description on the ventral part of articles 2 and 3, along with some long ciliary setae. In Fig. S4 can be seen that these setae are present in all articles from 2 to 7.

The labial palp (Figs 11 and 23) matches that described by Stach.

The legs (Figs 12–14 and 24–26) also match the original description, except for the number of spines on the tibia of the female's third pair of legs: Stach indicates 4 to 8 spines, while our results shown 5 to 16 (see Table S3 in Supplementary Material and Fig. S5).

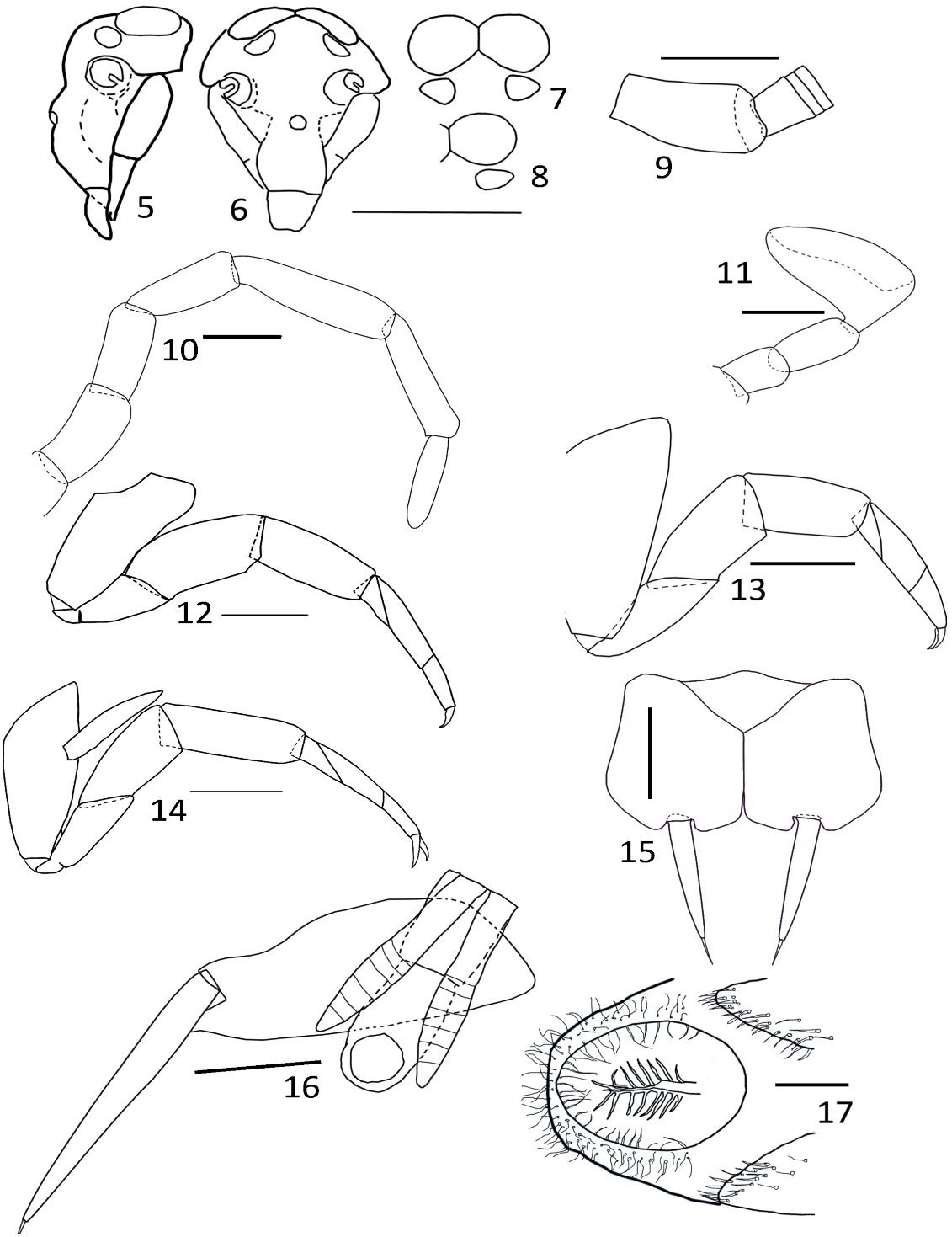
The urosternites (Figs 15–16 and 27–29) also match Stach's description, but the relationships of the samples studied in biometric study are provided (Table 5).

