

Psocoptera (Insecta) from the Sierra Tarahumara, Chihuahua, Mexico

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Abstract. Results of a survey of the Psocoptera of the Sierra Tarahumara, conducted from 14-20 June, 2002, are here presented. 33 species, in 17 genera and 12 families were collected; 17 species have not been described. 17 species are represented by 1-3 individuals, and 22 species were found each in only one collecting locality. It was estimated that from 10 to 12 more species may occur in the area. Fisher's Alpha Diversity Index gave a value of 9.01. Only one species of Psocoptera had been recorded previously in the area. This study rises to 37 the species of Psocoptera known in the state of Chihuahua .

Key words: Psocoptera, Tarahumara, Chihuahua, Mexico.

Resumen. Se presentan los resultados de un censo de insectos del orden Psocoptera, efectuado del 14 al 20 de junio de 2002 en la Sierra Tarahumara, en el que se obtuvieron 33 especies, en 17 géneros y 12 familias; 17 de las especies encontradas son nuevas, 17 especies están representadas por 1-3 individuos y 22 especies se encontraron sólo en sendas localidades. Se estimó que 10-12 especies adicionales pueden encontrarse en el área; el Índice de Diversidad Alpha de Fisher tuvo un valor de 9.01. Sólo una especie de Psocoptera se conocía previamente de la región. Este estudio eleva a 37 el número de especies de Psocoptera del estado de Chihuahua.

Palabras clave: Psocoptera, Tarahumara, Chihuahua, México.

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Introduction

With an area of 244 938 km², Chihuahua is the Mexican “Big State”; it is also one of the least known biologically; systematic collecting has been poor for almost all groups. For the insects of the order Psocoptera, the map published by Mockford & García Aldrete (1996), for number of species of Psocoptera in each Mexican state, indicates four species in Chihuahua (although their appendix for the distribution in Mexican states of species of Psocoptera lists only three species in the “Big State”: *Psyllipsocus ramburii* Selys-Longchamps, *Liposcelis brunnea* Motschulsky and *Lachesilla texcocana* García Aldrete). Specimens deposited in the Illinois State University Collection, collected by E. L. Mockford and F. Hill on July 12, 1963, add *Rhyopsocus texanus* (Banks) and at least one more species of *Liposcelis* to the list of psocids known in the state. The above strongly contrasts with the states of Veracruz, Chiapas or Jalisco, where, respectively, 255, 185 and 146 species of Psocoptera have been recorded. As for the Sierra Tarahumara, one of CONABIO’s Terrestrial Priority Regions of Mexico (Alta Tarahumara-Barrancas, RTP-30, www.conabio.gob.mx, Arriaga *et al.* 2000), the picture is even worse: only one species of Psocoptera known from the Sierra, and that in the Sonoran part of it (*Lachesilla newi* García Aldrete 1990a, collected in Yécora).

As part of the Sierra Tarahumara Diversity Project, a survey of the Psocoptera of the area was conducted from 14-20 June, 2002. The survey was funded by the Instituto de Biología, UNAM and indirectly by CONABIO, through project in progress X007 “Insectos del orden Trichoptera de la Sierra Tarahumara, Chihuahua, México” awarded to Dr. Joaquín Bueno Soria of the Instituto de Biología, UNAM, Mexico City.

Material and methods

Psocids were collected in eleven localities in the Sierra (Table 1, Figure 1). They were taken by beating vegetation (including dead branches with dead leaves), sifting ground litter and directly from rock surfaces covered by bryophytes and lichens. UV light traps were extensively used to capture Trichoptera, but not a single psocid was attracted to the lights. The psocids captured were preserved in 80% ethyl alcohol; for identification purposes specimens were dissected and their parts mounted, either in Euparal or in Canada Balsam, following García Aldrete (1990b) and Lienhard (1998).

