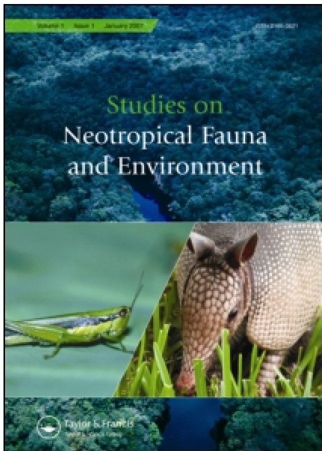

Studies on Neotropical Fauna and Environment
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713817190

New record, geographic variation and redescription of **Apedilum elachistus** Townes (Diptera: Chironomidae: Chironominae)

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Online Publication Date: 01 August 2008

To cite this Article: Donato, Mariano, Paggi, Analía C. and Epler, John H. (2008) 'New record, geographic variation and redescription of **Apedilum elachistus** Townes (Diptera: Chironomidae: Chironominae)', Studies on Neotropical Fauna and Environment, 43:2, 125 — 134

To link to this article: DOI: 10.1080/01650520701437707
URL: http://dx.doi.org/10.1080/01650520701437707

Studies on Neotropical Fauna and Environment
Vol. 43, No. 2, August 2008, 125–134

ORIGINAL ARTICLE

New record, geographic variation and redescription of *Apedilum elachistus* Townes (Diptera: Chironomidae: Chironominae)

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(Received 30 June 2006; accepted 7 May 2007)

Apedilum elachistus Townes 1945 is recorded from Argentina, representing the southernmost record of this species. Due to dissimilarities found between South and North American specimens a Principal Component Analysis and Minimum Spanning Tree were performed in order to determine if these differences reflect a geographic differentiation. The results show North–South variation in the number of acrostichal setae, number of dorsocentral setae, number of prealar setae, wing length, VR, length of thorax, and length of abdomen for males, and number of gonocoxite IX setae, length of thorax, number of temporal setae, length of palpomere III, wing length, BV_2, length of notum, BV_1, number of dorsocentral setae, length of palpomere IV, length of abdomen, VR, and length of palpomere V for females. Consequently, *Apedilum elachistus* is redescribed as larva, pupa, male, and female.

Keywords: *Apedilum*; Chironomidae; Chironominae; geographical variation; Neotropical region

Introduction

The genus *Apedilum* Townes includes the species *A. subcinctum* Townes and *A. elachistus* Townes (Townes, 1945; Epler, 1988), both distributed in the Nearctic and Neotropical regions. The former occurs in Canada and the USA in the Nearctic and it has restricted distribution in the Neotropics, with Guatemala as its known southern limit. The latter occurs in the USA in the Nearctic and is widespread in the Neotropical region, occurring in Guatemala, Nicaragua and Brazil (Spies & Reiss 1996).

The only distributional data for *A. elachistus* in South America were two male specimens examined by Epler (1988) from Piedra de los Indios (Uruguay) and the finding of this species in Mato Grosso (Brazil) by Nolte (1995). New specimens of *A. elachistus* have been found by the first author in Buenos Aires province (Argentina), thus extending its range southwards.

As the new material collected represents the southernmost known distribution of this species, it was measured and compared with material from US samples. We found differences between southern and northern specimens, mainly in measurements of adults of both sexes.

The primary goal of geographic variation analysis in biological systematics is the description and summarization of variation and covariation patterns in the characteristics of organisms that are distributed over an area. The basis for studies in geographic variation rests on the existence of populations of comparable organisms at a number of localities in the area under study. Comparisons among these populations are made in terms of one or more observable characters, and this kind of analysis relates these comparisons to differences in location (Gabriel & Sokal 1969). Due to the dissimilarities found between southern and northern specimens of *A. elachistus*, the aim of this study is the application of a statistical method in order to determine if such differences reflect a geographic differentiation. Therefore, we look for statistical evidence to reject the null hypothesis (H_0) that there are morphometric differences between northern and southern specimens. On the other hand, the alternative hypothesis (H_1) postulates that there are no geographic differences between northern and southern specimens.

Materials and methods

New *A. elachistus* material was collected by hand netting of swarms. Larvae were collected with a net and reared in the laboratory in individual containers at room temperature (18–20°C). The specimens were mounted on slides with Canada balsam.

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ISSN 0165-0521 print/ISSN 1744-5140 online

DOI: 10.1080/01650520701437707
http://www.informaworld.com

The morphological nomenclature follows Sæther (1980) and Epler (1987). All measurements are given as ranges followed by the mean. The specimens examined for this study correspond to the following institutions: Epler's collection (USA, JE), Florida State Collection of Arthropods at Florida A & M University, Tallahassee, Florida (USA, FS) and Museo de La Plata (Argentina, MLP).

Multivariate analysis

A total of 15 adult males (10 from Argentina and Uruguay and five from the USA), eight adult females (four from Argentina and four from the USA), 14 pupae (five from Argentina and nine from the USA) and 16 larvae (seven from Argentina and nine from the USA) were used to perform the multivariate analysis (for more details see "Material examined"). Each developmental stage was analyzed independently.

Two methodologies were applied in order to investigate differences between groups: Principal Components Analysis (PCA) and Minimum Spanning Tree (MST).