Figure 3. Habitus of *C. ancorata* from Flix (loc. type).

Figure 4. Habitus of *C. ilerdensis* sp. n. from La Pobla de Segur (loc. type).

In the biometric study, we have found differences in the shape of the genital opening of the penis and in the number of divisions of the ovipositors. *C. ancorata* has the male genital opening oval in longitudinal sense (length/width ratio is 1.37 with a range between 1.13 to 1.61) see figure 17 and Fig. S6.

Regarding the ovipositor, it has been seen that the number of divisions is a differentiating character of



Figs 5–17. *Catamachilis ancorata* Stach, 1930. All figures of a male from Flix (M1962-1) except fig. 17 of a male from La Bisbal del Penedés (M0594-1). (**5 – 8**) Head, frontal, lateral views and two different views of eyes. (**9**) Scapus and pedicellus; (**10**) Maxillary palp; (**11**) labial palp; (**12–14**) fore, mid and hindlegs; (**15**) Urosternite VIII; (**16**) Urosternite IX with penis and parameres; (**17**) Penis opening. Scale bar: 5–8: 1 mm; 9–16: 0.5 mm; 17: 0.1 mm.

C. ancorata with respect to the new species (Table 2), however there is a certain variability, in the case of *C. ancorata*, gonapophyses VIII (Fig. 28) have 34 to 44 divisions (mean: 38), Stach indicates 41 to 44. The IX gonapophyses (Fig. 29) show a variability between 32 to 38 divisions (mean: 35) and Stach indicated 40–41. We do not know if in the description of the female Stach used only characters from the Flix specimens or also from La Pobla de Segur (which would correspond to *C. ilerdensis* sp. n.), Bach de Roca (1982) indicated in their discussion relative to *Catamachilis clipeata* Stach, 1930 (pag. 38–39), referring to the comments of Dr. Andrzej Szeptycki (Polish Academy of Science) that sometimes Prof. Stach included parts of different specimens in the same slide. So, the possibility of data of specimens from both populations (Flix and La Pobla de Segur) in the *C. ancorata* original description cannot be rejected. Details of gonapophyses apex are shown in Supplementary Material Fig. S7).

Material studied. Barcelona: Marganell, 31/08/1973, 1F + 25j (F), J. Roca and C. (Bach leg., Ref. UCO M0052a; Calafell, 25/05/1992, 1M+2F (M-F), R. Molero leg., Ref. UCO M0782; Tarragona: Vilarodona (to Santes Creus), 18/07/1974, 1F, J. Roca and C. Bach leg., Ref. UCO M0113; Alfara de Carles (From Roquetas to Monte Caro after Requés): 28/05/1982, 4M+1F (M-F), M. Gaju leg., Ref. UCO M0595; 20/02/1990, 2M (M), M. Gaju leg., Ref UCO M0601; 20/02/1990, 2M+2F (M), M. Gaju leg., Ref UCO M0602; 03/04/1993, 1F, M. Gaju leg., Ref UCO M0542; Falset (Falset mountain pass Alt. – 500 m ASL), 1M + 1F (M-F), M. Gaju leg., Ref. UCO M0596; La Bisbal del Penedés (C-51 km 17) Alt. 240 m ASL, 8M+4F (4M-3F) M. Gaju leg., Ref. UCO M0594); Flix -Type locality- (close to the Castle), 22/05/2023, 3M + 3F (M-F), M. Gaju leg., (coord.: 41.23713N 0.5563352E Alt. 107 m ASL, Ref. UCO M1962; Flix (C-233 to road to Meandre), 3M + 1 F M. Gaju leg., (coord,: 41.24885N 0.5582821E) Alt. 59 m ASL, Ref. UCO M1963. Between parentheses, after the number of specimens for each locality, the number of specimens dissected and mounted on slides.

