Keys to the Subgenera, Complexes, and Species of the Genus *Pogonomyrmex* (Hymenoptera: Formicidae) in North America, for Identification of the Workers  

ARTHUR C. COLE, Jr.  
The University of Tennessee, Knoxville

**ABSTRACT**

Keys are presented to workers of the North American subgenera *Pogonomyrmex* s. s. and *Ephebomyrmex*, the 4 complexes (*badius*, *barbatis*, *occidentalis*, and *maricopa*), and 21 taxa (17 named and 4 unnamed species).

In response to requests that I publish diagnostic keys to the workers of the harvester ant genus *Pogonomyrmex* Mayr in North America, the following abbreviated keys, extracted from my completed but unpublished revisionary monograph of the genus, are presented herewith. These keys have been tested repeatedly for more than 3 years. Nevertheless, I shall be glad to assist anyone who may have difficulty in interpreting them.

**A KEY TO THE SUBGENERAE**

1. Basic (maximum) number of mandibular teeth 6, the basalmost tooth much reduced; eye placed decidedly below approximate center of side of head; scape strongly bent in proximal 2/3 of its length; outer margin of frontal lobes nearly straight, subparallel; psammophore weakly developed; head and thorax extensively and coarsely rugoreticulate; femora, especially those of forelegs, strongly incassate; epinotal spines connected basally by a prominent and usually straight keel; postpetiole, viewed from the side, massive, the ventral process very large and bulbous, the height much greater than the length. *Subgenus Ephebomyrmex* Wheeler

   Basic (maximum) number of mandibular teeth 7, the basalmost tooth usually not at all reduced; eye placed at approximately the center of side of head; scape not strongly bent, the bend involving a notably greater extent of the scape length; outer margin of frontal lobe distinctly convex; psammophore strongly developed; head and thorax not extensively and coarsely rugoreticulate; femora not strongly incassate; epinotal spines (when present) not connected basally by a prominent keel; postpetiole, viewed from side, smaller, the ventral process less well developed and not especially bulbous, the height not notably greater than the length. *Subgenus Pogonomyrmex* Mayr

2. Eyes small, weakly convex, not extending beyond sides of head with head in full-face view, head length between occipital corner and mandibular insertion more than 3 times greatest eye length; with head in full-face view, the longitudinal cephalic rugae nearly straight and parallel, diverging slightly into posterior corners of head; vent of petiolar peduncle with a few, long, erect hairs extending downward from the peduncular process and vicinity, or from that region when a process is absent; first gastric segment broader than long...

*barbatis* complex

Eyes large, strongly convex, extending well beyond sides of head with head in full-face view, head length between occipital corner and mandibular insertion distinctly less than 3 times greatest eye length; with head in full-face view, the longitudinal cephalic rugae is straight, less parallel, tending notably to curve over area above eye and toward occipital corner, where they either end or continue around area above eye and anteriorly on side of head, thus forming whorls above and around sides of eyes; vent of petiolar peduncle without hairs; first gastric segment not broader than long...

3. Base of antennal scape strongly enlarged, broad, robust, basal flange (when present) thick, lip of scape weakly prominent; frontal lobes strongly developed, broad, moderately to very strongly convex medially; cephalic rugae usually not forming concentric whorls above eye; thoracic dorsum, in lateral view, not strongly arched, gradient of epinotal base at most very slight; epinotal armature (angles, denticles, or spines) present; postpetiole, viewed from above, very robust, generally no longer than broad...

*occidentalis* complex

Base of antennal scape weakly enlarged, basal flange thin, lip rather weak; frontal lobes less strongly developed, narrower, weakly convex medially; cephalic rugae generally forming crescentic whorls above eye; thoracic dorsum, in lateral view, rather strongly arched, gradient of epinotal base moderate to strong; epinotal armature present or absent, denticles or spines (when present) appearing directed rather strongly upward; postpetiole, viewed from above, less robust; generally longer than broad...