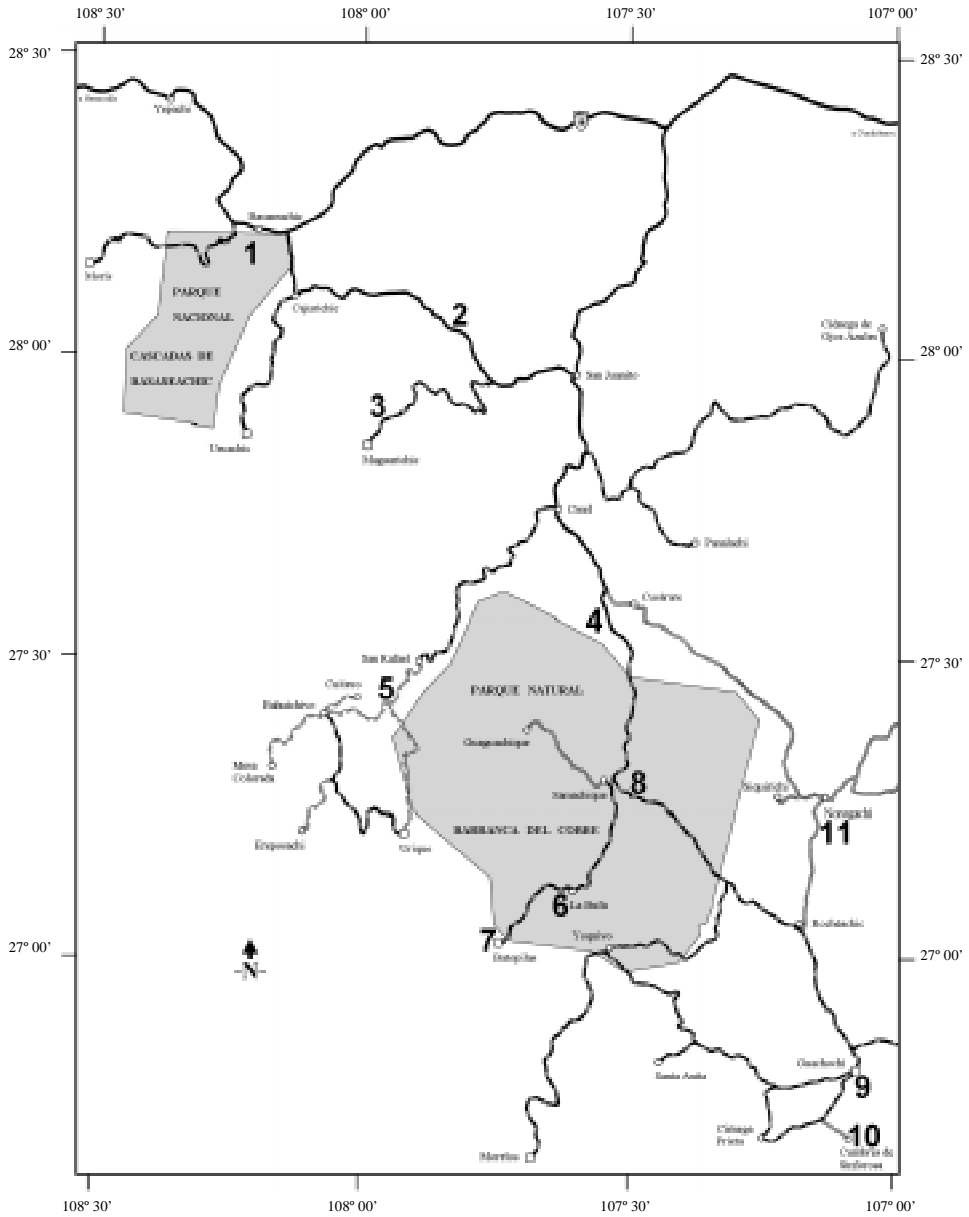


Fig. 1. Collecting localities in the Sierra Tarahumara, Chihuahua, Mexico. 14-20 June, 2002.

