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SOIL MOVEMENT BY DESERT ANTS

Estimates of the quantities of soil moved by the activities of ants in forests and grasslands suggest that this activity is an important soil process (Petal, 1978; Talbot, 1953; Lyford, 1963). Since there are no comparable data for semi-arid or arid environments, we made estimates of the quantities of soil transported from the soil profile to the surface by ants in a shinnery oak (*Quercus harvardii*)—mesquite (*Prosopis glandulosa*) area 40 km east of Carlsbad, New Mexico. The soils were sandy loams. The area is characterized by spring and summer rainfall averaging 304 mm and a frost free period from March through October.

We established twelve permanent 1 m^2 plots in which we collected all the new soil moved out of the nests of the ant colonies in these quadrats. This soil was placed in bags identified by plot number, returned to the laboratory, dried and weighed.

The quantities of soil ($\bar{x} \pm$ SD) transported from deep in the soil profile to the surface in nest workings (i.e., cleaning tunnels, new chambers, etc.) were as follows: May 8, 17.4 ± 15.7 g/m^{-2}; June 10, 13.5 ± 8.8 g/m^{-2}; July 10, 2.1 ± 1.8 g/m^{-2}; August 9, 9.8 ± 7.5 g/m^{-2}; and, September 26, 43.1 ± 19.1 g/m^{-2}.

In August and September all plots had active ant nest excavations and fresh earth moved to the surface but on the other sample dates there were several plots with no evidence of nest excavations that accounts for the large standard deviations. The average quantity of soil moved to the surface by ants during the period of surface activity was 84.2 ± 4 g/m^{-2}.

The quantities of soil moved by ants is particularly important in a consideration of their role as soil animals. Materials transported to the surface by ants in the process of nest building or nest enlargement are particles of relatively uniform size and in many instances have been mixed with fluids from the ants to form pellets of soil transported from the nests. Our data show this amounts to approximately 80 g/m^{-2} over a single growing season. Soils not transported to the surface develop a soil crust and are relatively more stable.

Petal (1978) reported that *Pogonomyrmex occidentalis* moved between 0.28-0.8 gm/m^{-2} soil in the growing season in a Colorado pasture. Talbot (1953) found that *Lasius niger* moved 85.5 gm of soil/m^{-2} in Michigan old fields and Lyford (1963) reported that ants on a New England podsol moved 60 gm/m^{-2} over the growing season. Thus ants in this semi-arid environment move as much soil as ants in more mesic environments and considerably more than *P. occidentalis* in Colorado. Petal (1978) states that such soil movement increases porosity of the soil and that ants mix organic matter with this transported material, which increases soil water holding capacity. Although quantities of soil moved are not large, when we used the bulk density to calculate the volume of soil transported to the surface, we calculated that ants in this habitat transport about 2 cm of soil per 100 years to the soil surface. Such activity could be an important contribution to long term soil processes in such an area and may contribute to soil characteristics that determine plant species composition.

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A BILATERAL GYNANDROMORPH OF THE WESTERN HARVESTER ANT, *POGONOMYRMEX OCCIDENTALIS* (HYMENOPTERA: FORMICIDAE)

Occasionally an individual with both male and female characteristics is found in an otherwise normally dioecious population of animals, and different terms are used to identify such anomalies. Gynandromorphs are individuals displaying mosaicism for the sex-determining chromosomes, hermaphrodites are individuals with reproductive organs of both sexes, and intersexes are individuals with intermediate phenotypes (White, 1973). Ants have a haplodiploid sex determining mechanism, and the favored hypotheses to explain gynandromorphism are gene dosage effects (homozygosity at some loci) and chromosomal non-disjunction during early embryogenesis. Ant gynandromorphs have been described from 42 species in 22 genera (Jones and Phillips, 1985; and citations therein). Berndt and Kremer (1982) were able to induce the condition in *Monomorium pharaonis* (L.) by heat shocking experimental colonies maintained in the laboratory.

Gynandromorphs have been reported from only two of the 27 species of North American *Pogonomyrmex* harvester ants (Cole, 1968). A specimen of *Pogonomyrmex salinus* Olsen, primarily with a male phenotype, but with a partially feminized head, female coloration on the thorax, and a female petiole was collected in Ely, Nevada. Several specimens of *Pogonomyrmex californicus* (Buckley) from Claremont, California, possessed both male and worker characters (=ergatandromorphs). Herein we describe the first known bilateral gynandromorph of the genus *Pogonomyrmex*.

The unusual specimen of *Pogonomyrmex occidentalis* (Cresson), was collected by the authors on 1 July 1985, 17.6 km west of the junction of U.S. highway 180 and New Mexico highway 78, Grant Co., New Mexico. The abnormal individual was collected from a large, gravelly mound typical of the species, along with 18 workers, 17 males, and 5 females, none of which showed any aberrations. The gynandromorph and its normal nestmates are deposited in the entomological collection at Texas Tech University (Cat. No. 6834).

Female *Pogonomyrmex occidentalis* are concolorous orange, and are sparsely covered with short white setae. The male is densely covered with long, white silky hairs, and is brown except for the gaster, which is orange like that of a female. The left side of the gynandromorph is yellow (not fully sclerotized) and primarily female, and the right side is brown and predominantly male. The head is asymmetric, and has two patches of brown coloration on the female side: one patch extends from the left occiput, passes beneath the compound eye, and terminates at the mandibular insertion; the other patch surrounds the lateral ocellus. On the frontal area the bilateral distinctiveness breaks down: both scapes are male-like in shape and are densely pubescent. The right funiculus is male-like and has partially fused distal segments. The left funiculus has a normal female configuration. The mandibles resemble those of a male: there are five teeth on the right side, and six (the normal male number) on the left. The offset ultimate mandibular tooth, a diagnostic character found on all castes of this species, is lacking in the gynandromorph. Frontal views of a normal female, male, and the gynandromorph are illustrated in Fig. 1, A-C.

Dorsally, the pronotum, scutum, and scutellum are nearly bisected into male and female components. A rectangular patch of light coloration and sparse setation crosses the midline of the scutum anterolaterally and terminates on the right side at the Mayrian furrow (Fig. 1, D and E). The right mesothoracic epimeron displays coloration of both sexes. Faint traces of male