PCA is a statistical technique useful for identification of patterns in high-dimensional data, and expressing the data in such a way as to highlight their similarities and differences. The PCA performed in this study is based on a square symmetric matrix of Correlation since the variables are not expressed in the same units. The Correlation matrix has the advantage of equalizing the influence of each variable by inflating the influence of variables with relatively small variance and reducing the influence of high-variance variables.

MST is another statistical method useful to see how the data relate to each other by looking for the best path to unite them. It is useful for superimposition on ordinations (such as PCA) to help detect local distortions (i.e. pairs of points which look close together in a plot but actually are far apart if other dimensions are taken into account) (Gower & Ross 1969).

The characters used in the PCA for both sexes are: length of thorax; length of abdomen; number of temporal setae; number of clypeal setae; length of palpomeres I–V; Antennal Ratio (AR, ratio of length of apical elongated flagellomere divided by the combined length of the more basal flagellomeres); number of acrostichal setae; number of dorsocentral setae; number of scutellar setae; number of prealar setae; length of wing; width of wing; Venarum Ratio (VR, ratio of length of Cu to length of M); number of setae on $R+R_1$; number of setae on R_{4+5}; number of sensilla chaetica; Leg Ratio (LR, ratio of length of metatarsus divided by length of tibia; LR_{1-3} refers to front, mid and hind leg, respectively); Beinverhältnisse (BV, combined length of femur+tibia and metatarsus divided by combined length of tarsomeres 2–5; BV_{1-3} refers to front, mid and hind leg, respectively); and Schenkel-Schiene-Verhältnis (SV, combined length of femur+tibia divided by length of metatarsus; SV_{1-3} refers to front, mid and hind leg, respectively). Additionally, the following measurements were taken for analysis of females: length of notum; length of cerci; number of setae on sternite VIII; number of setae on tergite X; and number of setae on gonocoxite IX.

The program NT-SYS, version 2.0 (Rohlf, 1998) was used to perform both analyses.

Results

In the PCA of male specimens, the first two components accounted for 63.64% of the total variation (42.58 and 21.05%, respectively). Several characters had significant representation on Component 1 (Table 1), including: number of acrostichal setae, VR, number of temporal setae, length of palpomere III, length of abdomen, length of palpomere V, wing length, BV_1 and length of thorax. The characters number of setae on $R+R_1$ veins, number of setae on R_{4+5} vein, AR, LR_1, number of sensilla chaetica, number of clypeal setae and number of scutellar setae showed strong association with the second component (Table 1). Figure 1 shows that two major groups were formed when the first and second components were plotted: group A comprising the southern specimens and group B consisting of the northern specimens. Internal dispersion of the groups is observed mostly along the first component.

The separation between southern and northern specimens of *A. elachistus* occurs in both first and second components, but mainly in the former. The characters with best scores in this component and with different values between southern and northern specimens are number of acrostichal setae, number of dorsocentral setae, number of prealar setae, wing length, VR, length of thorax and length of abdomen. Thus, southern specimens possess 2–4 acrostichal setae, 16–24 dorsocentral setae, 2–4 prealar setae, wing length between 1.12 and 1.47 mm, VR between 1.28 and 1.35, length of thorax between 0.69 and 0.84 mm and length of abdomen between 1.42 and 2.12 mm. On the other hand, northern specimens have 10–12 acrostichal setae, 9–13 dorsocentral setae, 1–2 prealar setae, wing length between 1.51 and 2.00 mm, VR between 0.6 and 0.94, length of thorax between 0.93 and 1.39 mm and length of abdomen between 2.26 and 2.81 mm. The results from MST

Table 1. PCA loadings obtained from male's PCA analysis.

Character	Component 1	Component 2
Length of thorax	2,6821	0,8976
Length of abdomen	3,0003	0,8904
Number of temporal setae	−3,354	0,4004
Number of clypeal setae	1,457	1,5434
Length of palpomere I	2,851	−0,833
Length of palpomere II	2,5773	−0,4609
Length of palpomere III	3,1164	−0,5333
Length of palpomere IV	2,6014	−0,1995
Length of palpomere V	2,9708	−0,1589
AR	−1,5555	2,1913
Number of achrostical setae	−3,3634	0,9007
Number of dorsocentral setae	−2,9462	−0,3193
Number of scutellar setae	0,4493	−1,3343
Number of prealar setae	−2,7188	−0,8637
Length of wing	2,9626	0,9842
Width of wing	2,4179	0,618
VR	−3,358	−0,4339
Number of setae on R+R_1	0,3203	−2,2167
Number of setae on R_{4+5}	−1,0957	−2,2103
Number of sensilla chaetica	−1,8783	1,6422
LR_1	1,5661	−1,794
LR_2	−1,1484	−1,0735
LR_3	0,8366	0,0602
BV_1	−2,9171	0,9371
BV_2	−2,2834	−1,2825
BV_3	−1,6352	−1,1497
SV_1	0,1322	−0,775
SV_2	−0,5533	0,1914
SV_3	0,9883	−0,8643

agree with those of PCA. Based on these results, a direct relation between the measurements with highest loadings mentioned above and the geographic distribution of the specimens becomes evident. This is interpreted as a direct relationship between character gradient and geographic distribution of specimens and therefore H_0 is accepted for the PCA of males.