Table 1. Collecting localities in the Sierra Tarahumara. 14-20 June, 2002

Locality	Altitude	Coordinates	Dates
1. Basaseachic waterfall.	1870 m	28°10.623'N: 108°12.79'W	14.VI.2002
2. 5 km NW junction to Maguarichic, rd. Cajurichic-San Juanito.	2390m	28°02'35"N: 107°49'39"W	15.VI.2002
3. 6 km NE Maguarichic.	1780m	27°53'31"N: 107°57'45"W	15.VI.2002
4. Cusárare waterfall, 21 km SE Creel.	2080m	27°37'27"N: 107°33'58"W	16.VI.2002
5. 13 km SE San Rafael, towards Cuiteco.	1870m	27°28'07"N: 107°56'34"W	17.VI.2002
6. 2 km S La Bufa, rd. to Batopilas.	1065m	27°07'06"N: 107°37'05"W	18.VI.2002
7. Batopilas.	595m	27°01'55"N: 107°44'34"W	18.VI.2002
8. 5 km SE Samachique	2416m	27°16.804'N: 107°29.721'W	19.VI.2002
9. Guachochi waterfall.	2279m	26°49'08"N: 107°03'48"W	19.VI.2002
10. La Sinforosa Gorge, 22 km S Guachochi.	2400m	26°42.122'N: 107°04.640'W	20.VI.2002
11. Norogachic.	2085m	27°15.673'N: 107°08.480'W	20.VI.2002

Results

Three hundred and forty two specimens of Psocoptera were collected, in which 33 species, in 17 genera and 12 families are represented (Table 2); 16 of the species collected have already been described, and their presence in the Sierra Tarahumara fall within or extend their range of distribution. The 17 undescribed species will be treated taxonomically elsewhere. The specimens collected are deposited in the National Insect Collection (CNIN, acronym in Spanish for Colección Nacional de Insectos), housed in the Zoology Department, Instituto de Biología, UNAM.

The presence of *Lachesilla chiricahua* García Aldrete in the Sierra Tarahumara is noteworthy, as it adds an element of similarity of the area with the Chiricahua Mountains of southern Arizona. The species of *Lithoseopsis* found in the Sierra adds one more species to the many known in the genus, occurring mostly in Mexico (one species shared with the United States, ca. 20 species found only in Mexico, one found in Belize and one species occurring in the Dominican Republic). The finding of two new species of *Lachesilla* in the *rufa* group is of interest, as that

species group was revised by García Aldrete (1990a) and no additional species had been detected since. The species of *Palmicola* found in the Sierra rises to three the number of undescribed species in that genus in Mexico (Mockford & García Aldrete 1996). Similarly, the new species of *Psyllipsocus*, *Liposcelis*, *Valenzuela*, *Xanthocaecilius*, *Blastopsocus*, *Ptycta* and *Lichenomima* add to the vast array of undescribed species in those genera in Mexico, enhance the Tarahumara as an area of high biodiversity and support its status as a priority region.

Figure 2 shows the species accumulation curve over the collecting period; its shape indicates the likelihood of finding additional species in further collecting episodes (the data were fitted by means of a polynomial regression, cf. Microcal Origin vers. 6.0, www.microcal.com).

Table 3 lists the species of Psocoptera found in the Tarahumara in order of abundance and the number of specimens of each, found in each collecting locality. Most of the species are rare, even the most abundant, *Lichenomima* sp., as it was

