

OBSERVATIONS ON THE DIVERSITY AND DISTRIBUTION OF THE SPIDERS OF PERUVIAN MONTANE FORESTS

by

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ABSTRACT

An estimated 750 spider species, from 38 families, were collected in eight montane forest sites in Peru, located above 800 m elevation. Although the data given are preliminary and much more field work is needed, the information drawn from this study permits some tentative conclusions about the species richness and distributions of spiders in the montane forests of Peru. The majority of species exhibit very restricted distributions. The predominance of these endemic species has important consequences for the conservation of the invertebrates of Peru.

RESUMEN

Aproximadamente 750 especies de arañas, pertenecientes a 38 familias, fueron colectadas en ocho diferentes localidades ubicadas en bosques montanos del Perú, por encima de los 800 m. Si bien el cuadro que se presenta está lejos de ser completo y existe la necesidad de más trabajos de campo, la información obtenida permite discutir algunas patrones tentativos de la riqueza de especies y las distribuciones de arañas en los bosques montanos del Perú. La mayoría de las especies presentan distribuciones muy restringidas. La predominancia de estas especies endémicas tiene consecuencias importantes para la conservación de los invertebrados en el Perú.

INTRODUCTION

Spiders belong to the order Araneae, which is one of the most diverse groups of arthropods. One forested hectare in the lowland Neotropics can harbor approximately 300 to 800 spider species (Coddington *et al.*, 1990).

There are multiple lines of evidences (Turnbull, 1973; Coddington *et al.*, 1990) that show that the ecology and behavior of spiders contribute to make these predators an important control agent of insect populations, in many cases even determining the structure and size of insect communities. Spiders are on top of the invertebrate trophic chain and thus must be considered important for the stability of ecosystems (Coyle, 1981).

The spider fauna from Peruvian montane forests has never been reviewed or summarized. The taxonomy of many spider groups is inadequately known and knowledge of their distributions is rather poor at present. Many species are known from few specimens, and many more species remain to be discovered in unexplored and poorly collected areas.

Despite these limitations, field work done during the last several years in various sites in the north, center, and south of Peru now permits the outline of broad distributional patterns for the Peruvian montane spiders. Moreover, some taxonomic studies contribute to this attempt by providing the basic data that allow the identification and characterization of distribution patterns of particular Peruvian spider species. For instance, Baert (1990) describes mysmenids from Peru; Levi (1985, 1988, 1990, 1991) revises Neotropical genera of Araneidae; Levi (1986) describes some tetragnathid genera; and Millidge (1991) describes many new South American linyphiids.

The goals of this article are to present a summary of the data gathered, to begin to explain the distributional patterns and species richness of spider species from Peruvian montane forests, and to offer additional information which might contribute to the development of conservation policies for these ecosystems.

STUDY AREAS

Spiders were collected in areas from 800 to 3500 m that were entirely covered by forest, except for some open formations associated with small clearings or the adjacent high elevation grasslands. The montane forests were partly primary, and partly secondary, though the greater part of the collections were made in primary forest.

The eight study areas were located on either the western or eastern slopes of the Peruvian Andes. They are listed below, giving location, collection dates, and an estimate of sampling intensity.

1.) Cordillera del Cóndor. The studied area is located on the eastern Andean slopes in the department of Amazonas, at approximately 5°02'S and 78°51'W, and between 800 to 1100 m elevation. The field work was done in fifteen days, with at least 30 working hours, during October-November 1987.

2.) Canchaque. This area lies on the western slopes of the Cordillera de Huancabamba in the department of Piura, at 5°24'S and 79°36'W, between 1750 and 1850 m. Two types of vegetation were included: deforested, cleared areas, now covered with grass and cultivated plants; and secondary forests. Part of the material was collected by H.-W. and M. Koepcke in the 1950's. Other collections were obtained during two days in April 1989, with at least four working hours.

3.) San Andrés de Cutervo. The area is located on the eastern slopes of the Andes in the department of Cajamarca, at 6°22'S and 78°51'W, between 2000-2430 m. The collections were obtained from two types of vegetation, secondary and primary forests, during three days in April 1989, with at least six working hours.

4.) Río Abiseo National Park. It is located in the eastern Andes at 7°45'S and 77°30'W, in the department of San Martín. The collections were taken between 3100-3500 m in the localities known as Pampa del Cuy and Puerta del Monte, in the northwest sector of the Park, during February-March 1988, with at least 50 working hours. A few additional collections, taken by B. Roth in 1986 at 2100 m, are also considered here. Three types of vegetation were sampled: the fragmented timberline forest, the continuous montane forest, and the high elevation grasslands (described in Young & León, 1990, 1991).

