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The Sexual Castes of *Pogonomyrmex anzensis* Cole (Hymenoptera: Formicidae)

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Abstract.—The previously unknown sexual forms of the rare harvester ant, *Pogonomyrmex anzensis* Cole, were discovered at the type locality. They are here described and illustrated for the first time and the ecology of this species is discussed. Updated keys to the sexual forms of the California desert species of *Pogonomyrmex* are also presented.

Pogonomyrmex anzensis was described by Cole (1968) from a single series of workers collected by W. S. Creighton at Split Mountain, Anza-Borrego Desert State Park (ABDP), San Diego County, California. Several efforts were made to recollect this species by A. C. Cole, Jr., S. Taber (Taber 1998), R. R. Snelling, and others, to no avail. All such searches concentrated on the area of Split Mountain Wash, at a site that was presumably near the place where the type series was collected.

A further effort was undertaken in April 1997 by the team of S. P. Cover, R. A. Johnson, and G. C. Snelling (GCS). While previous searchers concentrated their efforts in the bed of the wash, this team began to investigate the steep rocky slopes on the south east side of the wash. Eventually, a few foraging workers were found and followed back to their nest under a moderate-sized stone. *P. anzensis* was easily recognizable in the field because the mandibles of the workers have only six teeth. The other two *Pogonomyrmex* species

in the immediate area (*P. californicus* and *P. magnacanthus*) both have seven mandibular teeth. Several other *P. anzensis* colonies were found at the Split Mountain site, all living on steep, extremely rocky slopes. This initial success gave us a better notion of how to search for the species. This species was eventually found at several other sites in Anza-Borrego Park (see below). A return visit by GCS in the following year resulted in the discovery of the sexual forms in one nest. These are described below.

TERMINOLOGY

All measurements were made from mounted, fully dry, specimens under a binocular microscope with 15× oculars, fitted with an ocular micrometer. In the descriptions, the following acronyms are used:

CI	(HW) (100/HL).
EL	Maximum length of compound eye in lateral view.
EW	Maximum width of compound eye in lateral view.
HL	With head in full face view, the maximum length from ante-

[†]Deceased

	riormost margin of clypeus (the thin lamelliform clypeal apron) to posterior margin.
HW	With head in full face view, the maximum width, exclusive of compound eyes.
IOD	The minimum distance between the inner margins of the posterior ocelli.
ML	Length of mandible, measured from articulation with head to greatest distance from articulation, regardless of any curvature.
OD	The transverse diameter of the anterior ocellus.
OI	(EL) (100/HL).
OMD	The distance between the lower margin of the compound eye and the base of the mandible, measured in lateral view.
OOD	The minimum distance between the outer margin of a posterior ocellus and the adjacent inner margin of the compound eye.
OVD	With the head in frontal view, the shortest distance between either posterior ocellus and the posterior margin (see below)
PW	Maximum width of pronotum in dorsal view.
SI	(SL) (100/HL).
SL	Maximum length of scape, exclusive of basal condyle.
WL	Diagonal length of mesosoma in profile, from anterior declivity of pronotum (exclusive of pronotal "neck") to apex of metapleural lobe.

Pogonomyrmex anzensis Cole

Pogonomyrmex (P.) anzensis Cole 1968:84, 7–89; pl. III fig. 13 pl. IV fig. 11; pl. VI fig. 12; pl. VII fig. 15; Taber 1998:101, 140, 149, 165.

Male

Diagnosis.—Mandible with four teeth on strongly oblique cutting margin; propodeum evenly curved to broadly subangu-

late in profile; gastral tergum 1 (abdominal tergum 4) with no pilosity visible in profile and in dorsal view with only sparse, inconspicuous short, straight hairs.

Measurements (mm) (n = 10). HL 1.37; HW 1.50; SL 0.93; EL 0.47; EW 0.33; OMD 0.20; WL 2.45; TL ca. 7.20. Indices. CI 109; SI 62; OI 31.

Description.—Mandible with four teeth on strongly oblique masticatory margin (Fig. 6); tip of subbasal tooth sometimes weakly bifid; basal tooth not offset. Anterior margin of clypeus broadly and shallowly concave. Scape long, in repose nearly attaining level of posterior margin as seen in full frontal view. Pilosity suberect to erect, long hairs of vertex mostly straight, longest slightly curled apicad, not much, if any, exceeding eye width; scape hairs all short and decumbent, all shorter than minimum scape width. Cephalic rugae fine and close, slightly wavy, interspaces weakly punctate and moderately shiny.