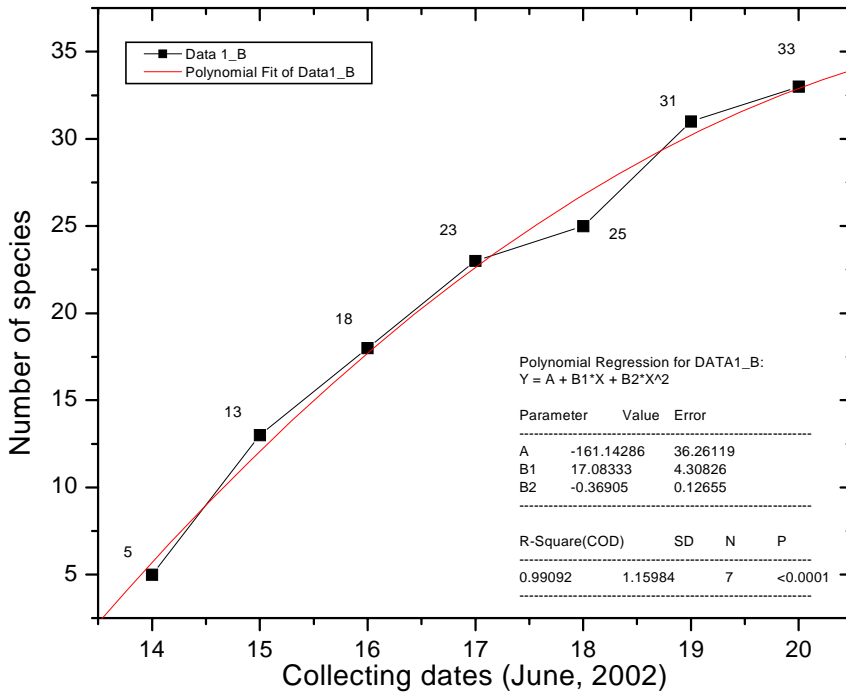


Fig. 2. Species accumulation curve for the collecting period. Sierra Tarahumara, Chihuahua, Mexico.

found in a single locality, in a cryptic habitat. It is striking that 51.5% of the species (17), are represented by 1-3 individuals (10 singletons, three doubletons, and four with three individuals each), and that 22 species are 'uniques', each found in only one locality. The most important species are *Cerobasis* sp., with 69 specimens and found in five localities, *Lithoseopsis* sp., with 25 specimens and found in six localities and *Liposcelis* sp., with 16 specimens and found in four localities. Figure 3 presents the species abundance distribution for the collection of Psocoptera from the Tarahumara. The richest localities were Cusárare (loc. 4), Samachique (loc. 8) and 13 km SE San Rafael (loc. 5), with 8-9 species each, and the least diverse were Batopilas (loc. 7) and Guachochi (loc. 9), with only one species each.

Utilizing Colwell's EstimateS, the Abundance-based Coverage Estimator (ACE) of species richness for the area, produced a value of 42.71 and a Chao 1 richness estimator of 44.56, both of which seem reasonable; the program also computed a Fisher's α diversity index value of 9.01; this value is low as compared with the tropical areas of Chamela, Jalisco ($\alpha = 24.01$) or Los Tuxtlas, Veracruz ($\alpha = 32.4$); it is considerably higher than the values for Trinidad lowlands and East Africa and Jamaica highlands (3.6, 5.7 and 5.0 respectively), and it is comparable to the values for Wilson's Promontory, in temperate SE Australia and Muogamarra Nature Reserve, in New South Wales, Australia (10.0 and 10.2 respectively) (Colwell 1997, García Aldrete *et al.* 1997).

Table 2. Psocoptera of the Sierra Tarahumara. Species, number of individuals, distribution, habitats and comments.

Suborder Trogiomorpha

Family Psoquillidae

1. *Rhyopsocus maculosus* García Aldrete. 3♂♂, 3♀♀, 4n (loc.3); 1♂, 1n (loc. 5). In *Quercus* litter. This species has also been recorded in the Mexican states of Chiapas, Distrito Federal, Durango, Mexico, Michoacán, Nuevo León and Oaxaca (Mockford & García Aldrete 1996).
2. *R. texanus* (Banks). 2♀♀ (loc.6). In ground litter. This species is known to occur only in the lower Rio Grande Valley of Texas and in the Mexican states of Baja California Norte, Baja California Sur, Chiapas, Guerrero, Jalisco, Morelos, Nayarit, Nuevo León, Oaxaca, Puebla, San Luis Potosí, Tamaulipas and in María Madre island (Mockford 1993, Mockford & García Aldrete 1996).

