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A new species of *Entomobrya* (Collembola, Entomobryidae) from La Caldera de Taburiente National Park (La Palma Island, Canary Islands) and its associated collembolan fauna

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Abstact

Entomobrya palmensis n. sp. is described from the Canary Islands (Macaronesian Region). The new species shares the colour pattern with *E. multifasciata* (Tullberg, 1871), but clearly differs in chaetotaxy. A list of species and locations of the collembolan fauna of the area is given.

Key words: morphological characters, macrochaetotaxy, Macaronesian Region, faunistic

1. Introduction

In the course of study of invertebrate biodiversity in La Caldera de Taburiente National Park (La Palma, Canary Islands, Spain) a new species of *Entomobrya* was found. With the traditional examination of colour pattern and longitudinal or transversal colour stripes (Christiansen, 1958), the specimens, upon initial inspection, appeared to belong to the species *E. multifasciata*. However, a careful study with use of morphology and macrochaetotaxy (Jordana & Baquero 2005) made it possible to detect a cryptic species, occuring syntopically with *E. nigrocincta* Denis, 1923. This is one of the results of the project 'Convenio de Cooperación Parques Nacionales - CSIC Inventario y estudio de la fauna invertebrada del Parque Nacional de la Caldera de Taburiente' (see Domingo-Quero et al. 2003).

Abreviations: Abd = abdominal segment; Ant = antennal segment; asl = above sea level; MNCN = Museo Nacional de Ciencias Naturales, Consejo Superior de Investigaciones Científicas, Madrid, Spain; MZNA = Museo de Zoología Universidad de Navarra, Pamplona, Spain; asl = above sea level; Th = thoracic segment

2. Material and Methods

The La Palma Island is the most north-westerly of the Canary Islands and, like the other islands of the archipelago, is volcanic. The upland areas of La Palma are covered by so-called 'laurisilva' (laurel forest), a temperate cloudy forest, dominated by *Laurus* sp., but which includes *Juniperus cedrus* (Canary Islands Juniper) and other trees. This is a relic of the Pliocene subtropical forests and was established as a biosphere reserve in 1983. It was extended and renamed in 1997 and 2002, respectively. The 'Caldera de Taburiente –a mountain arch with a curious crater shape– dominates the northern part of La Palma, having a width of 9 km and a depth of 1500 m. It is surrounded by a ring of mountains (1600 m to 2400 m asl). It was designated as a national park in 1954.

The specimens were captured during systematic sampling at 31 localities using different methods (see the faunal study part, below)

Some specimens were mounted in Hoyer medium, sometimes cleared with Nesbitt solution. Observation of the slides was done under an Olympus BX51-TF microscope with a multi-viewing system and phase contrast, and a Zeiss Axio Imager A1 with differential interference contrast (DIC). For the measurements, a UDA drawing attachment UIS (Universal Infinity System) and a scale calibrated with a Graticules Ltd slide (1 mm/0.01 div) were used.