Description of *Catamachilis ilerdensis* sp. n.

***Catamachilis ilerdensis* Gaju, Bach de Roca, Remache and Molero sp. nov.**

= *Catamachilis ancorata* Stach, 1930, pro parte (non *C. ancorata* Stach, 1930) n. syn. (sensu Bach de Roca 1982).

Diagnosis: Head with compound eyes slightly wider than long. Ocelli in submedian position. Antennae approximately as long as the body (males) or slightly shorter (females). Maxillary palp of the male modified in shape and chaetotaxy, lacking small, strong, curved and spiralized setae on ventral side of articles 2–4. Labial palp of the male with the third article greatly modified (widened). Thorax normal, only the third pair of legs with a coxal style. Abdominal urosternites with well-developed sternites, approximately at right angles, with a pair of eversible vesicles on segments I-VII, with coxal styli on segments II-IX. Males with a well-developed penis, with hidden by the IX coxite and parameres only on the ninth segment. Females with a secondary type of ovipositor with ca. 42 divisions, clearly extending beyond the coxite of the ninth segment.

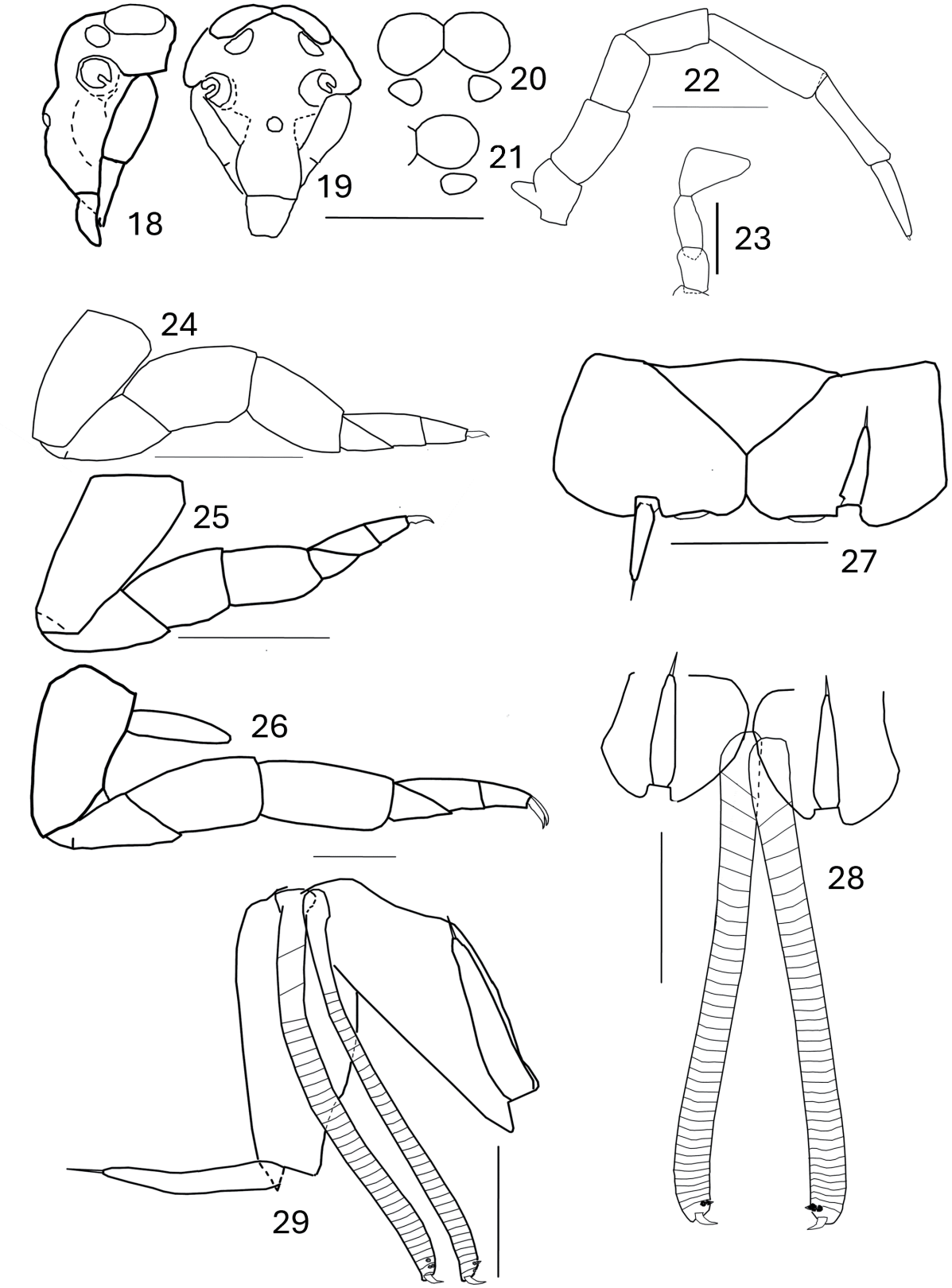
Derivation of the name: The species name refers to "Ilerda", name given by the Romans to the capital of the Spanish province in which the new species is found.