Family Trogiidae

3. *Cerobasis* sp. 1♀ (loc.1); 5♀♀, 2♂♂, 5n (loc.2); 14♂♂, 7♀♀, 3n (loc.4); 2♀♀ (loc.8); 20♀♀, 8♂♂, 2n (loc.10). On rock surfaces with lichens, on dead branches of *Pinus*, *Quercus* and *Cupressus*, and on dead, hanging *Nolina* leaves.
4. *Lepinotus reticulatus* Enderlein. 6♀♀ (loc. 6). In ground litter. This species is nearly worldwide in distribution. In Mexico it has been found in the states of Campeche, Distrito Federal, Jalisco, Michoacán, Nuevo León, Puebla, Sinaloa and Tamaulipas (Mockford & García Aldrete 1996).

Family Psyllipsocidae

5. *Psyllipsocus* sp. 1♂ (loc. 1). On rock surface with lichens.
6. *Psyllipsocus* sp. 1♂ (loc. 4). On rock surface with lichens.

Suborder Troctomorpha

Family Liposcelididae

7. *Liposcelis bostrychophila* Badonnel. 1♀ (loc. 3, in *Quercus* litter); 4♀♀ (loc. 6, on dead branches of shrubs and trees); 1♀ (loc. 7, on tree trunk). This is a widely distributed thelytokous species; it has been found in Europe, Africa, Madagascar, southeastern Asia, temperate South America, Canada and in the states of Florida, Indiana, Idaho and Texas. In Mexico it has been recorded in the states of Jalisco, Quintana Roo, Veracruz, Yucatán and in María Madre, Socorro and Clarión islands (Mockford 1993, Mockford & García Aldrete 1996).
8. *L. deltachi* Sommerman. 5♀♀ (loc. 3, in *Quercus* litter); 19♀♀, 1n (loc. 6, under bark of *Platanus*, in ground litter and on dead branches of shrubs and trees). This species is known from Texas and New Mexico. In Mexico it has been found in the states of Coahuila, Distrito Federal, Jalisco, México, Michoacán, Nuevo León, San Luis Potosí and Veracruz (Mockford 1993, Mockford & García Aldrete 1996).
9. *Liposcelis* sp. 3♀♀ (loc. 1, on grass tufts).
10. *Liposcelis* sp. 7♀♀, 1♂ (loc. 2, on dead branches of *Pinus* and *Quercus*); 1♀ (loc. 4, on dead branches of *Quercus*); 3♀♀, 1n (loc. 5, in *Quercus* litter); 3♀♀ (loc. 8, in pine cones).
11. *Liposcelis* sp. 5♀♀ (loc. 10, on dead *Cupressus* branches and on dead, hanging *Nolina* leaves).

Family Amphientomidae

12. *Lithoseopsis* sp. 4♀♀, 1n (loc. 1); 1n (loc. 3); 2♀♀, 4n (loc. 4); 11♀♀ (loc. 5); 1♀ (loc. 6); 1♀ (loc. 11). On rock surfaces with lichens. This species is close to *L. hellmani* (Mockford & Gurney), that occurs in southern Texas and in the Mexican state of Nuevo León.

Family Protoctopsocidae

13. *Protoctopsocus enigmaticus* Mockford. 1♀, 1n (loc. 3, in *Quercus* litter). This species has also been found in the Mexican states of Durango, Hidalgo, México, Nuevo León and Oaxaca (Mockford & García Aldrete 1996).

Suborder Psocomorpha

Family Caeciliusidae

14. *Válenzuela totonacus* (Mockford). 1♀ (loc. 8). In pine cones. This species is known from southern Colorado, New Mexico and Arizona. In Mexico it has been found in the states of Chiapas, Distrito Federal, Durango, Guerrero, Hidalgo, Mexico, Michoacán, Morelos, Nuevo León, Oaxaca, Puebla, Tamaulipas and Veracruz (Mockford 1993, Mockford & García Aldrete 1996).
15. *Válenzuela* sp. 4♂♂, 1♀, 3n (loc. 8). On dead branches and dead leaves of *Pinus*.
16. *Válenzuela* sp. 5♂♂ (loc. 8). In pine cones.