3. Descriptions

***Entomobrya palmensis* n. sp.**

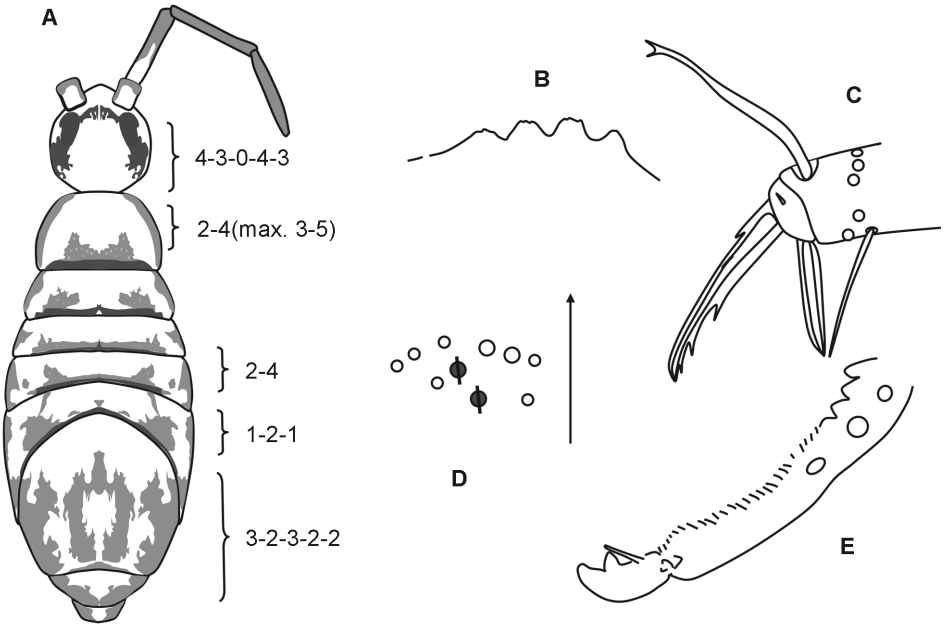

Fig. 1 *Entomobrya palmensis* n. sp.; A: Colour pattern; B: labral papillae; C: unguis-claw. D: manubrial plate; E: end of dens and mucro.

Type locality. Spain, Canary Islands, La Palma, Caldera de Taburiente, Roque de la Cumbrecita ('parcela de los *Heliantemum*'), UTM Coordinates 28RBS2177, Altitude 1377 m asl.

Type material. Holotype, specimen on slide labelled as 'M4-241199-01 1377 m, UTM 28RBS2177-1 24-11 1999 leg: T. Domingo-Quero Trampa Malaise; recogió 14 días seguidos [works 14 days]'. 95 paratypes in ethyl alcohol. Deposited in MNCN. 1 Paratype on slide and 2 in alcohol deposited in the MZNA.

Other material. See Table 3 and the faunal study part.

Description

Body length up to 2.3 mm excluding antennae. Body colour pattern as Fig. 1A, ground colour white and coloured patches dark blue. Detailed morphometrical data are summarised in Tab. 1

Head: Eight eyes, G and H smaller than E and F. Antennae length 1000-1300 μm, 2.2-2.7 times as the length of the head. Relative length of Ant 1/2.1/2.1/2.1. Ant IV with bilobed apical vesicle. Four labral papillae wrinkled or with some projections, but observed as smooth in some specimens (Fig. 1B).

Tab. 1 Measurements of the new species (in micrometers), average from 7 specimens[(1)].

	***E. palmensis* n.sp.**			
	Holotype	**mean [(1)]**	**Max.**	**Min.**
Ant I	200	153	200	110
Ant II	400	315	400	250
Ant III	400	317	400	240
Ant IV	380	345	380	290
Ant	1380	1130	1380	890
Head	500	439	500	350
Ant/head ratio	2.76	2.54	2.76	2.34
Th II	320	253	320	200
Th III	250	189	250	140
Abd I	150	136	190	100
Abd II	190	173	220	130
Abd III	120	142	190	100
Abd IV	620	551	640	440
Abd IV/III ratio	5.17	4.03	6	3.26
Abd V	140	124	150	100
Abd VI	90	86	100	70
Body	2380	2092	2410	1780
Manubrium	460	367	460	300
Dens	580	477	580	370
Claw	52	-	-	-
Empodium	32	-	-	-
Tenent hair	56	-	-	-

Body: Length ratio Abd IV/III = 3-5. Claw with 4 internal teeth: first pair at 55% of distance from base of claw, and two odd teeth, first at 80% of distance from base and the most distal one minute; dorsal tooth in more basal position than the lateral ones that are below the level of paired teeth. Empodium spike-like, with smooth inner edge on leg III (Fig. 1C). Furcal length 1080 µm (Holotype). Manubrial plate with 7-11 chaetae and 2 pseudopores (Fig. 1D). Mucro with basal spine, subapical teeth similar to terminal one (Fig. 1E).

Chaetotaxy: Simplified macrochaetae formula: 4-3-0-4-3/2-4/2-4/1-2-1/3-2-3-2-2.