***Catamachilis ilerdensis* sp. n.**

Description: Adult body length over 7–13 mm, maximum length in males 9.5 mm (holotype), in females 13 mm; thorax width 2.6 mm in males and 2.9 mm in females; maximum antennae length 9 mm in males and 8 mm in females; paracercus approximately the same length as the body, 9 mm in the holotype, and cerci 3.8 mm in the holotype. The dorsal pattern formed by the scales is characteristic, was presented by Bach de Roca in 1982. A photograph is provided (Fig. 4) compared with that of *C. ancorata*. It is more defined in males than in females, in which a pattern like that of the male can be seen, but not as sharp (see photograph in supplementary material Fig. S8).

Table 5. Relationships between coxites (Cx), styli (St) and the spine of the styli (Sp) in urosternites V, VIII and IX.

	Female		Male	
	C. ancorata	*C. ilerdensis*	*C. ancorata*	*C. ilerdensis*
StV/CxV	0.47	0.48	0.52	0.53
Sp/St-V	0.33	0.31	0.30	0.32
StVIII/CxVIII	0.87	0.72	0.72	0.70
Sp/St-VIII	0.24	0.23	0.24	0.25
StIX/CxIX	0.66	0.69	0.87	0.83
sp/St-IX	0.16	0.14	0.15	0.16



Figures 18–29. *Catamachilis ancorata* Stach, 1930. Female. All figures from a specimen from Falset (Tarragona) (M0596) except Figs (**18–21**) and (**23**) of a female from Flix (loc type) (M1962-2). (**18 – 21**) Head, frontal, lateral views and two different views of eyes. (**22**) Maxillary palp; (**23**) Labial palp; (**24–26**) Fore, mid and hindlegs; (**27**) Urosternite V; 28: Urosternite VIII with gonapophyses; (**29**) Urosternite IX with gonapophyses. Scale bar: 18-21: 1 mm; 22-29: 0.5 mm.

Head (Figs 30–33, 44–47 and Fig. S8): unpigmented, only a small spot between the clypeus and the labrum; with brown scales between the paired ocelli up to the odd ocellus, also on the sides of the head outside the paired ocelli; some setae on the frons between the paired ocelli; clypeus and labrum with fine, colorless setae.

Eyes of a uniform light color, without spots, slightly wider than long; paired ocelli are somewhat pale reddish color, surrounded by white. Relationships of eyes and ocelli are in Table 4.

The antennae are almost as long as the body in males (Fig. 4), shorter in females; they are covered by brown scales from the scape to the distal chains. The scape length-to-width ratio is somewhat greater in females (1.5 to 2.1) than in males (1.5 to 1.85) (Figs 34 and 48); if the distal chains are not broken, their number of divisions ranges from 10–11 to 17–18, the average number for the last four distal chains, in various individuals, both males and females, is 14.