In profile, anterior face of pronotal collar straight and oblique. Anterior face of mesonotum straight and not overhanging pronotum, about one-half as long as dorsal surface. Propodeum evenly curved to broadly subangulate in profile, without spines or denticles. Side of pronotal collar with fine superficial rugulae, especially laterad; mesepisternum with fine irregular, mainly longitudinal rugulae and superficially shagreened; mesonotum shiny between scattered coarse piligerous punctures; propodeum mostly with fine close punctures, but with variable smooth shiny areas, especially mesially. Tibiae with suberect hairs that are much shorter than tibial width.

Petiole without anteroventral process; node rounded in profile, broadly and evenly rounded into anterior peduncle; venter glabrous. Postpetiole node low and broadly rounded, anterior slope about three times as long as posterior slope.

Disc of gastral tergum 1 (abdominal tergum 4) smooth, shiny and impunctate; following segments similar but with scat-

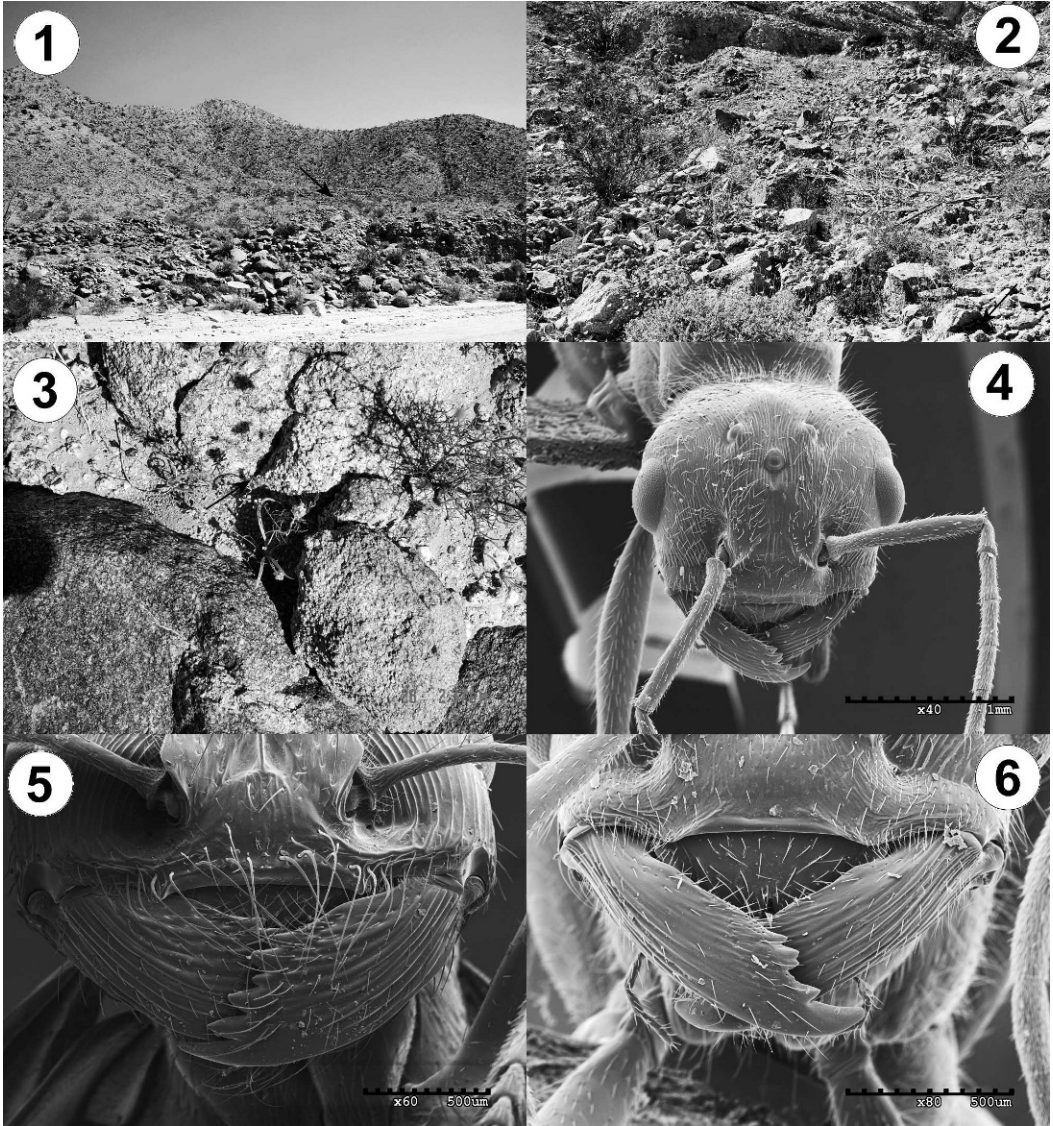


Fig. 1. Habitat of *Pogonomyrmex anzensis* at the type locality of Split Mountain; arrow indicates location of colony.
Fig. 2. Habitat immediately surrounding a *P. anzensis* colony at the type locality; arrow in lower right corner indicates nest entrance.
Fig. 3. Nest entrance hole (indicated by arrow) of *P. anzensis* colony at the type locality.
Fig. 4. Head of male *P. anzensis*.
Fig. 5. Mandibles of female alate *P. anzensis*.
Fig. 6. Mandibles of male *P. anzensis*.

tered minute piligerous punctures. Tergum 1 largely bare, with sparse short hairs basad on each side; following segments with sparse short and medium-length hairs, especially at segment margins; sterna

only slightly more pilose, second segment with short straight hairs on disc.

Queen

Diagnosis.—Mandible with six teeth on oblique cutting margin, sometimes with

small subbasal tooth or denticle. Mesoscutum prominent in side view, forming broadly rounded, anterodorsally projecting dome that does not protrude over the pronotum, sculpture absent except for scattered coarse punctures and faint traces of longitudinal striae visible on parts of the dorsal surface, pubescence absent. Ventral surface of postpetiole with well-developed tooth.

Measurements (mm) (n = 1). HL 1.79; HW 1.87; SL 1.33; EL 0.41; EW 0.31; OMD 0.53; WL 2.44; TL ca. 6.80. Indices. CI 104; SI 74; OI 23.