5.) Yanachaga-Chemillén National Park. The localities studied were in forested areas near the town of Oxapampa. They are on the eastern slopes of the Andes in the department of Pasco, at approximately 10°33'S and 75°24'W, between 1800-2800 m. The study area was covered with secondary and primary cloud forest. The spiders were collected during four days in June 1986, with at least 12 working hours.

6.) Zárate forest (Bosque de Zárate). It is located on the western slopes of the Andes in the department of Lima, between 11°53'-11°56'S and 76°25'-76°31'W. For this study only the oligotherm forest (*sensu* Koepcke & Koepcke, 1958) at 2700-3200 m is considered (described in Valencia & Franke, 1980; León & Valencia, 1988). Collections used were made by H.-W. and M. Koepcke in the 1950's and by I. Franke & N. Valencia in the 1980's.

7.) Manu National Park. Various sites along the Cusco-Atalaya highway, at approximately 13°08'S and 71°25'W, were sampled during one week in February, 1990 between 2000-3000 m. The collections were made on brushy slopes and in montane forests, with at least 25 working hours.

8.) Wiñayhuaina. This site is located in the Historical Sanctuary of Machu Picchu (Santuario Histórico Machu Picchu), at approximately 13°07'S and 72°34'W. The collections were taken within montane forest from 2700 m to timberline at 3100 m, during four days in February 1990, with at least 20 working hours.

MATERIAL AND METHODS

The material upon which this study is based was collected largely by the author during the last five years. It was supplemented by collections of spiders from Zárate forest made by H.-W. & M. Koepcke in the 1950's and by I. Franke and N. Valencia in the 1980's. Material collected by the Koepckes in several other sites was also included. Because genitalia of both male and female spiders are necessary in order to make accurate identifications, only adult specimens were considered for the present study.

The spiders were collected by sweeping a net over low vegetation, beating of foliage, pitfall trapping (only in Zárate forest), and direct searching. Collections were made both at night and during the day, although only direct searching with a headlamp was possible at night.

Identifications were made by using the relevant literature and by sending specimens to specialists (L. Baert for mysmenids, A. Millidge for linyphiids, P. Sierwald for pisaurids, and H. Levi for araneids). All material is deposited in the collections of the Museo de Historia Natural, Lima, Peru.

RESULTS

About 750 spider species, distributed in 38 families, were collected in total from the eight study sites (Table 1); very few of these species were found in more than one site. More than 500 species occurred above 1500 m, and 228 species were found in the Cordillera del Cóndor (below 1100 m).

Most families found in the montane forest sites (Table 1) also occur in the Amazon lowlands of Peru. Two families are basically restricted to the lowlands, Deinopidae and Aphantochilidae; they were found in this study at 800-1100 m, but were never found at higher elevations. The theridiids *Twaitesia* and *Thymoites*, the araneids *Araneus* and *Micrathena*, the tetragnathids *Chrysometa* and *Leucauge*, and the linyphiid *Dubiaranea* all have species in the montane forests, but are also represented in the lowlands by other species.

Sites on the eastern slopes of the Andes were more diverse than those on the western slopes (Table 1). In total, the former harbored more than 450 species, while the latter had about 50 species. Two families, Diguettidae and Zoridae, appear to be endemic to the western slopes of the Andes.

In each of the eight sites studied, some nonarboreal vegetation was included in the sampling. In general, these open areas had a lower number of species than in the forests, although the species appeared to have higher population densities. The dominant groups in forest were the araneids, theridiids and salticids, while in open areas the linyphiids, tetragnathids, dictynids and amaurobiids predominated.

Two genera collected are particularly speciose in the Peruvian highlands. They occurred in high population densities in the nonarboreal vegetation of the study sites and at lower densities in the forests. These genera are *Dubiaranea*, with 44 species in total from the eight study areas, and *Chrysometa* with 39 species. Most of these species were found in only one of the sampled areas, and are thus apparently highly restricted in distribution.

Quantitative samples are not available from all study areas, but apparently there is an increase in species richness from secondary to primary forests. Thus, there was a great reduction in numbers of species and individuals in habitats affected by humans, like those sampled in Canchaque. Another example was found in Cutervo, where, with about one working hour, 32 species were collected in a primary forest, and only 26 species were collected with at least two working hours in an area of secondary vegetation.

DISCUSSION

Although diversity of spiders is higher in the Amazon lowlands (Silva & Coddington, in prep.), the number of endemic species is probably much higher in the highlands of South America. Peruvian montane forests are known to have a wide range of habitats and microhabitats (León, 1991; León & Valencia, 1988; Young & León, 1991), which probably favors the existence of specialized and endemic spider species. Increased knowledge about these very restricted groups would allow for a better understanding of the historical and ecological processes responsible for the diversity and distribution of spiders in the Andes.