For female specimens, the principal component analysis showed that the first two components accounted for 74.73% of the total variation (59.19 and 15.53%, respectively). Component 1 (Table 2) had significant representation from characters number of gonocoxite IX setae, length of thorax, number of temporal setae, length of palpomere III, wing length, BV_2, notum length, BV_1, BV_3, number of dorsocentral setae, length of palpomere IV, length of abdomen, VR and length of palpomere V. The characters AR, number of scutellar setae, LR_3, number of sensilla chaetica on leg II, LR_1, length of palpomere I and wing width showed strong association with the second component (Table 2). Two major groups were formed when the first and second components were plotted: group A contains the southern specimens and group B consisted of the northern specimens (Figure 2).

Internal dispersion of the groups was observed mostly along the second component. In the case of

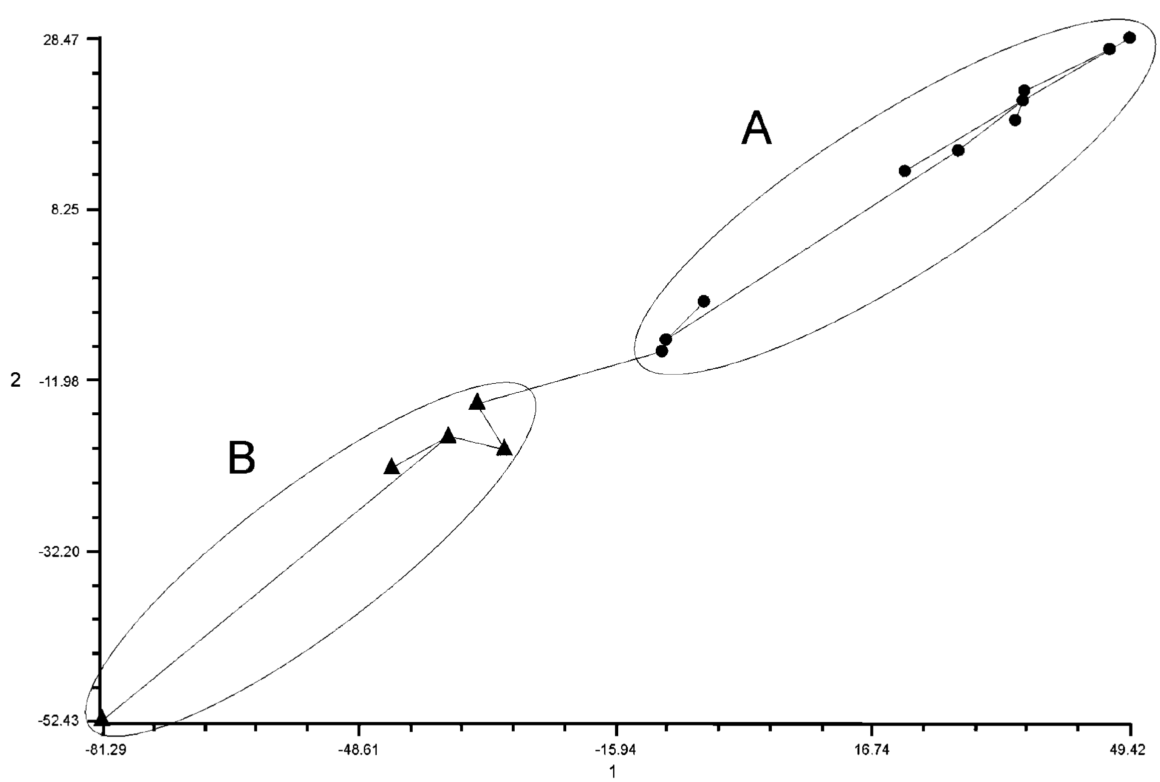

Figure 1. PCA of *Apedilum elachistus* males. Minimum spanning tree is superimposed. (▲) Northern specimens; (•) southern specimens.

Table 2. PCA loadings obtained from female's PCA analysis.

Character	Component 1	Component 2
Length of thorax	4,4461	0,0637
Length of abdomen	4,1299	−0,8245
Number of temporal setae	−4,4329	0,0835
Number of clypeal setae	−3,8214	−0,1132
Length of palpomere I	3,331	1,4937
Length of palpomere II	3,5237	1,1567
Length of palpomere III	4,3596	0,5975
Length of palpomere IV	4,158	0,449
Length of palpomere V	4,1003	0,5123
AR	2,2519	−0,8894
Number of achrostical setae	−0,1577	0,585
Number of dorsocentral setae	−4,2312	0,1845
Number of scutellar setae	−0,875	1,9286
Number of prealar setae	−4,0717	0,2521
Length of wing	4,3124	0,6143
Width of wing	3,3352	1,4067
VR	−4,1167	0,1914
Number of setae on $R+R_1$	2,097	−0,1391
Number of setae on R_{4+5}	2,9235	1,0229
Number of sensilla chaetica II	2,4496	−1,5259
Number of sensilla chaetica III	0,1179	−0,9757
Length of notum	4,2628	0,3166
Length of cerci	3,839	0,8693
Number of setae on sternite VIII	−0,81	0,1989
Number of setae on tergite X	4,4814	0,5275
Number of setae on gonocoxite IX	3,6108	−0,2304
LR_1	2,6966	1,5073
LR_2	3,7285	−1,1019
LR_3	2,7058	−1,7934
BV_1	−4,2582	0,134
BV_2	−4,2738	0,4606
BV_3	−4,203	0,5931
SV_1	0,0007	−1,24
SV_2	−3,5758	1,1376
SV_3	−3,6892	1,2018