The maxillary palp (Figs 35 and 49) is not pigmented and differs between males and females, since in the male it is highly modified in shape and chaetotaxy; biometric studies have shown that both males and females show differences with respect to *C. ancorata*. The chaetotaxy of the male allows the new species to be clearly differentiated from *C. ancorata* (Figs S4, S9 and S10); the ventral part of all maxillary palp articles is covered by numerous short, strong and spiralized setae in *C. ancorata* (Fig. S4 and S10), while in the new species similar setae are only present in part of the fifth article and in the last two. Likewise, the new species presents numerous thin, long, spiralized setae throughout the ventral region of articles 2 to 6 (Fig. S9 and S10), less numerous in the latter and missing in the seventh, while in *C. ancorata* these setae are observed in the same position in articles 2 to 4, are scarcer in the fifth and missing in the last two. The hyaline spines, characteristic of the last three articles, are more numerous in females than in males, with the following values: in females 7: 10 to 16, 6: 13–14, 5: 1–2; males: 7: 8–12, 6: 7–9, 5: 1.

The labial palp (Figs 36 and 50) also shows secondary sexual differences. The male's third article is much more widened. It has not shown significant differences from the male *C. ancorata*, although in females, the second article is somewhat shorter than that of *C. ancorata*, resulting in significant differences (Table 2).

The legs of *C. ilerdensis* sp. n. (Figs 37–39 and 51–53) are slightly smaller than those of *C. ancorata*, but only the length of the femur and tibia of the first pair of legs show significative differences (Table 2). Moreover, the number of spines in ventral side of the articles is lower in *C. ilerdensis* sp. n. (see Table S3 in Supplementary Material); specifically the number of spines on the tibia of the female third pair of legs is clearly higher in *C. ancorata*, (an average of 6 versus 11) (Figs S5), a statistically significant result analyzed with U-Mann Whitney ($p < 0.001$***).