The species of spiders found in this study appear to fall into four general classes of distribution, presented here in order of increasing importance:

- 1) A few species have broad distributions in the Neotropics. For example, *Alpaida bicornuta* (Tacz.) is found from Costa Rica to Argentina (Levi, 1988) and was common in the open

TABLE 1. Families and number of spider species in the eight Peruvian montane forests. Western or eastern slopes refers to the location on the Peruvian Andes.

Family	Western Slopes		Eastern Slopes					
	Canch.	Zárate	Cóndor	Cutervo	Abiseo	Yana.	Manu	Wiñay
Amaurobiidae	0	0	4	1	0	0	1	2
Anapidae	0	0	1	1	0	0	1	0
Anyphaenidae	6	4	5	4	5	2	18	10
Aphantochilidae	0	0	1	0	0	0	0	0
Araneidae	5	3	58	6	8	12	25	11
Clubionidae	0	3	0	0	0	0	2	1
Corinnidae	0	0	4	1	0	0	3	1
Ctenidae	1	0	7	0	0	2	1	1
Cybaeidae	0	0	0	0	2	0	0	1
Deinopidae	0	0	1	0	0	0	0	0
Dictynidae	0	0	0	0	1	1	0	0
Diguetidae	0	1	0	0	0	0	0	0
Dipluridae	0	1	1	0	0	0	0	0
Dolomedidae	0	0	3	0	0	0	0	0
Dysderidae	1	1	0	0	0	0	0	0
Gnaphosidae	0	3	1	1	2	1	0	0
Hahniidae	0	1	0	0	2	0	1	1
Heteropodidae	0	0	1	1	3	0	1	1
Linyphiidae	4	1	2	7	24	14	14	6
Lycosidae	1	1	1	4	2	6	0	1
Mimetidae	0	0	3	0	1	0	2	1
Miturgidae	0	1	0	1	1	0	0	1
Mysmenidae	0	0	1	1	1	0	3	1
Ochyroceratidae	0	1	0	0	1	0	0	0
Oonopidae	0	0	1	0	0	0	0	0
Pholcidae	1	2	5	1	5	1	6	5
Pisauridae	0	0	2	0	0	0	0	0
Salticidae	1	0	3	45	11	7	6	5
Scytodidae	0	0	0	0	1	0	0	1
Senoculidae	0	0	0	0	0	0	1	0
Symphytognathidae	0	0	2	0	1	0	1	1
Tetragnathidae	6	1	19	8	13	7	19	4
Theridiidae	6	3	45	19	7	11	31	26
Theridiosomatidae	1	0	16	2	2	3	4	2
Thomisidae	1	0	7	1	1	1	2	7
Titanoecidae	0	0	0	0	0	0	0	1
Uloboridae	0	0	5	0	0	1	1	1
Zoridae	0	1	0	0	0	0	0	0
Total	34	28	228	64	94	69	143	92

hábitats and ecotonal areas studied. *Chrysometa zelotypa* (Keys.) is an example of a widespread neotropical species (Levi, 1986) that was found in Zárate, where it was abundant. One of the most common species within almost all the studied montane forests was *Micrathena agriliformis* (Tacz.), which is known from the mountains of Costa Rica to Bolivia (Levi, 1985).

2) A few of the species collected have wide elevational ranges, and can be present both in the lowlands and the highlands. An example is *Sphecozone nitens* Millidge, which occurs at elevations above 2000 m in the forests near Yanachaga-Chemillén National Park and also at 250 m in the lowlands of the department of Madre de Dios. *Araneus koepckeorum* Levi occurs mostly at 200 m on the western side of the Peruvian Andes (Levi, 1990), but it was collected in Zárate forest at 2800 m.

3) Some species show a disjunct distribution between the Andes and eastern Brazil. *Gravipalpus crassus* Millidge, which was found in the montane forest of Río Abiseo National Park, is also known from eastern Brazil (Millidge, 1991). *Araneus bogotensis* (Keys.) is apparently distributed in the Andes from Venezuela to Bolivia, and also appears in eastern Brazil (Levi, 1990); it is one of the few species shared among the eight sites examined in this study.

4) Most species have restricted distributions in the mountains of Peru. *Araneus urubamba* Levi, described for Cuzco (Levi, 1990) was found in this study in Manu National Park. *Dubiaranea tristis* Millidge is known only for the forests in Yanachaga-Chemillén National Park (Millidge, 1991). Other endemics include *Labicymbium dentichele* Millidge, *Maymena roca* Baert and *Ocrepeira abiseo* Levi known only from Río Abiseo National Park, in addition to at least 15 more species described from material from this area by Levi (pers. com.) and Millidge (1991). Other examples are *Aculepeira machu* Levi from Historical Sanctuary Machu Picchu (Levi, 1990), and *Alpaida nancho* Levi restricted to montane forests in the department of Cajamarca (Levi, 1988). The predominance of these endemic species has important consequences for the conservation of montane invertebrates in Peru.

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