females, all the characters with highest scores have different values between northern and southern specimens except character BV_3. The southern female specimens of *A. elachistus* are characterised by 14–21 gonocoxite IX setae, length of thorax between 1.03 and 1.16 mm, 7–10 temporal setae, length of palpomere III between 80.83 and 101.04 µm, wing length between 1.68 and 1.97 mm, BV_2 between 3.64 and 3.89, notum length between 189.95 and 204.6 µm, BV_1 between 2.16 and 2.38, 15–18 dorsocentral setae, length of palpomere IV between 81 and 101 µm, length of abdomen between 1.92 and 2.86 mm, VR between 1.19 and 1.32 and length of palpomere V between 151.56 and 199.55 µm. In contrast, northern female specimens of *A. elachistus* are characterized by two gonocoxite IX setae, length of thorax between 0.65 and 0.76 mm, 23–24 temporal setae, length of palpomere III between 53 and 58 µm, wing length between 1.26 and 1.42 mm, BV_2 between 4.17 and 4.54, notum length between 162 and 175 µm, BV_1 between 2.65 and 2.74, 26–32 dorsocentral setae, length of palpomere IV between 70 and 90 µm, length of abdomen between 1.2 and 1.46 mm, VR between 1.35 and 1.43 and length of palpomere V between 120 and 128 µm. MST did not agree with the results of PCA, showing one southern specimen that was more related with a northern specimen than with the remaining southern specimens. This result is due to missing entries for the northern specimen on characters length of thorax and length of abdomen, and it was controlled for by replacing the missing values with the northern specimens mean for each character. The MST obtained from these new data agrees with the results from PCA. These results demonstrate a direct relationship between the measurements with highest loadings mentioned above and the geographic distribution of the specimens. As in the case of male specimens, there is a direct relationship between character gradient and geographic distribution of female *A. elachistus* specimens and therefore, the female PCA also accepts the proposed H_0. Table 3 summarizes the differences/similarities between southern and northern specimens.

The PCA performed for larvae and pupae specimens did not show any groupings. Therefore, there is no evidence of a geographic differentiation at larval and pupal character level.

Discussion

An individual within a population needs an ecological space of a certain "size" to survive. This is one of the most important facts that regulate the effective establishment of sexual interactions among individuals of a species. Given equal ecological conditions, sexual reproduction will be more frequent between neighbouring individuals than between those occurring at greater distance from each other. Among the latter, sexual interbreeding with certain members of the opposite gender will be disrupted, and this will be correlated with a certain degree of geographical isolation between them. Another factor affecting sexual interbreeding is the different migratory capabilities of the species, both active and passive. An important consequence of diploidy and Mendelian relationships within populations is that a small spatial change in gene frequencies may be accompanied by a large change in genotype or phenotype frequencies (Endler 1977). Hence, these events may produce variations (e.g. morphological) within individuals of a species and are manifested as geographic variation. For these reasons the patterns of spatial variation are among the most important sources of study for microevolutionists. Usually the term "cline" (Huxley 1938) is used in order to account geographic variations.

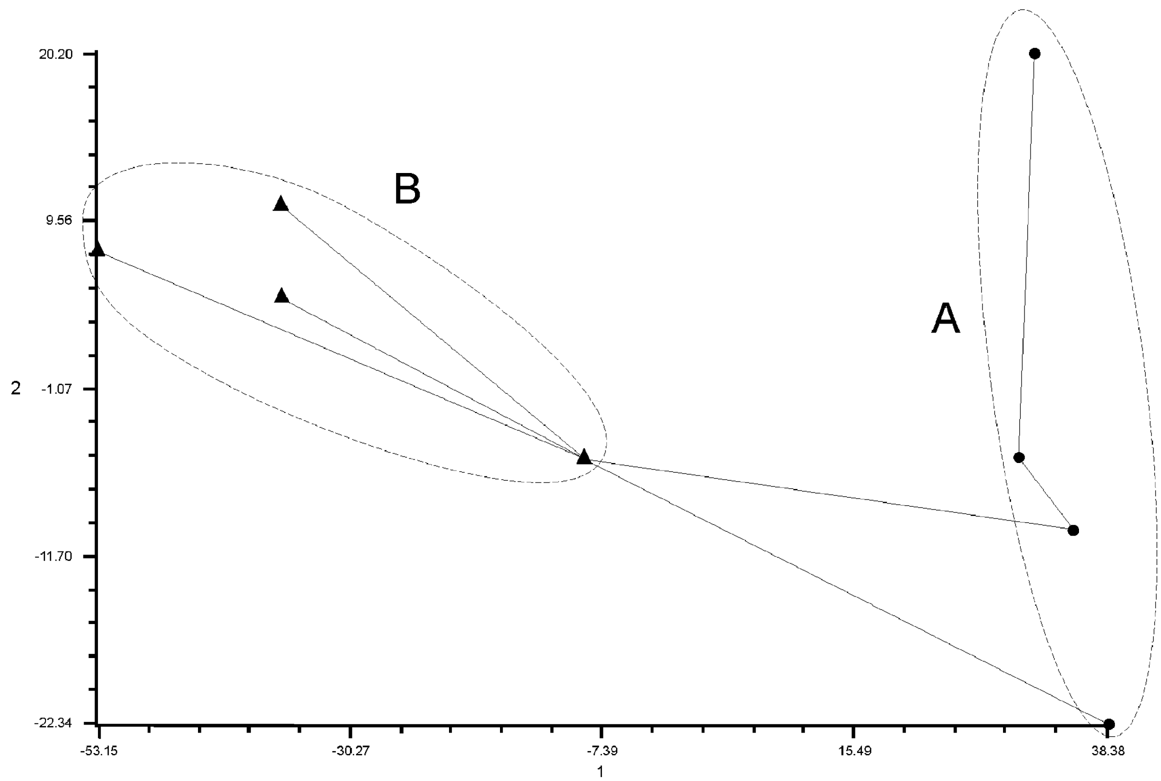

Figure 2. PCA of *Apedilum elachistus* females. Minimum spanning tree is superimposed. (▲) Northern specimens; (•) southern specimens.