Head chaetotaxy as in Fig. 2A. Thorax chaetotaxy: T1 area on Th II with 2 (m_1 and m_{2i}) (3 in some specimens by presence of m_2), T2 area on Th II with 4 (5 in some specimens by macrochaetae duplication of a_5) macrochaetae present (a_5, m_4, m_{4i} and m_5) (Fig. 2B). Abdomen chaetotaxy (Figs 2 C–D): A1 area on Abd II with two macrochaetae and A2 area on Abd II with four macrochaetae. Abd III with one macrochaeta on area A3 and A5, two macrochaetae on A4 area.

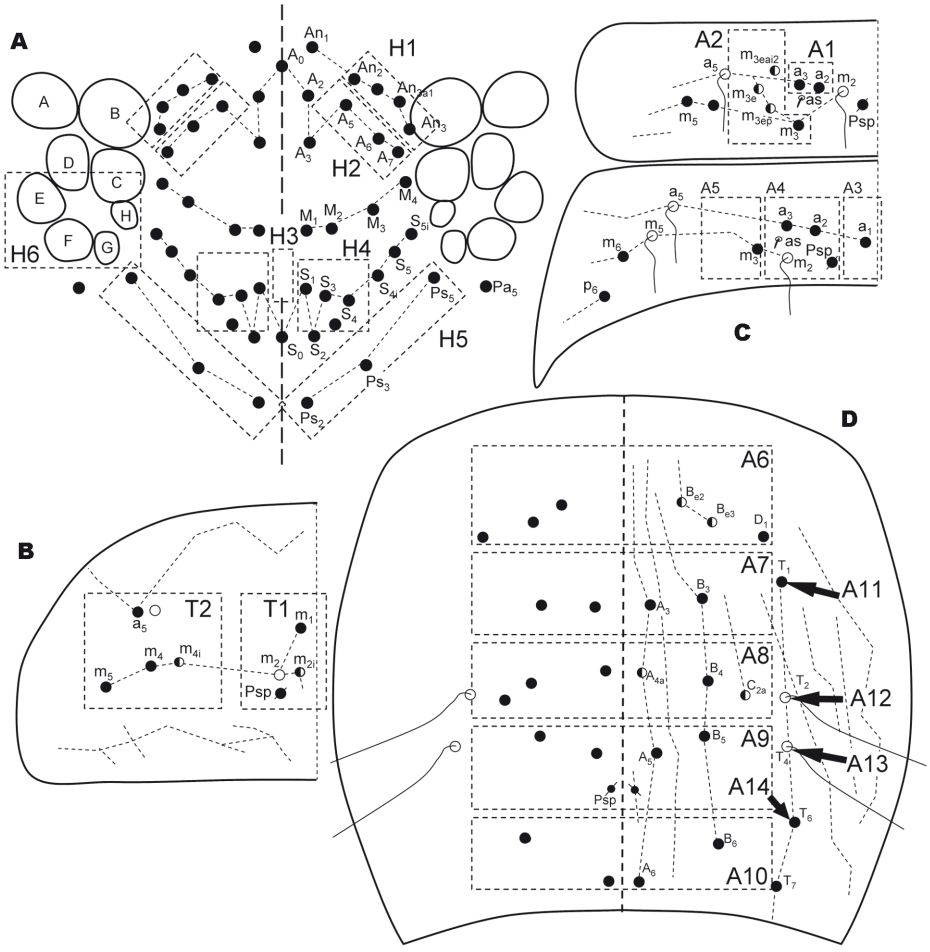

Fig. 2 *Entomobrya palmensis* n. sp. macrochaetotaxy. A: head; B: Th II; C: Abd II-III; D: Abd IV.

Biology: Habitats between 225 to 760 m asl mainly in soil, under stones and litter of *Pinus canariensi* and *Salix* sp., and on or under low vegetation such as *Heliantemun* sp., *Descurainia millefolia*, *Viola palmensis*, *Erysimum scoparium*, and in mosses near water. This species could be hygrophilous.

