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A NEW REFUGE FOR *SIMULIUM* (*RUBZOVIA*) *PARALOUTETENSE* CROSSKEY, 1988 (DIPTERA: SIMULIIDAE) ON LA GOMERA (CANARY ISLANDS)

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ABSTRACT

Given the destruction of the only previously known locality of *S. paraloutetense* Crosskey 1988 on Gran Canaria, the discovery of a young larva in a spring brook on La Gomera is of special faunistic importance. The determination was difficult as there are no clear diagnostic characters for young larvae; plausible differentiation from the similar species was, however, possible. Bionomic information about the distribution and ecology of other simuliid species on La Gomera are given.

Keywords: Aquatic insects, black flies, *Rubzovia*, larva, new finding, spring brook, morphology, taxonomy, faunistics.

RESUMEN

Un nuevo refugio para *Simulium (Rubzovia) paraloutetense* Crosskey, 1988 (Diptera: Simuliidae) en La Gomera (Islas Canarias)

Debido a la destrucción de la única localidad conocida anteriormente de *S. paraloutetense* Crosskey, 1988 en Gran Canaria, el descubrimiento de una larva joven en un arroyo primaveral de La Gomera reviste una especial importancia faunística. La determinación fue difícil ya que no hay caracteres diagnósticos claros para las larvas jóvenes; sin embargo, fue posible una diferenciación plausible de especies similares. Se proporciona información bionómica sobre la distribución y ecología de otras especies de simúlidos en La Gomera.

Palabras clave: Insectos acuáticos, moscas negras, *Rubzovia*, larva, nuevo hallazgo, arroyo de primavera, morfología, taxonomía, faunística.

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Introduction

Even if the blackfly fauna of La Gomera has already been examined several times (Crosskey, 1988; Crosskey & Báez, 2004; Reidelbach, 2004; Lüderitz *et al*., 2010), three holiday stays in 2013, 2016 and 2020 offered the possibility to also examine the preimaginal stages in selected flowing waters. All in all, 1207 individuals could the determined, the existence and distribution of which confirmed the results of the previous examinations (Table 1): in the longitudinal profile of the El Cedro stream, the hypocrenal areas as well as the upper course in the laurel forest are preferred by *S. guimari* Becker, 1908 and the following stream section is populated by *S. intermedium* Roubaud, 1906 and *S. velutinum* (Santos Abreu, 1922); *S. tenerificum* Crosskey 1988 mentioned in earlier examinations has been synonymised in the meantime (Adler *et al*., 2015). Outside the laurel forest, there is also *S. ruficorne* Macquart, 1838 which is able to even populate smallest trickles that are drying out such as in Barranco de Arure near El Guro (Table 1) (cf. Chereiria & Adler, 2018). *Simulium pseudequinum* Séguy, 1921 which is also mentioned for La Gomera could not be found as no samples were taken in the corresponding biotope, the lower stream sections of the lower altitudes.

Table 1.— Species composition at the 9 sampling sites on La Gomera, with annotations for the individual numbers (“la”: larvae; “pu”: pupae), the geographical coordinates and the altitude.

Tabla 1.— Composición de especies en las 9 localidades de muestreo en La Gomera, con indicación del número de individuos (“la”: larvas; “pu”: pupas), las coordenadas geográficas y la altitud.