Huxley (1938) defined a cline as the gradual variation of the measured values of some character (phenotypic, genetic, ecological, behavioural, etc.) along a geographical axis. A cline may be discontinuous if it involves isolated groups or continuous when the groups are connected. There are two types of clinal variations: a smooth cline refers to polytypic species varying smoothly along the geographical gradient, and in stepped cline polytypic species comprise definite geographical groups (subspecies), breeding in definite sub-areas with a hybrid intergradation zone. Huxley (1938) proposed that these two forms of clinal variation could be interpreted as two successive stages of an evolutionary process and the eventually isolated groups would generate new species by parapatric speciation.

Since the studies in population genetics suggested that barriers are necessary for speciation to take place, parapatric speciation and classical cline theory is nowadays rejected (Salomon 2002). Recently Salomon (2002) presented a theory without the assumption of parapatric speciation including a third stage that he called the broken cline which corresponds to the stage at which speciation finally takes place.

Few studies have addressed geographic variation in Chironomidae (Säwedal 1979; Lindeberg 1980; Savage 1980). For the genus *Apedilum*, Epler (1988) has described two apparent forms of adult male *A. elachistus* in the USA. Western populations (California) have a low AR (0.83–0.85), high number of setae on $R+R_1$ (23–25) and R_{4+5} (17–19), and low number of palmate sensilla chaetica on the mid metatarsus (4–5). Eastern populations (Florida) have a high AR (1.19–1.21), low number of setae on $R+R_1$ (8–12) and R_{4+5} (0–2), and high number of palmate sensilla chaetica on the mid metatarsus (7–11).

The analysis performed here shows that some characters from males and females of *A. elachistus* present geographic variation. Variation in the characters number of acrostichal setae, number of dorsocentral setae, number of prealar setae, wing length, VR, length of thorax and length of abdomen for males, and number of gonocoxite IX setae, length of thorax, number of temporal setae, length of palpomere III, wing length, BV_2, length of notum, BV_1, number of dorsocentral setae, length of palpomere IV, length of abdomen, VR and length of palpomere V for females show a close fit between northern and southern specimens. In this way, *A. elachistus* shows two morphological variation axes, one east–west axis in North America and another north–south axis in the Americas.

Table 3. Comparative chart showing range, mean, standard deviation and number of specimens measured of the characters used in the Principal Components Analysis of southern and northern specimens of *Apedilum elachistus* (measurements are in µm unless otherwise stated).