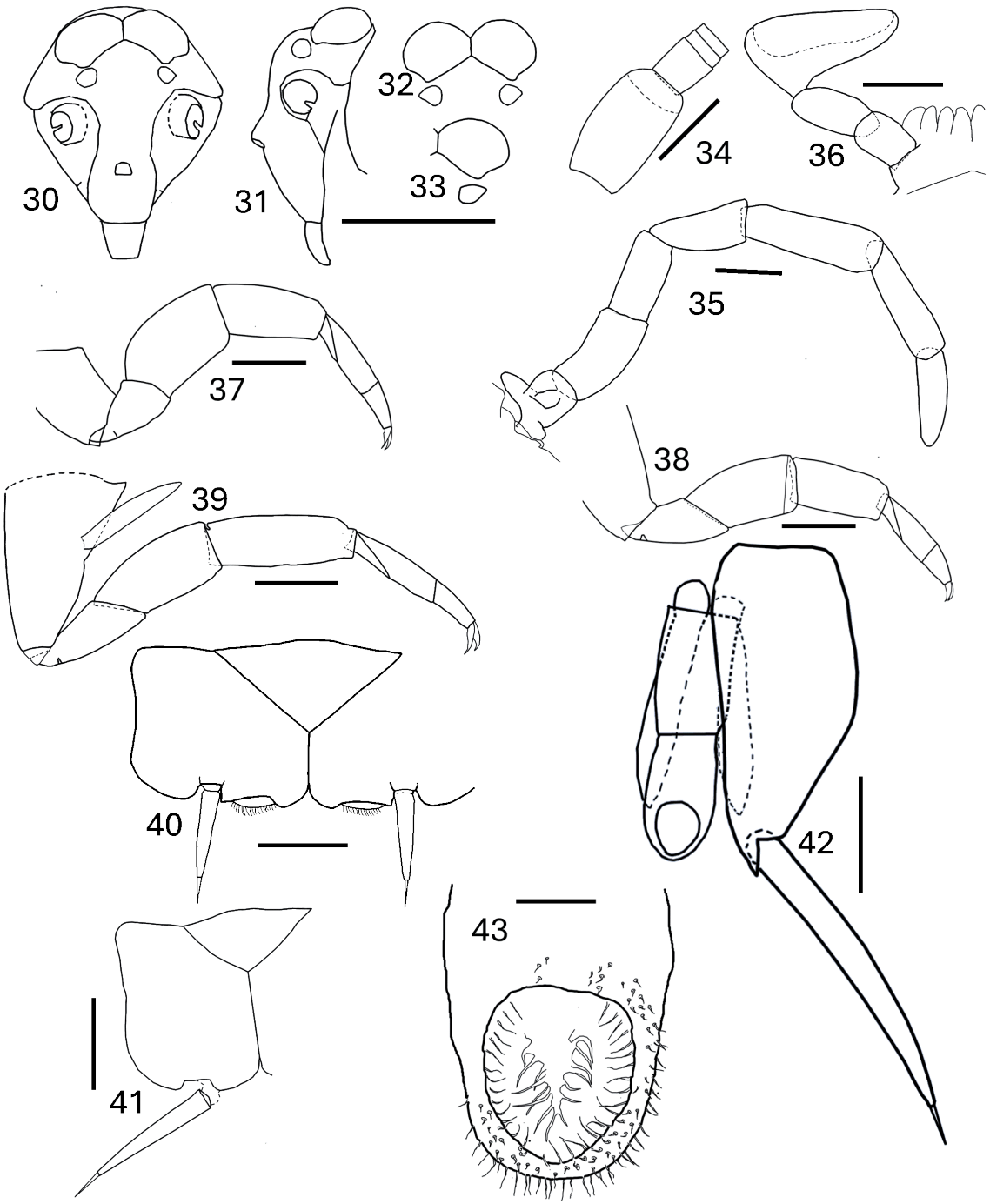
The abdomen is characterized at the level of the urosternites by presenting a single pair of eversible vesicles on urosternites I-VII and coxal styles on II-IX; the sternites are large, with a posterior angle of almost 90º. The urosternites (Figs 40–42 and 54–56) are similar to those of *C. ancorata*, but because *C. ilerdensis* sp. n. is slightly smaller, some coxites and styli show slight statistical differences (see Table 2). Table 6 shows the results of the relationship for urosternite variables. The average of the 11 males studied is provided and compared with the values of the holotype; the values of the 8 females analyzed are also included. Urosternite VII is usually studied in females because it presents an extension in the distal medial region of the coxites.

Urosternites VIII and IX include genitalia; males only have parameres on the ninth segment. They consist of 1+6 divisions. The penis is large, with the distal and basal parts of similar size, Basal part/Distal part= 1.0; the genital opening has a distinctly different shape from that of *C. ancorata*, thus constituting a diagnostic character. It is slightly longer than it is wide (Fig. 43) their length/width ratio is 1.09 with a range between 1.0 to 1.18, while in *C. ancorata* it is clearly longer and oval longitudinally (Fig. 17 and S6).

Table 6. Relationship for urosternite variables. Mean Pop= Mean of specimens studied in morphometric analysis 11 males and 8 females.

	Male		Female
	Mean Pop.	Holotype	Mean Pop,
Coxite V	0.85	0.89	0.94
Stylus V	0.48	0.48	0.46
Spine Stylus V	0.14	0.15	0.14
Stylus/Coxite	0.53	0.54	0.48
Spine/Stylus	0.32	0.31	0.31
Coxite VII			0.99
Stylus VII			0.56
Spine Stylus VII			0.15
Stylus/Coxite VII			0.56
Spine/Stylus VII			0.27
Coxite VIII	0.93	1.07	1.06
Stylus VIII	0.66	0.76	0.76
Spine Stylus VIII	0.16	0.19	0.17
Stylus/CoxiteVIII	0.70	0.71	0.72
Spine/Stylus VIII	0.25	0.25	0.23
Coxite IX	1.46	1.52	1.92
Stylus IX	1.21	1.35	1.33
Spine Stylus IX	0.20	0.23	0.19
Stylus/Coxite IX	0.83	0.89	0.69
Spine/Stylus IX	0.16	0.17	0.14