Location	Latitude/longitude	Elevation (m asl)	Date	*S. guimari*	*S. intermedium*	*S. paraloutetense*	*S. ruficorne*	*S. velutinum*	N
El Cedro stream, right spring brook	28°07`29"N/17°13`08"W	950	12/5/13	209 la/39 pu					248
El Cedro stream, upper reach	28°07`29"N/17°13`23"W	930	12/5/13	151 la/93 pu				0 la/1 pu	245
El Cedro stream, Ermita N. Señora	28°07`38"N/17°13`16"W	905	12/5/13	107 la/78 pu				10 la/0 pu	195
El Cedro stream near El Cedro village	28°08`09"N/17°12`51"W	810	12/5/13	42 la/1 pu	68 la/14 pu		0 la/1 pu	1 la/1 pu	128
			12/3/20	80 la/6 pu	12 la/15 pu			16 la/4 pu	133
Barranco del Cedro, Las Poyatas	28°09`10"N/17°11`56"W	225	15/5/13		15 la/0 pu			25 la/1 pu	41
		225	12/3/20	watercourse dried out					0
Stream near Ermita N.S. de Guadal.	28°07`40"N/17°12`35"W	750	15/5/13	1 la/0 pu	11 la/3 pu			6 la/5 pu	26
Waterfall, Camino Forestal La Meseta	28°09`08"N/17°17`16"W	710	15/5/13	20 la/1 pu		1 la/0 pu			22
			21/2/16	no sampling due to high water					0
			12/3/20	0 la/1 pu					1
Barranco de las Lagunetas	28°07`35"N/17°17`00"W	1022	15/5/13		2 la/1 pu		55 la/33 pu	25 la/8 pu	124
Barranco de Arure, El Guro	28°06`28"N/17°19`34"W	175	13/5/13				38 la/6 pu		44
Individuals (N)				829	141	1	133	103	1207

The determination of the samples of 2013 coming from a spring brook at “Camino Forestal La Meseta”, further up Vallehermoso, came as a surprise: in addition to 20 *S. guimari* larvae, one young *Rubzovia* larva was found, which at first sight was determined as *S. paraloutetense* Crosskey, 1988. Due to its little size of 3.3 mm and the not yet developed pupal respiratory buds which correspond to the third instar (Harrod, 1964), the final determination was, however, postponed. Apart from that, it has been planned to visit the island again in the future aiming at finding more animals, particularly the pupae which are easier to determine.

Material and methods

The next stay on the island followed in February 2016 and was disappointing in as much as at the time of the sampling, the spring brook had high water level due to long lasting rainfall so that no successful sampling was possible (Fig. 1). This was particularly also due to the fact that the laurel leaves that had served as substrate in the first sampling had been washed away by the water current and the rock had also been uninhabited. In March 2020, the spring was finally visited once again within the scope of a Tenerife holiday, during a one-day trip to La Gomera. It is true that the hydrologic conditions were ideal (Fig. 2), the success of the sampling was, however, limited to the finding of one single pupa exuvia of *S. guimari* settling on a laurel leave lying in the water.

Rubzovia species are generally not only rare but also only few individuals of them are found (Crosskey *et al.*, 1999). This fact is easy to confirm given the difficulties encountered in the previous, vain sample takings. As it was not clear how long it would take to make another finding, it seemed to be appropriate to intensively deal with the young larva once again to secure the faunistic importance of the finding from a taxonomic point of view.

The only existing determination key for the pre-imaginal stages of *Rubzovia* is based on the differentiation of the pupae (Crosskey *et al.*, 1999). Based on own examinations and using the available literature data, Seitz *et al*. (2012) list the most importing diagnostic characters of all five known *Rubzovia* species (Adler, 2020) for the larvae in a synoptic table. As, however, a safe determination is based on examinations of the mature larvae with fully developed gill histoblasts, clear diagnoses are usually not possible when examining young larvae due to the lack of this characteristic. One thus tried to amend the table mentioned above by additional larval determination characteristics with the goal of ensuring the most exact and

Figs. 1-2.— Waterfall “Camino Forestal La Meseta”. 1 High water after rainfall, February 2016. 2. Low water, March 2020.

Figs. 1-2.— Cascada “Camino Forestal La Meseta”. 1. Elevado caudal después de lluvias, febrero de 2016. 2. Escaso caudal, marzo de 2020.

safe determination for *S. paraloutetense* possible (Table 2); *Simulium vantshi* Petrova, 1983 was not considered due to its range restricted to the central Asian Pamir Mountains of Tajikistan where the preimaginal stages settle in glacial streams (Petrova, 1983).