	South American specimens					North American specimens				
	Minimum value	Maximum value	Mean	SD	*n*	Minimum value	Maximum value	Mean	SD	*n*
Male										
Total length (in mm)	3.19	4.14	3.60	0.36	10	2.12	2.97	2.69	0.33	5
Thorax length (in mm)	0.93	1.39	1.11	0.16	10	0.69	0.84	0.80	0.06	5
Abdomen length (in mm)	2.22	2.81	2.52	0.22	10	1.43	2.13	1.89	0.27	5
Temporal setae	8	11	9	1	8	20	32	26	5	5
Clypeal setae	13	17	15	1	10	12	16	14	2	5
Palpomere I length	40	53	48	5.48	8	28	40	32	5.42	4
Palpomere II length	43	71	50	8.38	9	30	45	35	7.14	4
Palpomere III length	86	114	98	9.34	9	63	90	72	12.50	4
Palpomere IV length	106	141	123	13.84	9	90	105	100	7.07	4
Palpomere V length	159	217	193	21.08	7	123	173	146	25.32	3
AR	0.88	1.08	0.99	0.07	10	0.83	1.23	1.062	0.20	5
Acrostichal setae	2	4	4	1	10	10	12	11	1	3
Dorsocentral setae	9	13	11	1	10	16	24	20	3	5
Scutellar setae	6	9	7	1	9	6	9	7	1	5
Prealar setae	1	2	2	0	10	2	4	4	1	5
Wing length (in mm)	1.51	2.00	1.78	0.18	10	1.13	1.48	1.38	0.14	5
Wing width (in mm)	0.37	0.60	0.52	0.08	10	0.35	0.49	0.43	0.05	5
VR	0.60	0.94	0.79	0.10	10	1.28	1.35	1.31	0.03	5
R+R$_1$ setae	10	19	14	3	10	8	25	15	8	5
R$_{4+5}$ setae	2	4	3	1	4	0	19	8	10	5
LR$_1$	1.13	1.22	1.19	0.03	8	1.07	1.27	1.16	0.10	3
LR$_2$	0.56	0.63	0.59	0.02	10	0.57	0.66	0.61	0.04	5
LR$_3$	0.69	0.94	0.77	0.07	10	0.73	0.76	0.74	0.01	4
BV$_1$	1.96	2.15	2.05	0.07	8	2.12	2.40	2.29	0.15	3
BV$_2$	3.11	3.79	3.43	0.19	10	3.67	4.16	3.86	0.24	5
BV$_3$	2.26	2.81	2.54	0.14	10	2.63	3.01	2.79	0.18	4
SV$_1$	1.74	1.86	1.80	0.04	8	1.77	1.95	1.85	0.09	3
SV$_2$	3.21	4.03	3.66	0.23	10	3.45	3.89	3.73	0.19	5
SV$_3$	2.35	2.93	2.76	0.18	10	2.08	2.93	2.67	0.40	4
Sensilla chaetica on mid metatarsus	4	7	6	1	10	4	11	7	3	5
Gonocoxite length	106.09	133.87	126.55	8.46	10	123	131	127	4.04	3
Gonostylus length	95.90	121.24	107.85	9.39	10	88	113	98	13.23	3
HR	1.04	2.70	1.44	0.62	10	1.09	1.43	1.31	0.19	3
HV	1.23	3.23	2.55	0.71	10	2.62	3.11	2.93	0.27	3
Female										
Total length (in mm)	3.05	3.96	3.53	0.39	4	1.85	2.17	2.04	0.17	3
Thorax length (in mm)	1.03	1.16	1.11	0.06	4	0.65	0.76	0.71	0.06	3
Abdomen length (in mm)	1.92	2.86	2.42	0.39	4	1.2	1.46	1.33	0.13	3
Temporal setae	7	10	8	1	4	23	24	24	1	4
Clypeal setae	16	17	16	1	3	19	25	23	3	4
Palpomere I length	30	56	40	14	3	22	28	24	3	4
Palpomere II length	32	56	43	12	3	23	33	27	4	4
Palpomere III length	81	101	90	10	3	53	58	55	2	4
Palpomere IV length	101	119	111	9	3	70	90	81	8	4
Palpomere V length	152	205	186	29	3	113	128	120	8	3
AR	0.43	0.68	0.51	0.11	4	0.41	0.49	0.45	0	4
Acrostichal setae	8	10	9	1	4	6	11	9	2	4
Dorsocentral setae	15	18	17	2	4	26	32	28.5	3	4
Scutellar setae	4	9	7	2	4	7	8	7.25	1	4
Prealar setae	2	3	2	1	3	4	4	4	0	4
Wing length (in mm)	1.68	1.97	1.81	0.15	3	1.26	1.43	1.36	0.07	4
Wing width (in mm)	0.53	0.68	0.6	0.08	3	0.48	0.54	0.51	0.03	4
VR	1.19	1.32	1.25	0.07	3	1.35	1.43	1.39	0.03	4
Setae R+R$_1$	21	22	21	1	3	18	22	20	2	4
Setae R$_{4+5}$	18	25	21	4	3	10	19	15	4	4

Table 3. Continued.

	South American specimens					North American specimens				
	Minimum value	Maximum value	Mean	SD	*n*	Minimum value	Maximum value	Mean	SD	*n*
Sensilla chaetica on mid metatarsus	20	25	23	2	4	18	25	21	3	4
Sensilla chaetica on mid hind tarsus	17	24	20.75	4	4	17	22	20	2	4
LR_1	1.15	1.25	1.19	0.05	3	1.09	1.17	1.14	0.04	4
LR_2	0.58	0.63	0.60	0.02	3	0.56	0.57	0.56	0.00	4
LR_3	0.68	0.72	0.71	0.02	3	0.68	0.69	0.69	0.01	4
BV_1	2.16	2.38	2.29	0.11	3	2.65	2.74	2.69	0.04	4
BV_2	3.64	3.89	3.80	0.14	3	4.17	4.54	4.35	0.15	4
BV_3	2.69	2.77	2.72	0.04	3	2.85	2.99	2.92	0.07	4
SV_1	1.73	2.03	1.84	0.16	3	1.8	1.94	1.86	0.06	4
SV_2	3.62	3.86	3.71	0.13	3	3.89	3.94	3.92	0.02	4
SV_3	2.88	3.02	2.94	0.07	3	3.03	3.11	3.06	0.03	4

These character differences could lead to the split of this species with the establishment of a new entity; however, extensive areas of *A. elachistus*' range were not represented by any samples, and the biology of this species is partially known. In addition, a geographic pattern usually consists of a mosaic of areas characterized by particular character state distributions separated by transition zones (Endler 1983). These considerations prevent us from describing a new species or any type of clinal variation. Future findings of *A. elachistus* will clarify the taxonomic status of the geographic variation found in this study.

The new *Apedilum elachistus* data from southern South America call for a redescription of the larva, pupa, and male and female imagos. Therefore, an emended species diagnosis is given below.

Taxonomy

Apedilum elachistus Townes

Apedilum elachistus Townes 1945, p. 33 (adult description).

Paralauterborniella elachista (Townes): Sublette & Sublette 1965, p. 173 (placement); Beck & Beck, 1970, p. 30 (pupal and larval descriptions).

nec *Paralauterborniella elachista* (Townes): Darby 1962, p. 47, 64, 88, 143 (misdetermination of *A. subcinctum*).

Apedilum elachistus Townes: Epler 1988, p. 109 (redescription of adult male and female and immature stages).