Discussion. It has a colour appearance of *E. multifasciata* or the females of *E. nigrocincta* Denis, 1923, but the macrochaetotaxy is different from those species and others with a similar colour pattern. *E. multifasciata* (3-1-0-2-2/2-3/2-2/1-2-1/0-2-3-2-2) is only coincident in Abd III chaetotaxy, *E. nigrocincta* (3-1-0-2-2/2-3/1-2/1-1-1/0-2-3-2-2) present in the same area is different in the whole chaetotaxy. The new species is the only known Entomobryini with this chaetotaxy (4-3-0-4-3) on the head.

4. Faunal study

Localities with UTM-coordinates (all from the island of La Palma). All T. Domingo-Quero leg. unless otherwise stated: Arroyo de la Cumbrecita (28RBS2078 4, 1200 m asl), 17 al 20 01 2001, **1**; Arroyo Rivanceras (antes de juntarse con Almendro Amargo) (28RBS1879 4, 480 m asl), 27 07 1999, leg.: R. Araujo, **2**; Barranco de las Traves (28RBS1780 2, 1040 m asl), 5 09 1999 al 16 07 2001, **3**; Bejenado, comienzo de la senda de subida (28RBS2076 2, 1300 m asl), 26 03 2001, leg.: T. Domingo-Quero y A. Sánchez-Ruiz, **4**; Casas de Taburiente (28RBS1880 3, 835 m asl), 13 12 1999 al 23 03 2001, **5**; Casas de Tenerra (28RBS1780 2, 1090 m asl), 06 02 2001, **6**; Cueva de los Arenales (28RBS2176 2, 1175 m asl), 16 06 2000 al 17 11 2000, leg.: R. García Becerra, **7**; Cueva El Llanito, 02 03 1995, leg.: R. García Becerra, **8**; El Riachuelo (28RBS2175 4, 950 m asl), 21 05 2001, **9**; El Rodeo (28RBS1976 3, 1600 m asl), 25 11 1999, **10**; Fuente de la Faya (Cumbrecita) (28RBS2176 4, 1100 m asl), 25 01 2001, **11**; Fuente de la Zarza (28RBS1977 1, 1248 m asl), 18 09 1999 al 16 01 2001, leg.: T. Domingo-Quero y A. Sánchez-Ruiz, **12**; Fuente de Viñátigo (28RBS2082 4, 1139 m asl), 03 07 2000 al 05 02 2001, **13**; Fuente del Barranco del Limonero (28RBS2280 4, 1349 m asl), 03 07 2000 al 24 10 2000, **14**; Fuente del Barranco Madera García (28RBS1977 3, 1152 m asl), 23 03 2000 al 16 01 2001, **15**; Fuente Piedra Majorera (28RBS2281 2, 1410 m asl), 24 10 2000, **16**; Genebuque (28RBS1680 2, 1150 m asl), 27 03 2001, leg.: T. Domingo-Quero y A. Sánchez-Ruiz, **17**; Hoya de Lucía (cabecera del Barranco Hondo) (28RBS2382, 2100 m asl), 26 05 2000, **18**; Hoyo Verde (28RBS1882 3, 1450 m asl), 21 09 1999 al 23 03 2001, **19**; Huerto de Tenerra (28RBS1780 2, 1090 m asl), 27 03 2001, leg.: T. Domingo-Quero y A. Sánchez-Ruiz, 20; Junto a la entrada de la cueva de 'Los Sorprendidos' (28RBS1976 2, 1259 m asl), 25 01 2001, **21**; Llano de los Pinos Chicos; junto a TS2 (28RBS1880 2, 800 m asl), 12 05 2001, **22**; Lomo de las Chozas (28RBS2077 3, 1260 m asl), 06 10 1999 al 12 04 2000, leg.: T. Domingo-Quero y A. Sánchez-Ruiz, **23**; Lomo Gazmil, base (28RBS1981 3, 850 m asl), 11 01 2000, **24**; Lomo Gazmil; cementerio guanche (28RBS1981 3, 950 m asl), 11 01 2000, **25**; Morro colorado (28RBS1880 1, 869 m asl), 12 05 2001, **26**; Playa de Taburiente (28RBS1980 1, 760 m asl), 25 09 1999 al 18 09 2000, leg.: T. Domingo-Quero y A. Sánchez-Ruiz, **27**; Recorrido de la Cumbrecita, barranco con humedad (28RBS2077 1, 1225 m asl), 30 03 2001, leg.: T. Domingo-Quero y A. Sánchez-Ruiz, **28**; Roque de la Cumbrecita, parcela de los *Heliantemun* (28RBS2177 1, 1377 m asl), 25 08 1999 al 24 08 2000, **29**; Roque de los Muchachos (parcela de la cebolla) (28RBS2084 3, 2250 m asl), 27 07 2000 al 09 05 2001, leg.: T. Domingo-Quero y A. Sánchez-Ruiz, **30**; Tenerra (28RBS1680 2 y 28RBS1780 2, 1130 m asl), 06 12 1999 al 27 03 2001, leg.: T. Domingo-Quero y A. Sánchez-Ruiz, **31**; Zona de Acampada; edificio (28RBS1980 1, 760 m asl), 12 05 2001, 32.