Results

The most striking features which the larvae of the *Rubzovia* species have in common are the triangular (sagittate) posteromedian headspot as well as the small and/or missing postgenal cleft, which immediately strike the eye in the determination. There are minor differences between the species as regards the form of this headspot and as regards the extension of the cleft allowing for a rough classification of the species (Table 2). Comparison of these two characteristics immediately allows for the conclusion that our larva can be identified as *S. paraloutetense* (Figs. 3–4). While Crosskey *et al*. (1999) describe the important “median tooth of hypostoma” character which is important for many blackfly species in a slightly inaccurate way as “moderately long”, the “nipple-like projection” of the corner teeth of hypostoma described by these authors can also be confirmed for our larva (Fig. 5). In contrast, the corner teeth of hypostoma of *S. joanae, S. knidirii* and *S. lamachi* have a triangular form (Table 2).

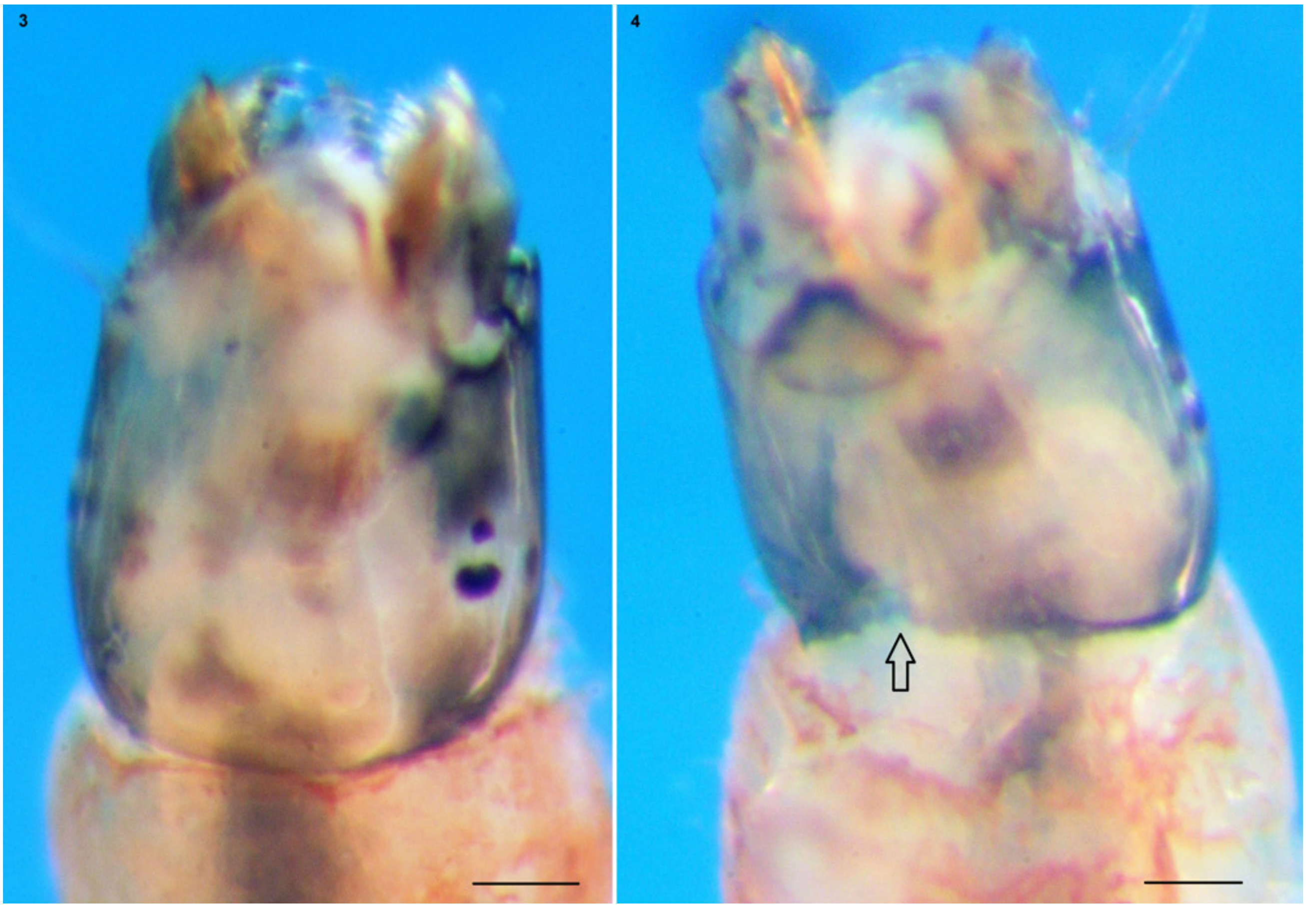
The number of lateral serrations of hypostoma following the two paralateral teeth seems to be a useful diagnostic character which – for *S. paraloutetense* - have a pointed form. Due to its young age, our larva has three fully developed, pointed serrations, the remaining ones are only hardly or not visible at all, yet (Fig. 5, arrow). As with the other species, these serrations are blunt and rounded or completely missing, this allows for a differentiation from the other species (Table 2).