Material examined

5♂♂ and 3♀♀ with pupal exuviae (MLP), Argentina, Buenos Aires, M. B. Gonnet, 34°52′32.8″S, 58°01′34″W, 1 May 2004, leg. M. Donato; 2♂♂ with larval and pupal exuviae (MLP), Argentina, Buenos Aires, M. B. Gonnet, 34°52′32.8″S, 58°01′34″W, 1 May 2004, leg. M. Donato; five larvae (MLP), Argentina, Buenos Aires, M. B. Gonnet, 34°52′32.8″S, 58°01′34″W, 1 May 2004, leg. M. Donato; 1♂ (MLP), Argentina, Buenos Aires, M. B. Gonnet, 34°52′32.8″S, 58°01′34″W, 16 May 2004, leg. M. Donato; six larvae (MLP), Argentina, Buenos Aires, M. B. Gonnet, 34°52′ 32.8″S, 58°01′34″W, 12 May 2004, leg. M. Donato; 1♀ with larval and pupal exuviae (MLP), Argentina, Buenos Aires, M. B. Gonnet, 34°52′32.8″S, 58°01′34″W, 10 May 2004, leg. M. Donato; 1♂ (MLP), Argentina, Buenos Aires, M. B. Gonnet, 34°52′32.8″S, 58°01′34″W, 16 May 2004, leg. M. Donato; three pupae (JE), Brazil, Mato Grosso, 15°57′S, 57°45′W, rock pools near a spring, September 1992, leg. U. Nolte; six larvae (JE), Brazil, Mato Grosso, 16°S, 57°W, 300 m asl, rock pools, 26 May 1992, leg. U. Nolte; 1♂ (JE), Uruguay, Colonia, Route 21, Piedra de los Indios, at light, 13 December 1983, leg. G. J. Wibmer; 1♂ (JE), Uruguay, Colonia, Route 21, Piedra de los Indios, at light, 24 December 1983, leg. G. J. Wibmer; 1♂ with larval and pupal exuviae (JE), USA., Florida, St. John's Co., St. John's river; 1♂ and 4♀♀ (JE), USA, Florida, Wakulla Co., St. Marks NWR, at lighthouse, swarming on road shoulder, 19 April 1980, leg. J. H. Epler; 1♂ (JE), USA, California, Imperial Co., Wister Wildlife Management Area near Niland, 26 December 1981, leg. J. H. Epler; 1♂ (FS), USA, Palm Beach Co., Palm Beach (residence), 4 December 1979, leg. R. P. Tomasello; 1♂ (JE), USA, Stock Island BLT, 25 January 1967, leg. F. A. Buchanan.

Male (n=15 except when otherwise stated)

Total length 2.12–4.14, 3.29 mm. Thorax 0.69–1.39, 1.00 mm long, abdomen 1.43–2.81, 2.31 mm long.

Coloration: head, thorax and abdomen mostly dark brown; legs whitish. Wing membrane whitish spotted with pale grey as in Figure 3.

Head. AR 0.83–1.23, 1.02. Temporal setae 8–32, 15 (13); clypeus with 12–17, 15 setae. Palpomere lengths (in µm): 28–53, 42 (12); 30–71, 46 (13); 63–114, 90 (13); 90–141, 116 (13); 123–217, 179 (10).

Thorax. Acrostichals 2–12, 5; dorsocentrals 9–24, 14; prealars 1–4, 2. Scutellum with 6–9, 7 setae (14).

Wing Figure *(*3*)*. Wing length 1.13–2, 1.64 mm; width 0.35–0.6, 0.49 mm. VR 0.6–1.35, 0.96. R+R_1 with 8–25, 14 setae; R_{4+5} with 0–19, 5 (9) setae.

Legs. Palmate sensilla chaetica: 4–11, 7 on mid metatarsus, 0–1 on hind metatarsus. Lengths and proportion of legs as in Table 4.

Hypopygium. Without anal point. Tergum IX with 4–6, 5 (10) setae, laterosternite IX with 1–2 setae (9). Phallapodeme 48–83, 64 µm long (10); transverse sternapodeme 50–83, 65 (10) µm long. Gonocoxite 106–134, 127 (10) µm long. Gonostylus 88–121, 108 (10) µm long. HR 1.04–2.7, 1.44 (10); HV 1.23–3.23, 2.55 (10).

Female (n=8 except when otherwise stated)

Total length 1.85–3.96, 2.88 mm (7). Thorax length 0.65–1.16, 0.93 mm (7). Abdomen length 1.2–2.86, 1.95 mm (7). Coloration as in males.

Head. AR 0.41–0.68, 0.48. Temporal setae 7–24, 16; clypeus with 16–25, 20 setae (7). Palpomere lengths (in µm): 22–56, 31 (7); 23–56, 34 (7); 53–101, 70 (7); 70–119, 94 (7); 113–205, 153 (6).

Thorax. Acrostichals 6–11, 9; dorsocentrals 15–32, 23; prealars 2–4, 3 (7). Scutellum with 4–9, 7 setae.

Wing. Wing length 1.26–1.97, 1.55 (7) mm; width 0.48–0.68, 0.54 (7) mm. VR 1.19–1.43, 1.33 (7). R+R_1 with 18–22, 21 setae (7). R_{4+5} with 10–25, 18 setae (7).

Legs. Palmate sensilla chaetica: 18–25, 22, on middle Ta_1; 17–24, 20, on hind Ta_1. Lengths and proportion of legs are shown in Table 4.