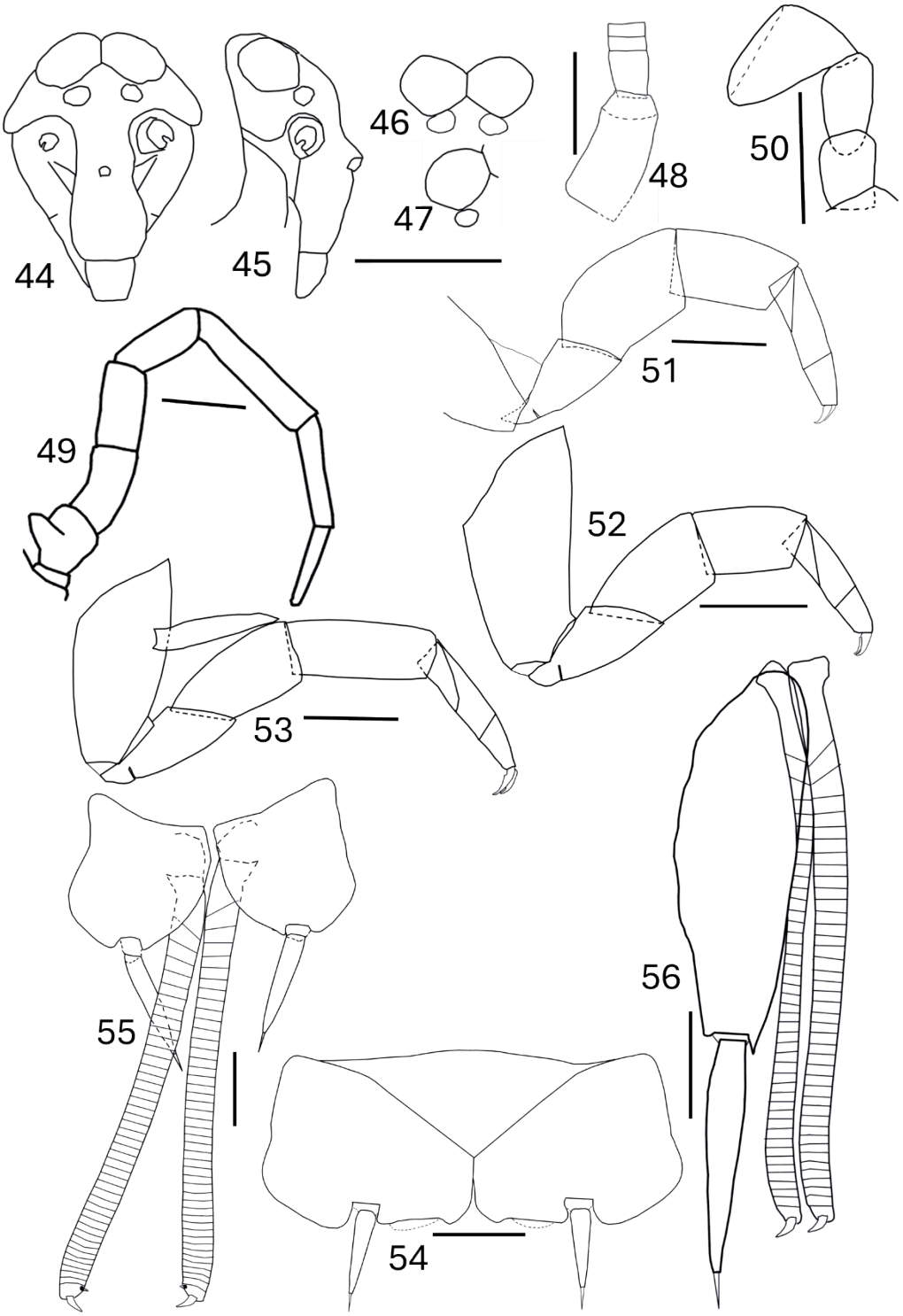
The ovipositor is of the secondary type and is long, reaching half or more of the styli of the ninth segment. Gonapophyses VIII (Fig. 55) with a range of 37 to 44 and a mean of 41 divisions. Gonapophyses IX (Fig. 56) with 40 to 44 divisions and a mean of 41. In both gonapophyses, the last division ends in a very large, curved spine. The number of divisions of the ovipositor constitutes a diagnostic character to differentiate the new species from *C. ancorata* since in *C. ilerdensis* the number of divisions is greater. Details of gonapophyses apex of *C. ilerdensis* sp. n. are shown in Supplementary Material Fig. S11).