The inner preapical ridge of our young larva shows a large distal mandibular serration, which is long, triangular, and sharply pointed (Fig. 6). On one mandible this serration is followed by one subsidiary tooth, on the other mandible, there is moreover an additional, hardly visible small tooth; this corresponds to the characteristics of a mature *S. paraloutetense* larva. In contrast, *S. knidirii* has three subsidiary teeth, while with *S. lamachi*, the subsidiary tooth is closer to the serration and moreover bent. This simplifies the differentiation from the other species (Table 2).

Table 2.— Selected diagnostic characters of the four western Palearctic *Rubzovia* larvae.

Table 2.— Caracteres diagnósticos seleccionados de las cuatro larvas de *Rubzovia* del Paleártico occidental.

Diagnostic character (distribution range)	***S. (R.) joanae*** **Seitz, Zwick & Adler, 2012**	***S. (R.) lamachi*** **Doby & David, 1960**	***S. (R.) knidirii*** **Giudicelli & Thiery, 1985**	***S. (R.) paraloutetense*** **Crosskey, Malmqvist & Nilsson, 1999 (last instar larva)**	***S. (R.) paraloutetense*** **present study (third instar larva)**
	Portugal (Madeira)	France, Germany, Morocco, Spain	Morocco	Spain (Gran Canaria)	Spain (La Gomera)
posteromedian headspot	isosceles triangle	isosceles triangle	isosceles triangle	sagittate short triangle with blunt tip	sagittate equilateral triangle
postgenal cleft	nearly absent	quadratic or trapezoidal	quadratic	small trapezoidal excavation	minute triangular excavation
median tooth of hypostoma	longer than corner teeth	shorter than /equal to corner teeth (own observation)	as long as corner teeth	moderately long	slightly longer than corner teeth
corner teeth of hypostoma	pointed triangular projection	strong, triangular	strong, triangular	nipple-like projection	nipple-like projection
lateral serrations of hypostoma	6 (short, blunt)	4 (blunt)	0	5-8 (pointed)	3 (pointed)
mandible, preapical ridge	1 elongate triangular tooth, 1 subsidiary tooth	1 elongate triangular tooth, close to 1 subsidiary bent tooth	1 elongate triangular tooth, 3 subsidiary teeth	1 long, triangular, sharply pointed tooth, 2-3 subsidiary teeth	1 elongate triangular tooth, 1-2 subsidiary teeth
primary fan rays	30-32 (juv. larva: 21)	30-35	26-35	22-25	22
sublateral setae of hypostoma per side	14-17 (juv. larva: 9)	6	7	10-14	7-8
posterior circlet, rows	120 (juv. larva: 93)	85-90	85	85	68
hooks per row	12-17 (juv. larva: 10)	12-15	12-16	12-15	8-10



Figs. 3-4.— *Simulium paraloutetense*. 3. Larva, head spots. 4. Larva, head underside (arrow indicates small post-genal cleft). Scale bars = 100 μm.