*maricopa* complex

**A KEY TO THE *barbatis* COMPLEX**

1. Cephalic rugae extremely fine, very closely set, producing a silky luster...

   *badius* complex

2. Cephalic rugae not extremely fine, not so closely set, not producing a silky luster...

3. Posterior corners of head without rugae, smooth and strongly shining...

   *occidentalis* complex

4. Posterior corners of head with rugae, not smooth and strongly shining...

5. Epinotal armature unarmored (denticles sometimes present), its declivity extremely short; dorsal portions of metacoxal flanges fused so as to form a single arculate carina across posterior declivity of epimnion; outer lateral margin of scape base strongly concave; anterior margin of clypeal lobe...
deeply excised, often to level of frontal lobes; petiolar node, in lateral view, flattened dorsally. Western Texas, southwestern Colorado, southwestern New Mexico, southern Arizona, southern Nevada, southwestern Mexican states. Apache Wheeler.

**Epiotum with prominent short to long spines, its declivity not unusually short; dorsal portions of metasternal flanges free, not fused as a single arculate carina across posterior declivity of epinotum; outer lateral margin of scape base not notably concave; margin of petiolar node straight or only broadly and shallowly excised; petiolar node, in lateral view, not flattened dorsally.**

**Apache Wheeler.**

Epiotum more robust, notably tapered from base to apex; clypeal angles in front of antennal fossae strong and notably protuberant; peduncle peduncle without a prominent ventral lobe. Cape Region and off-shore islands of Baja California.

**tenuspinus Forel.**

Epiotum spines more robust, notably tapered from base to apex; clypeal angles in front of antennal fossae strong, not notably protuberant; peduncle peduncle with a prominent ventral lobe. Western Texas, southern New Mexico, southern Arizona, southern Nevada, southwestern Mexican states. Apache Wheeler.

**Very large ants (9.5–11.5 mm); concolorous ferrugineous; scape base strongly compressed, prorotal rugae not evenly and transversely subparallel; anterior declivity of petirotum, viewed from side, very steep and high.**

**Apache Wheeler.**

**Smaller ants (7.2–8.2 mm); concolorous (head and thorax red, gaster black); scape base not strongly compressed; prorotal rugae evenly and transversely subparallel; anterior declivity of petirotum, viewed from side, not notably steep and high.**

**Apache Wheeler.**

**Very large ants (9.5–11.5 mm); concolorous ferrugineous; scape base strongly compressed, prorotal rugae not evenly and transversely subparallel; anterior declivity of petirotum, viewed from side, very steep and high.**

**Apache Wheeler.**

Cephalic rugae very coarse, widely spaced, usually wavy; prorotal rugae not particularly coarse or wavy, not forming prominent reticulations; dorsum of petirotum generally somewhat flattened; dorsum of petirotal node with coarse, irregular rugae, not reticulose; color generally black or deep reddish-black, gaster often contrasting lighter. Western Texas, New Mexico, southwestern Colorado, southern Utah, Arizona, southern California, Mexico, Baja California.

**Apache Wheeler.**

Cephalic rugae notably finer, not widely spaced, not especially wavy; prorotal rugae not particularly coarse or wavy, not forming prominent reticulations; dorsum of petirotum generally even and broadly convex; dorsum of petirotal node without coarse, irregular rugae, not reticulose; body generally concolorous, light to deep ferrugineous. Western Louisiana, southern Kansas, southern Oklahoma, southwestern Colorado, New Mexico, Arizona, southern and central Nevada, Mexico.

**Apache Wheeler.**

**barbatus (F. Smith).**

A KEY TO THE *occidentalis* COMPLEX

1. Head, viewed from above, with each occipital corner bearing a prominent, longitudinal, strongly carinate ruga which is well set off from outer portion of occipital corner; petiolar peduncle, in lateral view, with a prominent ventral lobe; postpetiolate, in lateral view, with a strong triangular, ventral tooth; intertropical space of head and thorax shining, known only from the Anza desert, California.