Description.—Small, scarcely larger than large conspecific workers. Mandibles as described above, dorsal surfaces coarsely striate, strongly shining. Head in full-face view slightly broader than long, posterior corners abruptly rounded, almost angulate, posterior margin flat. Dorsum and sides of head conspicuously rugose, in side view rugae forming circumocular whorls posterior to the eye, interrugular spaces smooth and strongly shining. Antennal scape short, failing to reach the posterior margin by at least twice its maximum diameter. Psammophore well-developed. Mesoscutum as described above. Most of pronotum smooth and shining, but with several strong rugae that extend from the lower pronotal sides to nearly the midline on the pronotal collar. Katepisternum finely rugulose, interrugular spaces roughed, less shiny than those on most of the rest of the mesosoma, some coarse, decumbent pubescence present at least on the posterior surfaces, weakly to moderately shining. Propodeum unarmed, rounded to subangulate, sides and dorsal surface rugose, shining, posterior surface smooth and strongly shining. Petiole without anteroventral process, ventral surface glabrous. In side view, node with moderately sharp apex, posterior surface slightly convex, weakly rugulose, interrugular spaces roughened and only moderately shiny. Postpetiole in side view with low, rounded node, a

small anterior-facing denticle just ventral to the petiolar articulation, and a well-developed ventral tooth. Gastric tergites smooth and shining, with weak tessellated microsculpture, and scattered coarse setae-bearing punctures. Body surfaces in general with moderately abundant coarse erect to suberect setae.

Specimens examined.—CALIFORNIA, San Diego Co.: Split Mountain, ABDP, 22 Apr. 1952 (W. S. Creighton; LACM, MCZC, USNM); 1.7 mi S jct. Split Mtn. Rd. and Fish Creek Rd., ABDP, 33.02°N 116.10°W, 500 ft., 2 Apr. 1997 (G. C. Snelling, S. Cover, R. Johnson; GCSC, LACM, MCZC, RAJC); Split Mountain, ABDP, 33.01°N 116.10°W, 500 ft., 26 Apr. 1998 (G. C. Snelling; GCSC, LACM); Ocotillo Wells Vehicular Recreation Area, ABDP, 33.13°N, 116.13°W, 2 Apr. 1997 (G. C. Snelling, S. Cover, R. Johnson; GCSC, LACM, MCZC, RAJC); same except 28 Feb. 1998 (G. C. Snelling 98-005, and R. R. Snelling 98-005; GCSC, LACM); Henderson Rd. and Pegleg Rd., 33.28°N 116.30°W, 26 Apr. 1998 (G. C. Snelling 98-051; LACM), fragments ex unknown spider web under rock.