Sampling method. Under stones, **a**; Berlese under fig tree, **b**; Moss Berlese, **c**; Soil (organic matter and needles) Berlese, d; Under wood stump, **f**; In the water and on shores, **g**; In the sediment and water column, h; Among stones and moss in damp area, **i**; Gallery forest litter, **k**; Pine litter, **l**; *Phyllis nobla* humus, **m**; Algae wash, **n**; Stone washing, **o**; Washing stones, sediments and mosses, **p**; Washing plant roots and moss, **q**; Washing plant roots, **r**; Washing roots beside a pool, **s**; Raising 'madeira mahogany' bark (*Persea indica*), **t**; Washing sediment pond with little current, **v**; Washing of moss and plant aquatic

Tab. 2 Comparative set of characteristics between *E. palmensis* n. sp. and *E. multifasciata*. Differences in bold.

Character	Location	Description	Range within the genus	*E. multifasciata*	*E. palmensis* n. sp.
Ch. 1	H1 (Head)	An_2–An_3	1–6	3	**4**
Ch. 2	H2	A_5–A_7	1–3	1	**3**
Ch. 3	H3	S'_0	0–1	0	0
Ch. 4	H4	S_1–S_3–S_4	0–3	2	**4**
Ch. 5	H5	P_{s2}–P_{s3}–P_{s5}	0–3	2	**3**
Ch. 6	Labral papillae	simple and smooth papillae (1), wrinkled or with some projections (2), a projection chaetae like (3)	1–3	2	2
Ch. 7	Eyes G&H size	= E&F (1), <E&F (2)	1–2	1	**2**
Ch. 8	Apical antennal retractile bulb	no bulb (0), lobe simple (1), two lobe (2), three lobe (3)	0–3	1-2	1
Ch. 9	Ratio Ant/ Head	> or = 3 (1), > or = 2 < 3 (2), < 2 (3)	1–3	2	
Ch.10	Anterior dorsal mane Th II Mc	with Mc type 1 (1), without Mc or type 2 (2)	1–2	1	1
Ch.11	T1	chaetae number m_1–m_{2i2} or >4 (5)	0–5	2	2(3)
Ch.12	T2	chaetae number a_5, m_4–m_5 or >8 (9)	0–9	3	**4(5)**
Ch.13	Smooth chaetae on tibiotarsi	not or 1 in tibiotarsi III = 0, double file = 1	0–1	0	**1**
Ch.14	Unguis internal teeth	1(1), 2(2), 3(3), 4(4)	1–4	4	4
Ch.15	Unguis dorsal tooth	basal = 1, internal teeth level = 2, intermediate = 3	1–2	3	3
Ch.16	Unguis internal edge	without ciliation (0), with ciliation (1)	0–1	0	0