**Apache Wheeler.**

**Small ants (9.5–11.5 mm); concolorous ferrugineous; scape base strongly compressed, prorotal rugae not evenly and transversely subparallel; anterior declivity of petirotum, viewed from side, not notably steep and high.**

**Apache Wheeler.**

**Very large ants (9.5–11.5 mm); concolorous ferrugineous; scape base strongly compressed, prorotal rugae not evenly and transversely subparallel; anterior declivity of petirotum, viewed from side, very steep and high.**

**Apache Wheeler.**

Cephalic rugae very coarse, widely spaced, usually wavy; prorotal rugae not particularly coarse or wavy, not forming prominent reticulations; dorsum of petirotum generally even and broadly convex; dorsum of petirotal node without coarse, irregular rugae, not reticulose; body generally concolorous, light to deep ferrugineous. Western Louisiana, southern Kansas, southern Oklahoma, southwestern Colorado, New Mexico, Arizona, southern and central Nevada, Mexico.

**Apache Wheeler.**

**barbatus (F. Smith).**

A KEY TO THE *maricopa* COMPLEX

1. Dorsum of petirotal node, viewed from side, distinctly flattened, and viewed from above, with strong, widely spaced, wavy, subparallel, transverse rugae and unusually a distinct, broad, shallow, longitudinal depression; epinotum armed with sharp to short spines; cephalic intertropical punctures prominent. Northwestern Louisiana, Texas, western Kansas, western Oklahoma, western Arkansas.

**Apache Wheeler.**

Dorsum of petirotal node, viewed from side, not flattened, and viewed from above, without strong, widely spaced, wavy, subparallel, transverse rugae and a longitudinal depression; epinotum armature present or absent; cephalic intertropical punctures absent to slightly less than from lower eye margin to mandibular insertion; small ants (length 4.7–5.2 mm). Southwestern Arizona, southeastern California, southwestern Nevada, northwestern Mexican states. *Apache Wheeler.*

**Eye not unusually large, its greatest diameter more than, or only slightly less than distance from lower eye margin to mandibular insertion; small ants (length 4.7–5.2 mm). Southwestern Arizona, southwestern California, southwestern Nevada, northwestern Mexican states. *Apache Wheeler.*

2. Cephalic intertropical punctation rather strong; intertropical space of epinotum moderate to strong; intertropical spaces subopaque. Western Texas, New Mexico, southwestern California, southwestern Arizona, southwestern Nevada, southern Utah, Arizona, southeastern California, southwestern California, northwestern Mexican states. *Apache Wheeler.*

Cephalic intertropical punctation absent to moderate; intertropical punctation of epinotum very weak or absent; intertropical spaces strongly shining. Western Texas, southern New Mexico, southern Utah, Arizona, southwestern California, southwestern California, northwestern Mexican states. *Apache Wheeler.*

**California Wheeler.**

3. Cephalic intertropical punctation rather strong; intertropical space of epinotum moderate to strong; intertropical spaces subopaque. Western Texas, New Mexico, southwestern California, southwestern Arizona, southwestern Nevada, southern Utah, Arizona, southeastern California, southwestern California, northwestern Mexican states. *Apache Wheeler.*

Cephalic intertropical punctation absent to moderate; intertropical punctation of epinotum very weak or absent; intertropical spaces strongly shining. Western Texas, southern New Mexico, southern Utah, Arizona, southwestern California, southwestern California, northwestern Mexican states. *Apache Wheeler.*

**California Wheeler.**

A KEY TO THE *occidentalis* COMPLEX

1. Head, viewed from above, with each occipital corner bearing a prominent, longitudinal, strongly carinate ruga which is well set off from outer portion of occipital corner; petiolar peduncle, in lateral view, with a prominent ventral lobe; postpetiolate, in lateral view, with a strong triangular, ventral tooth; intertropical space of head and thorax shining, known only from the Anza desert, California.

