Keys to the Subgenera, Complexes, and Species of the Genus *Pogonomyrmex* (Hymenoptera: Formicidae) in North America, for Identification of the Workers[1, 2]

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ABSTRACT

Keys are presented to workers of the North American subgenera *Pogonomyrmex* s. s. and *Ephebomyrmex*, the 4 complexes (*badius, barbatus, 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ant genus *Pogonomyrmex* Mayr in North America, the following abbreviated keys, extracted from my completed but unpublished revisionary monograph of the genus, are presented herewith.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 SUBGENERA

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 ¼ of its length; outer margin of frontal lobes nearly straight, subparallel; psammophore weakly developed; head and thorax extensively and coarsely rugoreticulose; femora, especially those of forelegs, strongly incrassate; 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 rugoreticulose; femora not strongly incrassate; 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

A KEY TO THE COMPLEXES OF THE SUBGENUS *Pogonomyrmex*

1. Polymorphic species; minima with normal head size, occipital margin straight, the distance across it notably less than that across either the median or the anterior cephalic region; maxima with disproportionate and greatly enlarged head, which is strongly emarginate in median occipital portion and thus chordate-shaped when viewed from in front; thorax of maxima with accentuated female characteristics ....**badius** complex[3]

   Not polymorphic species, size variants, when present, in a linear, unimodal series; head not as above; thorax normal, without accentuated female characteristics 2

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; venter 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.... .... **barbatus** 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 less 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; venter of petiolar peduncle without hairs; first gastric segment not broader than long 3

3. Base of antennal scape strongly enlarged, broad, robust, basal flange (when present) thick, lip strong and 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 *barbatus* COMPLEX

1. Cephalic rugae extremely fine, very closely set, producing a silky luster.......................... 2

   Cephalic rugae notably less fine, not so closely set, not producing a silky luster.................. 6

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

   Posterior corners of head with rugae, not smooth and strongly shining............................ 5

3. Epinotum generally unarmed (denticles sometimes present), its declivity extremely short; dorsal portions of metasternal flanges fused so as to form a single arcuate carina across posterior declivity of epinotum; outer lateral margin of scape base strongly concave; anterior margin of clypeal lobe

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[3] With a single species, *badius* (Latreille), confined to the Atlantic and Gulf Coastal Plain, from North Carolina to Louisiana.

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, northwestern Mexico...... **apache** Wheeler

Epinotum 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 clypeal lobe straight or only broadly and shallowly excised; petiolar node, in lateral view, not flattened dorsally...... 4

4. Epinotal spines slender, scarcely tapered from base to apex; clypeal angles in front of antennal fossae strong and notably protuberant; petiolar peduncle without a prominent ventral lobe. Cape Region and off-shore islands of Baja California.................................... **tenuispina** Forel

Epinotal spines more robust, notably tapered from base to apex; clypeal angles in front of antennal fossae weak, not notably protuberant; petiolar peduncle with a prominent ventral lobe. Western Texas, southern New Mexico, southern Arizona, Mexico .... **desertorum** Wheeler

5. Very large ants (9.5–11.5 mm); concolorous ferrugineous; scape base strongly compressed; pronotal rugae not evenly and transversely subparallel; anterior declivity of pronotum, viewed from side, very steep and high. Southwestern Mexico.................................... **wheeleri** Olsen

Smaller ants (7.2–8.2 mm); bicolored (head and thorax red, gaster black); scape base not strongly compressed; pronotal rugae evenly and transversely subparallel; anterior declivity of pronotum, viewed from side, not notably steep and high.. species A[4]

6. Cephalic rugae very coarse, widely spaced, usually wavy; pronotal rugae very coarse, irregular, widely spaced, wavy, tending to form prominent reticulations; dorsum of pronotum generally somewhat flattened; dorsum of petiolar node with coarse, irregular rugae, often reticulose; color generally black or deep reddish-black, gaster often contrastingly lighter. Western Texas, New Mexico, southwestern Colorado, southern Utah, Arizona, southern California, Mexico, Baja California .... **rugosus** Emery

Cephalic rugae notably finer, not widely spaced, not especially wavy; pronotal rugae not particularly coarse or wavy, not forming prominent reticulations; dorsum of pronotum generally evenly and broadly convex; dorsum of petiolar node without coarse, irregular rugae, not reticulose; body generally concolorous, light to deep ferrugineous. Western Louisiana, southern Kansas, western Oklahoma, southern Colorado, New Mexico, Arizona, southern and central Nevada, Mexico.................................... **barbatus** (F. Smith)

A KEY TO THE *maricopa* COMPLEX

1. Dorsum of petiolar node, viewed from side, distinctly flattened, and viewed from above, with strong, widely spaced, wavy, subparallel, transverse rugae and usually a distinct, broad, shallow, longitudinal depression; epinotum armed with short to long spines; cephalic interrugal punctures prominent. Northwestern Louisiana, Texas, western Kansas, western Oklahoma, western Arkansas.. **comanche** Wheeler