17. *Xanthoacacilius anahuacensis* Mockford. 3 ♀♀, 1 ♂ (loc. 8). In pine cones. This species has also been found in the Mexican states of Chiapas, Durango, Hidalgo, Mexico, Morelos, Nuevo León and Puebla (Mockford & García Aldrete 1996).
18. *Xanthoacacilius* sp. 4 ♀♀ (loc. 8). On branches and leaves of *Pinus*.

Family Lachesillidae

19. *Prolachesilla terricola* Mockford & Sullivan. 3 ♀♀ (loc. 5). In *Quercus* litter. This species occurs in the Rocky Mountains (southern Colorado and New Mexico). In Mexico I found it in La Michilía, Durango (García Aldrete 1991, Mockford 1993).
20. *Lachesilla centralis* García Aldrete. 1 ♀ (loc. 5). On dead *Abnus* leaves. This species has been found in southern California and in the Mexican states of Durango, Guanajuato, Guerrero, Hidalgo, Jalisco, Mexico, Michoacán, Morelos, Nuevo León, Oaxaca, Puebla, San Luis Potosí, Sinaloa, Sonora, Veracruz, and in the Federal District (Mockford 1993, Mockford & García Aldrete 1996).
21. *L. chiricahua* García Aldrete. 8 ♀♀, 3 ♂♂ (loc. 4, on dead branches and leaves of *Quercus*); 1 ♂, 1 ♀ (loc. 8, on dead *Pinus* leaves). This species was only known from the Chiricahua Mountains, Cochise Co., Arizona (García Aldrete 1990a).
22. *L. michiliensis* García Aldrete. 1 ♂, 1 ♀ (loc. 2, on dead branches of *Pinus* and *Quercus*); 1 ♀ (loc. 10, on dead, hanging *Nolina* leaves). This species was described from La Michilía, Durango; it had not been collected since (García Aldrete 1991).
23. *L. picticeps* Mockford. 1 ♀ (loc. 5, in *Quercus* litter). This species has also been found in the Mexican states of Chiapas, Coahuila, Distrito Federal, Durango, Guerrero, Hidalgo, Jalisco, Mexico, Michoacán, Morelos, Nuevo León, Oaxaca, Puebla, San Luis Potosí and Sinaloa (Mockford & García Aldrete 1996).
24. *L. ca. abiesicola* García Aldrete (*rufa* species group). 4 ♀♀, 2 ♂♂ (loc. 2, on dead branches of *Pinus* and *Cupressus*); 1 ♂ (loc. 4, on dead branches of *Cupressus*); 2 ♀♀, 1 ♂ (loc. 8, in pine cones).
25. *Lachesilla* sp. (*rufa* species group). 6 ♀♀, 5 n (loc. 1). On dead branches of *Pinus* and *Cupressus*.

Family Ectopsocidae

26. *Ectopsocus californicus* Banks. 1 ♀ (loc. 5, in *Quercus* litter). This species occurs along the Pacific Coast of the United States and in southern British Columbia, Canada. In Mexico it has been found in the state of Baja California Norte. It also occurs in the highlands of Guatemala and in New Zealand (Mockford 1993, Mockford & García Aldrete 1996).
27. *E. vachoni* Badonnel. 1 ♀ (loc. 9, in pine cones). This species occurs in southern Georgia, Texas, California, and in Guatemala, Argentina, Chile, Morocco, Spain, France and England. In Mexico it has been found in the states of Chiapas, Durango, Guerrero, Hidalgo, Mexico, Nuevo León, Oaxaca, Querétaro, San Luis Potosí, Tamaulipas and Veracruz (Mockford 1993, Mockford & García Aldrete 1996).

Family Elipsocidae

28. *Palmicola* sp. 1 ♀ (loc. 4, on rock surface with lichens).

Family Psocidae

29. *Blastopsocus* sp. 1 ♂ (loc. 2, in *Quercus* litter); 1 ♀ (loc. 3, on *Quercus* branch).