Figures 30–43. *Catamachilis* ilerdensis sp. n. (Holotype): (**30**) Head frontal; (**31**) Head lateral; (**32**) Eyes frontal; (**33**) Eye fronto-lateral; (**34**) Scapus and pedicellus; (**35**) Maxillary palp; (**36**) Labial palp; (**37–39**) Fore, mid and hind legs; (**40**) Urosternite V; (**41**) Urosternite VIII; (**42**) Urosternite IX with penis and parameres; (**43**) Penis opening. Scale: 0.5 mm except Figs 30–33: 1 mm and Fig. 43: 0.1 mm.

***Catamachilis ilerdensis* sp. n.**

Material studied. **Holotype**: Lleida: Male 9.6 mm, La Pobla de Segur (Collegats N-260 km 303 to Gramuntill), 05/04/2023, 9 Males + 4 Females Victor Gaju and Miquel Gaju leg., 42,26902N/1.023950E, alt.: 576m, Ref. UCO M1947-2, deposited in the Museo Nacional de Ciencias Naturales in Madrid (Colection



Figures 44–56. *Catamachilis* ilerdensis sp. n. female (Paratype M1947-3): (**44**) Head frontal; (**45**) Head lateral; (**46**) Eyes frontal; (**47**) Eye fronto-lateral; (**48**) Scapus and pedicellus; (**49**) Maxillary palp; (**50**) Labial palp; (**51–53**) Fore, mid and hind legs; (**54**) Urosternite V; (**55**) Urosternite VIII with gonapophyses; (**56**) Urosternite IX with gonapophyses; Scale: 0.5 mm except Figs 44–47: 1 mm.

reference: "MNCN_Ent 283580 Holotipo") (slide + ethanol tube).

Paratypes: Same place and date than the Holotype: 1 Male + 1 Female in the Museo Nacional de Ciencias Naturales in Madrid (Colection reference: "MNCN_Ent_430052 Paratipos" in one ethanol tube). 1 Male + 1 Female in Museum National d'Histoire Naturelle París (waiting number of collection). 6 Males + 2 females in Department of Zoology University of Cordoba; Ref.; M1947-1 Male 8.5 mm length in slide + ethanol tube; 1 Female M1947-3 10.5 mm length in slide + ethanol tube; and 5 Males + 1 Female Ref. M1947, in two ethanol tubes.

Other material studied. Talarn, 14/05/1978, 18M+6F (M-F), J. Roca and C. Bach leg. Ref. UCO M0202; La Pobla de Segur (Collegats) 14/05/1978, 2M + 1 F (2M-F) J. Roca and C. Bach leg., Ref. UCO M0207; La Pobla de Segur (Collegats),15-05-1978. 1M + 1F, J. Roca and C. Bach leg. Ref. UC M0205; La Pobla de Segur (Collegats N-260 km 303) Alt. 540 m ASL, 28/05/1986, 2M, (M), M. Gaju leg., Ref. UCO M0569; La Pobla de Segur (Collegats N-260 km 302), 28/05/1986, 10M + 6F (4M-4F), M. Gaju leg, Ref. UCO M0570; La Pobla de Segur (Collegats N-260 Km 303), 17/02/1990, 1M + 1F (F), M. Gaju leg, Ref-UCO M0568; Conca de Dalt (Pont de Claverol – desllicador), 04/09/1992, 1M + 14j (M), J. Roca and C. Bach leg., Ref. UCO M1316. Between parentheses, after the number of specimens for each locality, the number of specimens dissected and mounted on slides.

Online supplementary material

Supplementary Figures S1 to S11 and Tables S1 to S3.

Acknowledgements

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