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The microarthropod fauna associated with a deep rooted legume, *Prosopis glandulosa*, in the Chihuahuan Desert

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Summary. The rhizosphere microarthropod fauna of a woody, deep-rooted legume, *Prosopis glandulosa,* was sampled at four sites in the northern Chihuahuan Desert and compared with the rhizosphere microarthropod fauna of a co-dominant shrub, *Larrea tridentata.* Prostigmatid mites (*Speleorchestes* sp., *Neognathus* sp., *Rhagidia* sp., *Tydaeolus* sp., *Steneotarsonemus* sp., *Tarsonemus* sp., *Nanorchestes* sp., *Gordialycus* sp.), the cryptostigmatid mites (*Bankisonoma ovata* and *Passalozetes neomexicanus*), the mesostigmatid (*Protogamasellus mica*), and the collembolan (*Brachystomella arida*) characterized the fauna at depths greater than 1 m. Microarthropods were recovered from soils at a depth of 13 m at the edge of a dry lake and at depths of 7 m in a dry wash which were pre-European man *P. glandulosa* habitats. In habitats where *P. glandulosa* is a recent invader, root depth and microarthropods were less than 3 m. In most habitats, population densites of microarthropods at depths <0.5 m were more than 100 times those at depths >0.5 m. Population densities of microarthropods associated with *P. glandulosa* growing at the edge of a dry wash were not significantly smaller at 0.5–1.0 m depth than at 0–0.5 m. The deep-rhizosphere microarthropod fauna is a reduced subset of the fauna of surficial soils, suggesting that this fauna plays a role in decomposition and mineralization processes functionally similar to that of microarthropods in surficial soils.

Key words: *Prosopis glandulosa* – Rhizosphere – Mites – Collembolans – Chihuahuan Desert

Small trees and shrubs in deserts have some of the deepest root systems known (Cannon 1925). Mesquite, *P. glandulosa*, is a deep-rooted legume found in all of the hot deserts of North America, and other species of *Prosopis* are found in the deserts of South America, Africa and the Middle East (Simpson and Solbrig 1977). In the Sonoran Desert, mesquite roots have been reported up to 53 m in depth (Phillips 1963). In the Chihuahuan Desert of North America, this species has expanded into areas that were formerly grasslands, and in many areas mesquite forms thickets or coppiced dunes to the exclusion of most if not all perennial grasses (Buffington and Herbel 1965; Fisher 1977). The habitats of *P. glandulosa*, prior to the introduction of domestic livestock into the Chihuahuan Desert by European man, were edges of ephemeral rivers (arroyos) and perimeters of ephemeral lakes (playas) where the growth form of mesquite is primarily single-stem small trees. In areas where mesquite has recently increased it is generally a multistemmed, 1- to 2-m tall shrub (Hennessey et al. 1983).

The different morphologies of *P. glandulosa* suggest different rooting patterns and this plant is known to show a range of root distributions, reflecting patterns of soil moisture (Cannon 1925). The variation in mesquite morphologies and the recent history of expansion into new habitats suggests the possibility that the assemblages of rhizosphere organisms differ in the different habitats. We sampled rhizospheres to the maximum depth of detectable roots. We compared the microarthropod fauna associated with mesquite roots in four habitats: dry lake fringe, dry wash edge, grassland, and coppice dune, with the microarthropod fauna in the rhizosphere of the shallow-rooted shrub, *Larrea tridentata.* In general, studies of microarthropods and rhizosphere fauna have been limited to the upper 0.5 m of the soil column. We addressed the question, are microarthropod assemblages present in soils throughout the rhizosphere of a deep-rooted desert plant? If microarthropods are present, what is the tax-

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onomic and functional structure of that assemblage? The presence of a generalist microarthropod assemblage would suggest functional relationships among deep soil biota similar to the relationships documented in shallow soils (Santos et al. 1981; Parker et al. 1984).