Figs. 3-4.— *Simulium paraloutetense*. 3. Larva, manchas cefálicas. 4. Larva, parte inferior de la cabeza (la flecha indica una pequeña hendidura postgenal). Escalas = 100 μm.

Figs. 5-6.— *Simulium paraloutetense*. 5. Larva, hypostoma (arrow indicates lateral serrations of hypostoma). 6. Larva, mandible. Scale bars = 50 μm.

Figs. 5-6.— *Simulium paraloutetense*. 5. Larva, hipostoma (la flecha indica estrías laterales del hipostoma). 6. Larva, mandíbula. Escalas = 50 μm.

The other diagnostic characters listed in Table 2 are typical meristic features, to which a certain range applies, depending on the individual. When it comes to the determination of the number of the primary fan rays of young blackfly larvae, there are more or less deviations from the reference value of the full-grown larvae (Schröder, 1987, 1988). Similarly, the number of the sublateral setae of hypostoma is clearly smaller with both, the young *paraloutetense* larva and the young *S. joanae* larva of identical size, which has been examined for comparative purposes, than the corresponding number of the mature larvae. Nevertheless, these two young larvae already have as many sublateral setae as mature *S. knidirii and S. lamachi* larvae.

For the number of rows of posterior circlet and the number of hooks per row it can be specified that with our larva, they were only developed about 80 percent due to its growth stage. This value complies with values that were for example also determined for corresponding young larvae of *Prosimulium tomosvaryi* (Enderlein, 1921) (Halgos & Jedlicka, 1973 sub. nom. *P. nigripes*).

Discussion

Given the diagnostic characters described above, it is also possible to determine the exact species of young *Rubzovia* larvae with high probability by means of combination and exclusion. If posteromedian headspot, postgenal cleft, corner teeth and serrations of hypostoma are available collectively, *S. paraloutetense* can be differentiated from the other three species. The characters preapical ridge of mandible and sublateral setae of hypostoma moreover allow for the pairwise differentiation between the four similar species.

As to the ecological differentiation, it can be stated based on the cited literature information as well as on own examinations of *S. lamachi* that *S. knidirii, S. lamachi* and *S. paraloutetense* live in smallest spring brooks with little water and weak current which may already trickle away after a short section. In contrast to these species strictly bound to the hypocrenal, *S. joanae* is also found on Madeira in rhithral stream sections characterised by stronger current.

One decade after the first description of *S. paraloutetense* (Crosskey, 1988), the preimaginal stages were described (Crosskey *et al*., 1999). After another five years, however, it was reported that the only known aquatic finding spot was lost due to drying up and destruction (Crosskey & Báez, 2004). So from a faunistic point of view, the present finding is a stroke of luck as now, a second record could be determined for *S. paraloutetense*. The number of species determined on La Gomera is thus increased to six; consequently, the island has the largest species variety of all Canary Islands (López-Peña & Jiménez-Peydró, 2017).

Let us hope that for the existence of this species on La Gomera, the sampling site can be regarded as protected as the spring is situated within the "Parque Nacional de Garajonay". The spring brook itself falls down a rock face already after few meters (Figs. 1–2); at the foot of which it originally accumulated and – after passing a trail – flowed down the valley. The major part of the discharge is, however, actually collected in the lower section of the small waterfall and led via a pipeline into a duct so that the lower section of the rock face is only kept wet by droplets.

As regards the water supply, it can be assumed that discharge is guaranteed throughout the year due to the North-East exposition favoured by the Trades and the related precipitation, which is – by the way – also confirmed by the existing syntopic taxa *Dugesia gonocephala* (Dugès, 1830) (Turbellaria) and Amphipoda.

All in all, the discovered situation at the spring largely corresponds to the descriptions of the habitat of *S. paraloutetense* on Gran Canaria stating that the spring there also showed a very low discharge, a short flowing section, North exposition and shading by trees; the larvae were mainly found in the phytal (Crosskey *et al.*, 1999). To confirm more potential localities on La Gomera, it thus seems to be appropriate to look in the area of the laurel forest for very small, spring-fed trickles in a targeted manner.

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