RESULTS AND DISCUSSION

Although known only from a few collections made in the Anza Borrego Desert State Park and immediate surrounding areas, this species will no doubt be found in other suitable habitats in western Imperial, Riverside and eastern San Diego Counties. Although this species will likely be found in other Southern California localities we feel that it may be a predominantly Mexican species which is at the northern limit of its range in California. Within the approximately 940 sq mile park this decidedly rare ant is known from only three locations. All are on relatively steep, extremely rocky, west to southwest facing slopes. It is unknown at this time if this slope preference is real or if it is an artifact of inadequate collecting. Of the three sites, the Pegleg location is the most comparable to the nesting sites of the other *Pogonomyrmex* species. At this location the hillside is much less severe than the other two sites,

being less steep and rocky. However it still does fall within the parameters we have concluded are integral for the survival of this ant species.

According to Creighton's field notes, the type nest at Split Mountain was found in gravelly soil located under a large, partly buried boulder. The entrance was obscure and to one side of the boulder. One hundred seventy workers were taken. Based on this description, subsequent collectors have concluded that the type colony was found in or at the edge of the wash. If this interpretation of his notes is correct, then this is an atypical nesting situation for this species. Thus far all other collections are from rocky hillsides in cactus scrub (Figs 1–2). The only other *Pogonomyrmex* species in California that sometimes occur in this habitat type are *P. tenuispina* Forel and *P. rugosus* Emery. However, neither of these species exhibits a preference for nest sites as steep and rocky as those of *P. anzensis*. Nest entrances are typically unmarked by a crater, although on occasion there may be a small dispersed amount of chaff or soil, barely discernable from the surrounding litter on the ground. Nest entrances are usually, but not always, situated adjacent to a large rock (Fig. 3). During the course of collecting, a few colonies were located in which the nest entrance was just a simple hole in the soil. Workers forage singly and are slow-moving and timid. Workers were noted often to tuck their gasters under the mesosoma when foraging. The ants make little effort to defend the nest when disturbed other than running around somewhat excitedly, then retreating. Although there are several other harvester ants in the general area, (*Pogonomyrmex californicus* Buckley, *P. magnacanthus* Cole, *P. rugosus* and *Messor pergandei* Mayr), these species all nest and forage primarily in the wash and on the lower hillsides. By nesting in these extreme habitats, *P. anzensis* avoids most of the foraging

competition from other harvester ant species in the area. *M. pergandei* will often forage onto the hillside but generally at times of the day when *P. anzensis* is not active. Other ants occurring with *P. anzensis* on the hillside are *Pheidole hyatti* Emery, *Pogonomyrmex imberbiculus* Wheeler and a large diurnal *Myrmecocystus* species, most likely *M. mendax* Wheeler, a common inhabitant of rocky localities in Southern California.

Kangaroo rats, *Dipodomys* spp., are known to frequently raid the seed caches of granivorous ants such as *Pheidole* spp. that store their seeds in shallow chambers of the nest. These rodents are thought to be capable of detecting the clumped seed resources by olfaction (Reichman and Oberstein 1977). It is not known if these rodents impact *Pogonomyrmex anzensis* colonies in search of seeds; however the rocky nature of the soil and depth at which the seeds are stored must make such rodent excavations nearly as hard for them as it is for mere humans.

Little is known about the foraging preferences of this ant species. However it is presumably a generalized seed collector and scavenger like its congeners. Dominant plants on the hillside at the type locality are creosote bush (*Larrea tridentata* (Sesse & Moc ex DC.) Coville), Brittlebush (*Encelia farinosa* Torrey and Gray) and ocotillo (*Fouquieria splendens* Engelm.). During the spring if adequate rain has fallen, the hillside is dotted with the numerous annuals that take advantage of the moisture to flower and set seed.

At the Ocotillo Wells site, foragers were observed to be collecting small pieces of the leaves of *Encelia farinosa*. It is very unlikely that this is a preferred food source and we have never seen any other ants collecting leaf bits from this plant. This behavior indicates to us that overall resources were very scarce that season, and that these ants are fairly adaptable relative to what they might consume.