Dorsum of petiolar node, viewed from side, not flattened, and viewed from above, without strong, widely spaced, wavy, subparallel, transverse rugae and a longitudinal depression; epinotal armature present or absent; cephalic interrugal punctures absent to prominent......................... 2

2. Eye unusually large, its greatest diameter equal to, 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, southeastern California, southwestern Nevada, northwestern Mexico.................. species B

Eye not unusually large, its greatest diameter notably less than distance from lower eye margin to mandibular insertion; larger ants (length 6.8–8.7 (mm)[5] 3

3. Cephalic interrugal punctulation rather strong; interrugal punctulation of epipleura moderate to strong; interrugal spaces subopaque. Western Texas, New Mexico, southern Colorado, southern Utah, Arizona, southeastern Nevada, southeastern California, northwestern Mexico.. **maricopa** Wheeler

Cephalic interrugal punctulation absent to moderate; interrugal punctulation of epipleura very weak or absent; interrugal spaces strongly shining. Western Texas, southern New Mexico, southern Utah, Arizona, western and southern Nevada, southern California, Baja California northwestern Mexico .... **californicus** (Buckley)

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; postpetiole, in lateral view, with a strong, triangular, ventral tooth; interrugal spaces of head and thorax shining. Known only from the Anza Desert, California.. species C

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

2. Interrugal spaces of head opaque, densely and strongly punctate, the punctures producing a beaded appearance 3

Interrugal spaces of head subopaque or shining, not so densely or strongly punctate, the punctures not producing a beaded appearance................ 5

3. Basalmost tooth of mandible distinctly offset, meeting the short basal mandibular margin at a pronounced angle. Western Kansas and Arkansas, northern Texas, Wyoming (except northwest), Colorado, central and northern New Mexico, Utah (except extreme north), Arizona, Nevada, eastern California .... **occidentalis** (Cresson)

Basalmost tooth of mandible not offset, meeting the long basal mandibular margin at a straight angle.. 4

4. Dorsum of petiolar and postpetiolar 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 .... **salinus** Olsen

Dorsum of petiolar and postpetiolar nodes not covered with numerous, strong, wavy, closely spaced, subparallel, transverse rugae, the nodes with or without irregular rugae, rugulae or striae; supe-

[4] This (and subsequent taxa so designed by letters) denotes a new species which is named, described, and figured in my monographic revision of the genus.

[5] Some workers of *californicus* may be this small, even in strong colonies, but they lack the large eyes so characteristic of this species.

rior lobe of scape base not evenly and broadly rounded; thoracic dorsum, in lateral view, flattened; body color usually notably paler. Washington, Oregon, Idaho, Montana, extreme northern Utah, northwestern Wyoming, southwestern Canada ....**owyheei** Cole

5. Interrugal spaces of head distinctly shining; epinotal spines generally medium to long; dorsum of petiolar node without prominent transverse rugae. Coastal southern California to southcentral California, western Nevada, Baja California..................................... **subnitidus** Emery

Interrugal spaces of head subopaque; epinotum armed with angles to prominent spines; dorsum of petiolar node usually with prominent transverse rugae, but irregular rugulae or striae sometimes present 6

6. Frontal lobes very broad and strongly convex medially, extremely prominent; epinotum armed with angles, denticles, or short spines; venter of petiolar peduncle without a prominent process. Southcentral California, Nevada (Lyon Co.)....species D

Frontal lobes not especially broad, convex, and prominent; epinotum armed with short to long spines; venter of petiolar peduncle with a prominent process. California, southwestern Oregon, western Nevada..................**subdentatus** Mayr

A KEY TO THE SUBGENUS *Ephebomyrmex* WHEELER

1. Small ants (length 3.2–4.6 mm); eye rather large, notably longer than wide, the distance between its anterior margin and mandibular articulation no more than about 1½ times eye length; base of epinotum with strong, wavy, transverse rugae, in lateral view not meeting mesonotum at a prominent angle 2

Larger ants (length 4.6–5.5 mm); eye small, not notably longer than wide, the distance between its anterior margin and the mandibular articulation about twice the eye length; base of epinotum reticulose, without distinct transverse rugae, in lateral view meeting the mesonotum at a prominent angle. Southern New Mexico, southern Arizona ....**huachucanus** Wheeler

2. Clypeus without a prominent, toothlike projection in front of each antennal fossa; petiolar node punctate, conical in profile; dorsum of postpetiolar node punctate and sometimes irregularly striate. Southern Arizona, northwestern Mexico...**pima** Wheeler

Clypeus with a prominent, toothlike projection in front of each antennal fossa; petiolar node rugoreticulose, not conical in profile, posterior declivity much longer and less steep than anterior declivity; dorsum of postpetiolar node irregularly, longitudinally rugulose. Southern Oklahoma, western Texas, southwestern Colorado, southern New Mexico, southern Arizona, southern Nevada, southeastern California, northwestern Mexico.......................................**imberbiculus** Wheeler

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Sex Pheromones and Mating Behavior of *Culiseta inornata* (Diptera: Culicidae)[1]

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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} μg of the sex attractant of a female gypsy moth, *Porthetria dispar* (L.), will lure numerous males from a distance of ¼ 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.

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