Ch.17	External unguiculous	smooth (0), serrate (1)	0–1	0	0
Ch.18	A1 Abd II	a_2–a_3	0–2	2	2
Ch.19	A2 Abd II	m_3 series chaetae number	0–7	2	**4**
Ch.20	A3 Abd III	a_1	0–1	1	1
Ch.21	A4 Abd III	above m_2 chaetae number	0–3	2	2
Ch.22	A5 Abd III	m_3–m_4 series chaetae number	0–4	1	1
Ch.23	A6 Abd IV	a_1–a_5 (A_1–D_1) chaetae number; >8 (9)	0–9	0	**3**
Ch.24	A7 unpaired chaeta	ma_0 (A_{03})	0–1	0	0
Ch.25	A7 Abd IV	ma_1–ma_4 (A_2–E_1) chaetae number; >9 (10)	0–10	2	2
Ch.26	A8 unpaired chaeta	m_0 (A_{04})	0–1	0	0
Ch.27	A8 Abd IV	m_1–m_3 (A_{4a}–C_{2a}) chaetae number; >5 (6)	0–6	3	3
Ch.28	A9 unpaired chaeta	mp_0 (A_{05})	0–1	0	0
Ch.29	A9 Abd IV	mp_1–mp_3 (A_5–B_5) chaetae number; >6 (7)	0–7	2	2
Ch.30	A10 Abd IV	p_{1a}–p_3 (A_6–B_6) chaetae number; >5 (6)	0–6	2	2
Ch.31	A11 Abd IV	T_1 (ma_{4e}) as trichbothrium	0–1	0	0
Ch.32	A12 Abd IV	T_2 (m_4) as trichobothrium	0–1	1	1
Ch.33	A13 Abd IV	T_4 (mp_4) as trichobothrium	0–1	1	1
Ch.34	A14 Abd IV	T_6 (p_4) as trichobothrium	0–1	0	0
Ch.35	Ratio Abd IV/Abd III	$2 < R < 4$ (1), $R > 4$ (2)	1–2	2	2
Ch.36	Manubrial plate	chaetae number; >10 (11)	0–11	4	**7-11**
Ch.37	Manubrial plate	pseudopores 1–2	1–2	2	2
Ch.38	Mucro	sub–apical tooth, without (0), normal (1), big (2), small (3)	0–1	1	1
Ch.39	Mucro	basal spine, absent (0), present (1)	0–1	1	1

Tab. 3 Collembolan fauna found in the 'Caldera de Taburiente'. For localities and capture methods see the part of faunal study. sp or g. sp. meaning juveniles or deteriorated specimens.