30. *Camelopsocus monticolus* Mockford. 1♀, 1n (loc. 4, on dead branches of *Quercus*); 1n (loc. 10, on dead branch of *Cupressus*). This species is known in Colorado, New Mexico and Arizona. In Mexico it has been taken in the states of Durango, Nuevo León, Oaxaca and Zacatecas (Mockford 1993, Mockford & García Aldrete 1996).
31. *Ptycta* sp. 1♀ (loc. 5, on rock surface with lichens).

Family Myopsocidae

32. *Lichenomima* sp. 1♂ (loc. 4, on rock surface with lichens).
33. *Lichenomima* sp. 20 ♂♂, 60 ♀♀, 15n (loc. 11, forming a large group on rock surface with lichens, on stream edge).

Table 3. Psocoptera of the Sierra Tarahumara. Species in order of abundance, and number of specimens in each locality sampled.

SPECIES	N	LOCALITIES										
		1	2	3	4	5	6	7	8	9	10	
<i>Lichenomima</i> sp.	95											
<i>Cerobasis</i> sp.	69	1	12		24				2		30	
<i>Liposcelis deltachi</i> Sommerman	25				5			20				
<i>Lithoseopsis</i> sp.	25	5			1	6	11	1				
<i>Liposcelis</i> sp.	16		8			1	4			3		
<i>Lachesilla chiricahua</i> García Aldrete	13						11				2	
<i>Rhyopsocus maculosus</i> García Aldrete	12						10		2			
<i>Lachesilla</i> sp. (<i>rufa</i> group)	11	11										
<i>L. ca. abiesicola</i> García Aldrete	10		6			1					3	
Valenzuela sp.	8										8	
<i>Liposcelis bostrychophila</i> Badonnel	6				1			4	1			
<i>Lepinotus reticulatus</i> Enderlein	6								6			
Valenzuela sp.	5									5		
<i>Liposcelis</i> sp.	5										5	
<i>Xanthoacilius anahuacensis</i> Mockford	4										4	
<i>Xanthoacilius</i> sp.	4										4	
<i>Liposcelis</i> sp.	3	3										
<i>Prolachesilla terricola</i> Mock. & Sull	3							3				
<i>Lachesilla michiliensis</i> García Aldrete	3		2								1	
<i>Camelopsocus monticolus</i> Mockford	3						2				1	
<i>Rhyopsocus texanus</i> (Banks)	2								2			
<i>Protoctopsocus enigmaticus</i> Mockford	2					2						
<i>Blastopsocus</i> sp.	2		1	1								
<i>Psyllipsocus</i> sp.	1	1										
<i>Psyllipsocus</i> sp.	1					1						
<i>Valenzuela totonacus</i> (Mockford)	1									1		
<i>Lachesilla centralis</i> García Aldrete	1						1					
<i>Lachesilla picticeps</i> Mockford	1						1					
<i>Ectopsocus californicus</i> Banks	1						1					
<i>Ectopsocus vachoni</i> Badonnel	1										1	
<i>Palmicola</i> sp.	1					1						
<i>Ptrycta</i> sp.	1							1				
<i>Lichenomima</i> sp.	1						1					
	N	342	21	29	20	48	24	33	1	31	1	37
	S	33	5	5	6	9	8	5	1	9	1	4