**Apache Wheeler.**

2. Head, viewed from above, without such definitive rugae; petiolar peduncle, in lateral view, with or without a ventral lobe; postpetiolate, in lateral view, without a strong, triangular, ventral tooth; intertropical space of head and thorax shining, subopaque, or opaque.

**Apache Wheeler.**

3. Intertropical spaces of head subopaque or shining, not so densely or strongly punctate, the punctures not producing a beaded appearance.

**Apache Wheeler.**

4. Basalmaloth of mandible distinctly offset, meeting the short basal mandibular margin at a pronounced angle. Western Kansas and Arkansas, southern Wyoming, eastern Colorado, central and northern New Mexico, Utah (except extreme north), Arizona, Nevada, California. *Apache Wheeler.*

**Occidentalis** (Cresson) Basalmaloth of mandible not offset, meeting the long basal mandibular margin at a straight angle.

**Apache Wheeler.**

4. Dorsum of petirotal and postpetirotal nodes generally covered with numerous, strong, wavy, closely spaced, subparallel, usually transverse rugae; superior lobe of scape base evenly and broadly rounded; thoracic dorsum, in lateral view, distinctly and broadly convex; dorsum of first gastric segment frequently densely and strongly punctate basally; body color generally a very deep ferrugineous brown. Nevada, eastern California, southeastern Oregon.

**Apache Wheeler.**

5. Dorsum of petirotal and postpetirotal nodes covered with numerous, strong, wavy, closely spaced, subparallel, transverse rugae, the nodes with or without irregular rugae, rugae of striae; super-
Sex Pheromones and Mating Behavior of Culiseta inornata (Diptera: Culicidae)

JOHN W. KLIEWER, TAKESHI MIURA, RICHARD C. HUSBANDS, AND CLAUDE H. HURST
University of California–State Department of Public Health Mosquito Project
5545 East Shields Avenue, Fresno, California

ABSTRACT

Field observations and laboratory experimentation on the mosquito Culiseta inornata (Williston) indicate that a volatile chemical substance (or substances) is involved in the mating behavior of this species. Mating is not dependent on either sound or sight, though these elements of communication may normally be involved. Materials recovered from females stimulate a sexual response in and are attractive to males.

Pheromones have been demonstrated in many groups of insects (see, e.g., Karlson and Butenandt 1959, Rogoff et al. 1964, Wilson 1965). Research on sex attractants and other pheromone responses has gained impetus recently owing, at least in part, to the realization that control of noxious insects with toxic chemicals has serious limitations. These limitations are especially apparent in the control of mosquitoes. Conventional insecticides are not only hazardous, but resistance of mosquitoes to them is becoming increasingly widespread (Brown and March 1959, Brown et al. 1963, Lewallen 1961).

Control measures based on pheromones would be of enormous importance because of their relative specificity; other forms of life presumably would not be affected. One of the most encouraging things about pheromones is the infinitesimally small amounts needed. It has been calculated that $10^{-7} \mu g$ of the sex attractant of a female gypsy moth, Porthetria dispar (L.), will lure numerous males from a distance of 1/4 mile or more (Jacobson and Beroza 1963). Workers in Germany calculate that it takes exceedingly minute amounts of sex attractant to set off an action potential in the antennal nerve of a male moth (Hecker 1958) and that in some groups of moths there is cross effectiveness among closely related species (Schneider 1962).

The importance of sound in the mating behavior of the yellow-fever mosquito, Aedes aegypti (L.), has been demonstrated in the laboratory by Roth (1948), who also showed experimentally that the plumose antennae of the male mosquito were the organs of sound reception. While it is commonly accepted that one of the chief mechanisms whereby male mosquitoes are able to detect the presence of female mosquitoes is by means of sounds produced by the female in flight, the general existence of pheromones in mosquitoes seems probable. It remains to be shown to what extent odors emitted by mosquitoes influence the behavior of other individuals.

---

1 Accepted for publication September 30, 1965.