Taxa, in alphabetic order	Number of individuals	Localities and sampling method
Arrhopalites sp.	6	7au
Bourletiellidae g. sp.	1	31ae
Brachystomella curvula Gisin, 1948	2	10l
Brachystomella parvula (Schäffer, 1896)	2	27k
Ceratophysella gibbosa (Bagnall, 1940)	282	3aw, 3au, 23au, 27au, 31b, 31d
Dicyrtomidae g. sp.	5	3a, 13av, 16n, 24aq
Entomobrya nigrocincta Denis 1923	173	1n, 3av, 4ay, 5ac, 11p, 11ab, 13r, 19a, 19aq, 23au, 23av, 27k, 27ao, 27au, 27av, 29au, 32al
Entomobrya palmensis n. sp.	866	3au, 3av, 4ay, 9a, 12g, 12p, 19as, 21a, 23au, 23av, 25ar, 26aa, 27k, 27au, 28ax, 29c, 29d, 29x, 29au, 29av, 30a, 30z, 30au, 30ak
Entomobrya sp. juvenile	25	3aw, 3at, 3au, 13a, 19j, 19aq, 23au, 27au, 29at, 30au, 31d, 31b
Fasciosminthurus sp.	1	29at
Folsomides cf. *zairensis* Martynova, 1978	58	29c
Hemisotoma cf. *bituberculatus* (Wahlgren, 1906)	24	3aw
Hemisotoma debilis (Cassagnau, 1959)	1	29c
Hemisotoma thermophilus (Axelson, 1900)	1	3au
Heteromurus nitidus margaritaria (Templeton, 1835)	31	7au, 8au
Isotomidae g. sp.	2	16h, 19v
Isotomurus cf. *palustris* (Müller, 1776)	32	1a, 12g, 12w, 12an, 13r, 14o, 15am, 16q, 19i, 27av, 28ax, 31b
Lepidocyrtus nigrescens Szeptycki, 1967	200	3a, 3m, 3t, 3au, 3av, 8au, 19a, 21a, 22a, 27ag, 27au, 27av, 27az, 31a
Mesaphorura orousseti Najt, Thibaud & Weiner, 1990	1	31b
Metaphorura denisi Simón Benito, 1986	1	3aw
Parisotoma notabilis (Schäffer, 1896)	16	27k, 29d, 31b
Pratanurida boerneri (Schött, 1902)	3	31d
Pseudosinella sp.	1	31b
Seira dinizi Gama, 1988	129	3a, 3at, 3av, 6a, 18a, 19as, 30a,30au, 30av, 31d
Seira sp.	3	5ap, 27au
Sminthuridae g. sp.	9	29d, 31d, 31y
Sminthurinus sp.	2	29c, 29au
Sminthurus sp.	38	5ad, 6ai, 15p, 17aj, 20ah, 23av, 27ag, 28ax, 31a, 31af
Sphaeridia sp.	2	3av, 29au
Symphypleona varia	53	3aw, 3av, 23au, 27k
Vertagopus sp.	2	2am
Xenylla maritima Tullberg, 1869	6	29c, 29d, 29au

roots, **w**; Beating *Descurainia millefolia*, **x**; Beating on low vegetation, **y**; Beating 'alholí' (*Erysimum scoparium* asl), **z**; Beating Saint-John´s-wort (*Lotus hillebrandii*), 'tedera' (Psoralea bituminoso), common bracken (*Pteridium aquilinum* asl) and faya (*Myrica faya*), aa; Beating faya (*Myrica faya*), crofton weed (*Ageratina adenophora*), tree heath (*Erica arborea*) and Canary Island pine (*Pinus canariensis*), **ab**; Beating herbaceous plants, **ac**; Beating herbaceous plants beside a road, ad; Beating purple viper's bugloss (*Echium plantagineum* asl) and common bracken (*Pteridium aquilinum* asl), **ae**; Discretionary beating, **af**; Beating at night, **ag**; Beating herbaceous plants and annual bastardcabbage (*Rapistrum rugosum* asl), **ah**; Beating grass, **ai**; Beating flowered viola (*Viola palmensis*), **ak**; Beating purple viper´s bugloss (*Echium plantagineum* asl) and Vicia, **al**; Water sampling, am; Water sampling: moss on stones, an; Nocturnal sampling, **ao**; On 'bejeque' (*Aeonium* sp.), **ap**; On crofton weed (*Ageratina adenophora*), common bracken (*Pteridium aquilinum* asl) and taro (*Colocasia esculenta*), **aq**; On pine (*Pinus canariensis*), **ar**; On 'poleo' (*Bystropogon origanifolius*), **as**; Yellow trap, **at**; Pitfall trap, **au**; Malaise trap, av; Moss on rocks, aw;Winkler trap (soil) and pine needles (*Pinus canariensis*), **ax**; Dead pine trunk (*Pinus canariensis*) and soil under it, **ay**; Winkler (soil of willows) (*Salix* sp.), az.

E. Palmensis is the most abundant collembola species in the fauna of the Caldera de Taburiente. Among the 1978 Collembola collected in the study, 866 are *E. palmensis* n. sp. followed by *Ceratophysella gibbosa* (Bagnall, 1940) (282 sp.), *Lepidocyrtus nigrescens* Szeptycki, 1967 (200 sp.), *Entomobrya nigrocincta* Denis 1923 (173 sp.) and *Seira dinizi* Gama, 1988. (129) (see Table 3)

Etymology. The species was named after the island.

5. Acknowledgements

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