Materials and methods

Five sites were sampled: (1) Playa (dry lake) perimeter in a dense stand of large (5–8 m height) mesquite; (2) dry wash with widely spaced 3–5 m tall mesquite trees; (3) grassland at the base of a watershed with widely scattered 2- to 3-m tall mesquite many of which are multiple stemmed; (4) coppiced dunes with 1- to 1.5-m tall mesquite and (5) creosotebush, *Larrea tridentata*, on the bajada uplands (alluvial slope) adjacent to the wash.

The studies were conducted on the Jornada Experimental Range, approximately 40 km NNE of Las Cruces, New Mexico. The dry wash, dry lake, and creosotebush site are features of a watershed that is the focus of the Jornada Long Term Ecological Research Project (LTER). The climate is semi-arid. The average annual rainfall is 230 mm, with 60% occurring as brief convectional storms during July through September. Summer maximum air temperatures regularly reach 38 °C and freezing temperatures occur from November through to March. The grassland site is 6 km east of the dry lake and the coppice dune site is 10 km north of the dry lake. The dunes are formed of wind-transported sand from which the clay and silt fractions have been stripped, as eroded soil was trapped by the mesquite plants. The dunes vary in height from 1.5 to 4 m above the interdune soil which forms a layer of 10–20 cm over an indurated calcium carbonate (caliche) layer (Table 1) through which *P. glandulosa* roots penetrate.

Two or three soil cores were collected at each site three times during 1986; January, midpoint of the dormant season; May, during peak growth; and October, following the summer rains.

Sampling to the depths necessary to study the rhizosphere soils of a deep-rooted plant like mesquite, required use of a mechanized drilling unit. The drilling machine was mounted on a 5.5-tonne

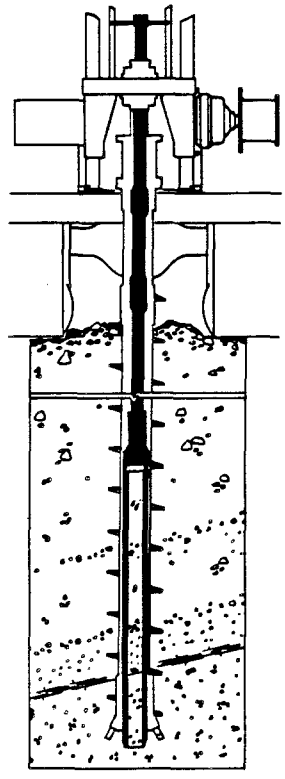

Fig. 1. A diagram of the split, hollow-tube cores mounted within a drill used in obtaining deep cores in the rooting zone of mesquite *Prosopis glandulosa*

Table 1. Comparisons of rooting depths and soil features with depth at mesquite sites and a *Larrea tridentata* site in the northern Chihuahuan Desert. Descriptions are for the January sampling

Depth (m)	Playa	Arroyo	Dunes	Grassland	*Larrea* sp.
0– 1.5	Abundant roots	Fine roots	Roots	Roots, sandy loam	Abundant roots
	Clay loam	Dry sand	Sand	75 cm caliche	Sandy loam
1.5– 3.0	Abundant roots	Large and fine roots	Fine roots	Fine roots	Sparse roots
	Clay loam	Moist sand	Sand/caliche	Dry sand	Sand/caliche
3.0– 4.5	Fine roots	Fine roots	Fine roots	No roots	Fine roots
	Caliche and clay	Gravel, caliche	Caliche	Dry sand	Caliche/sand
4.5– 6.0	Fine roots	Fine and coarse roots	No roots	No roots	
	Clay and caliche	Dry sand	Caliche and sand	Dense caliche	
			Dry fine sand		
6.0– 7.5	Fine roots, river gravel	Fine roots, small roots			
	Fine sand	Moist sand			
7.5– 9.0	Sparse roots, sand	No roots			
	Clay/caliche	Moist sand			
9.0–10.5	Sparse roots				
	Clay/caliche				
10.5–12.0	Fine roots				
	Sand				
12.0–13.5	Fine roots				
	Sand				
13.5–15.0	Fine roots				
	Clay/moist sand				