KEYS TO THE SEXUAL FORMS OF CALIFORNIA DESERT *POGONOMYRMEX*

Queens

- 1 Venter of petiole with several erect hairs, usually long; scape notably shorter than distance from mandible base to corner of vertex; forewing usually with one cubital cell 2
- Venter of petiole without erect hairs; scape usually at least as long as distance from mandible base to corner of vertex; forewing usually with two cubital cells 4
- 2(1) Frons uniformly longitudinally rugulose or striate between eye and midline; dorsum of petiolar node without longitudinal furrow; HW at least 1.9 mm, usually more than 2.2 mm 3
- Frons weakly longitudinally striate in middle, closely punctulate on either side; dorsum of petiolar node with longitudinal furrow dividing summit of node; HW no more than 1.8 mm *colei* Snelling
- 3(2) Cephalic and mesoscutal rugae fine and closely spaced, producing a silky luster; outer surface of scape base, in repose, not strongly concave; less than 10 mm long *desertorum* Wheeler
- Cephalic and mesoscutal rugae coarse and widely spaced, not producing a silky luster; outer surface of scape base, in repose, strongly concave; more than 11 mm long *rugosus* Emery
- 4(1) Mandible with seven teeth, basal tooth larger than subbasal tooth; petiole and postpetiole without prominent ventral processes; lateral angle of vertex not carinate 5
- Mandible with six teeth, basal tooth smaller than subbasal tooth (Fig. 5); petiole and postpetiole each with prominent ventral process; lateral angle of vertex with sharp, short carina *anzensis* Cole
- 5(4) In profile, cephalic rugae forming concentric loops over eye; propodeum generally unarmed, rarely with short denticles 6
- In profile, cephalic rugae not forming concentric loops over eye; propodeum distinctly bispinose *subnitidus* Emery
- 6(5) Eye small, OI 21–24; OMD nearly twice EL 7
- Eye large, OI 31; OMD no more than EL *magnacanthus* Cole
- 7(6) Interrugal spaces of head smooth and shiny, without definite sculpture; propodeum unarmed *californicus* (Buckley)
- Interrugal spaces of head moderately shiny, with weak to moderate sculpture; propodeum generally unarmed, but sometimes bituberculate *maricopa* Wheeler

Males

- 1 Venter of petiole with numerous long, erect, ventrally directed hairs; forewing usually with one cubital cell; head, in frontal view, with margin between eye and vertex corner evenly, rather strongly, convex 2
- Venter of petiole usually with no erect hairs, rarely 1–3 present; forewing usually with two cubital cells; head, in frontal view, not evenly or strongly convex between eye and vertex corner 4
- 2(1) Outer surface of base of antennal scape strongly flattened or broadly concave; body color generally fuscous yellow or brown 3
- Outer surface of base of antennal scape neither flattened nor concave; petiole, postpetiole and gaster lighter colored than head and mesosoma *desertorum* Wheeler
- 3(2) Large, HW at least 2.1 mm; hairs abundant, long, flexous, pale; node of petiole, in profile, low, broadly rounded *rugosus* Emery

– Smaller, HW about 1.5 mm; hairs straight and stiff, with blunt tips, yellowish; node of petiole, in profile, high and sharply rounded at summit *colei* Snelling

4(1) Denticulate margin of mandible transverse, with 2 to 5 teeth; vertex usually without sharply elevated longitudinal ridge; apex of paramere, in profile, angulate with lower margin 5

– Denticulate margin of mandible oblique, with 4 or 5 teeth; vertex usually with sharply elevated median longitudinal ridge; apex of paramere, in profile, broadly rounded into lower margin 7

5(4) Eye small, OI 32–43; OMD more than $0.33 \times EL$ 6

– Eye large, OI 52–54; OMD equal to, or less than, $0.33 \times EL$ *magnacanthus* Cole

6(5) Mandible with 2–4 (usually 2 or 3) teeth; anterior declivity of pronotum, in profile, straight, meeting collar at abrupt angle; length and width of terminal lobe of paramere, in profile, subequal *californicus* (Buckley)

– Mandible with 3–5 (usually 3 or 4) teeth; anterior declivity of pronotum, in profile, concave, meeting collar at well rounded angle; terminal lobe of paramere, in profile, broader than long *maricopa* Wheeler

7(4) Anterior declivity of pronotum long and not concave in profile; anterior declivity of mesoscutum short in profile; mandible slender and parallel-sided, apical tooth conspicuously longer than remaining teeth (Figs. 4, 6) *anzensis* Cole

– Anterior declivity of pronotum short and strongly concave in profile; mesoscutum massive and with long anterior declivity; mandible broader, not parallel-sided, apical tooth shorter *subnitidus* Emery

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