Abdomen. Notum 162–205, 183 µm long; cerci 73–121, 94 µm long. Tergum X with 2–21, 9 setae (7). S VIII with 6–9, 7 setae; gonocoxite IX with 1–2 setae each one (5).

Pupa (n=14 except when otherwise stated)

Color: hyaline. Total length 1.98–4.25, 3.3 mm (8); cephalothorax length 0.66–1.24, 1.01 mm (8); abdomen length 1.68–3.2, 2.77 mm (8). Transverse row of hooklets on posterior margin of T II 26–52, 35 (8). Anal lobe with 17–32, 26 setae (12). DR 1.65–3.20, 2.23.

Fourth instar larva (n=16 except when otherwise stated)

Head. Postmentum length 113–157, 134 µm (15). Mandible length 103–149, 121 µm. Mentum width 80–116, 98 µm (12). Ventromental plate width 69–103, 83 µm; length 32–55, 41 µm. VPR 1.57–2.41, 2.01 (12); IPD 11.3–25.2, 18.59 (10); PSR 3.9–7.15, 5.02 (10). Length of antennal segments (in µm) (14): 60–96, 73; 13–23, 18; 15–25, 20; 12–25, 17; 6–13, 9; 4–10, 6. AR 0.89–1.26, 1.05.

Biology

Epler (1988) mentioned the collection of larvae from submerged vegetation; the species was also found in a

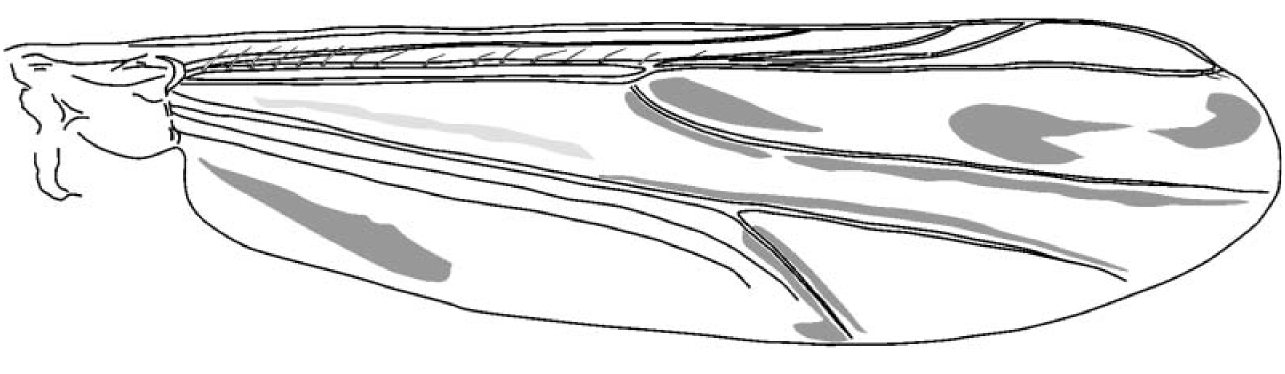

Figure 3. Male wing of *Apedilum elachistus*.

Table 4. Lengths (μm; ranges followed by the mean) and proportion of legs of *Apedilum elachistus*.

	Fe	Ti	Ta_1	Ta_2	Ta_3	Ta_4	Ta_5	LR	BV	SV
Male										
P_1	500–803, 689 (14)	415–681, 596	590–824, 726 (11)	280–427, 369 (11)	220–346, 288 (11)	135–254, 195 (11)	90–173, 121 (11)	1.07–1.27, 1.18 (11)	1.96–2.4, 2.12 (n=11)	1.74–1.95, 1.82 (n=11)
P_2	560–895, 751	440–742, 611	290–427, 370	130–224, 185	90–163, 136	50–112, 88	40–102, 80	0.56–0.66, 0.6	3.11–4.16, 3.58	3.21–4.03, 3.68
P_3	580–946, 786 (14)	500–844, 703 (14)	380–620, 541 (14)	190–356, 297 (14)	170–305, 262 (14)	90–153, 131 (14)	60–122, 98 (14)	0.69–0.94, 0.77 (14)	2.26–3.01, 2.61 (n=14)	2.08–2.93, 2.73 (n=14)
Female										
P_1	460–864, 597	415–651, 515	470–814, 600	195–376, 271	140–275, 196	90–183, 131	65–132, 95	1.09–1.25, 1.16	2.16–2.74, 2.52	1.73–2.03, 1.85
P_2	520–915, 680	420–732, 553	240–427, 324	105–203, 147	70–147, 104	40–102, 66	45–97, 69	0.56–0.63, 0.58	3.64–4.54, 4.11	3.62–3.94, 3.83
P_3	560–915, 709	510–864, 656	350–590, 455	185–315, 244	160–285, 216	70–142, 103	60–112, 84	0.68–0.72, 0.69	2.69–2.99, 2.83	2.88–3.11, 3.01

Male, n=15; female, n=7, except when otherwise stated.

brackish pond in Florida (USA). Likewise, southern *A. elachistus* were found in ephemeral rock pools (Nolte 1995) and submerged vegetation in a rhithral zone (Nessimian et al. 2003). The new material was found in an artificial pool with biofilm-covered substratum.

Acknowledgments

The first author wishes to thank Jorge V. Crisci for his comments on an earlier version of this manuscript. This work was supported by CONICET and National Geographic Society Grant 7646-04.

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