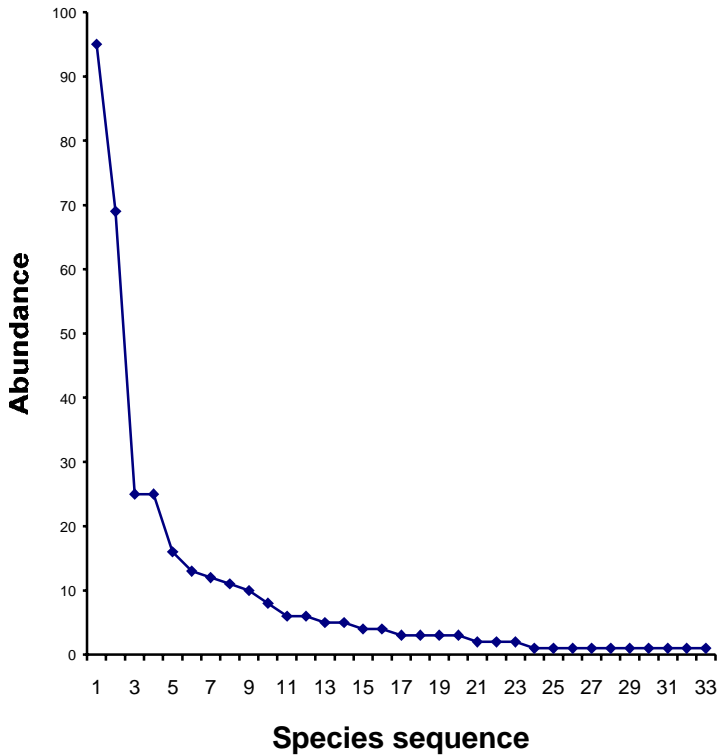


Fig. 3. Species abundance distribution of the Psocoptera collection from the Sierra Tarahumara.

Discussion

Previous to this work, only five species of Psocoptera were known to occur in Chihuahua; that count is now risen to 37 species. In the Chihuahuan portion of the Sierra Tarahumara 33 species are known to occur, a number that could, in the future, be risen to 45, if the richness estimates prove to be correct. In size, the fauna of the Tarahumara is comparable to that of the Biosphere Reserve “La Michilía” and surroundings, in southeastern Durango ($23^{\circ}15' - 23^{\circ}30'N$; $101^{\circ}05' - 104^{\circ}20'W$), where 30 species of Psocoptera have been collected (García Aldrete 1991 and unpublished data), and it is smaller than the fauna of Cerro de la Silla, Nuevo León ($25^{\circ}37'N$; $100^{\circ}14'W$) where 44 species are known to occur (García Aldrete, unpublished data); the composition of these faunas are quite different, as expected, given the distances among them, even taking into account that six species are shared with Michilía (closer), and only two species are shared with Cerro de la Silla (more distant).

Granting that what is presently known about the Psocoptera of Mexico is rather patchy and still presenting an ill defined picture, it is nevertheless striking that 51.5% of the species found in the Tarahumara are endemic to the area (species 3, 5, 6, 9, 10, 11, 12, 15, 16, 18, 24, 25, 28, 29, 31, 32 and 33 of Table 2). The other 16 species are either widely distributed (species 1, 2, 4, 7, 8, 13, 14, 17, 20, 23, 27 and 30 of Table 2) or have a restricted distribution in Nearctic Mexico (species 19, 21 and 22 of Table 2), all of which gives, as expected, a markedly nearctic character to the fauna of the Tarahumara.

The data for localities 7 (Batopilas), 9 (Guachochi) and 11 (Norogachi) are probably underestimated, due to the limited amount of time spent collecting there, which points to the need of additional, extensive collecting in those places.

One of the objects of the Tarahumara Diversity Project is to examine biological and anthropological verticality; the results of this survey allow for a limited comparison of verticality in the distribution of Psocoptera. Collecting localities 6 and 7 are low altitude sites, with 1065 and 595m respectively, as compared to all the other localities ranging from 1780 to 2416m. Five species of Psocoptera were found in the two lower localities, three of which (*Liposcelis bostrychophila*, *L. deltachi* and *Lithoseopsis* sp.) were also found in the upper ones, and two species only (*Rhyopsocus texanus* and *Lepinotus reticulatus*) were restricted to the low sites; it is evident that more data from the lower sites is required for a proper comparison with the upper sites and significant differences would be predicted, given the deep differences in vegetation and climate between both.

The richness of Psocoptera of the Tarahumara, the composition of the fauna and its high level of endemism, add elements to justify its status as a terrestrial priority region.

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