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A DIAGNOSTIC KEY TO ANTS ECOLOGICALLY AFFILIATED WITH THE GENUS *CAREX*

Laura Rericha-Anchor[1]: 28W040 State Route 58, Elgin, IL 60120–9223 USA

ABSTRACT. Prepared is a diagnostic key to the worker caste of 47 ant species that ecologically affiliate with the genus *Carex* in Indiana and the adjacent states. This key is a supplement to the floristic work presented in Rothrock (2021) and Wilhelm & Rericha (2017) and is to be used as a tool to enrich one's study of the ecological relationships between sedges and ants. To enhance one's experience identifying ants with the key, a suggested glossary should be used, as well as a hand lens and stereo microscope.

Keywords: ants, diagnostic key, morphology, ecological relationship, *Carex*

INTRODUCTION

Prepared is a diagnostic key to the worker caste of 47 ant species that ecologically affiliate with the genus *Carex* as an addendum to Paul Rothrock's treatise (2021) on this group of plants in Indiana and the adjacent states. However, the ecological relationships between ants and carices were first presented by Wilhelm & Rericha (2017). The key was created to enrich one's study of the genus *Carex* and stimulate further learning of the ecological relationships unique to this diverse group of plants and insects.

This work presents morphological terms that may seem esoteric to one who studies plants. The terms, however, are commonly used to describe ant morphology. An excellent glossary, with illustrations, is presented by MacGown (2021), and the reader is encouraged to use this resource while navigating the key. Recommended are a stereo microscope, with 20–40× magnification, and a 10–14× hand lens to study salient features.

THE KEY

1. With one petiolar node. FORMICINAE, DOLICHODERINAE, and PONERINAE.
   2. Terminal gastral segment without an acidopore or funnel-shaped arrangement of setae.
      3. Terminal gastral segment with an evident stinger; the first and second gastral segments with a constriction between them; ventral portion of the petiolar node transparent and possessing a circular pore. PONERINAE …… ……... *Ponera pennsylvanica*
      3. Terminal gastral segment with an elongate slit; the first and second gastral segments without a constriction between them; ventral portion of the petiolar node not as above. DOLICHODERINAE.

[1] *Corresponding author:* Laura Rericha-Anchor, 312–217–0121 (phone), laura.anchor@cookcountyil.gov.

4. Posterior face of the propodeum distinctly C-shaped or concave in side view; inodorous when disturbed.
    5. Antennal scapes beset with erect setae throughout; surface sculpture of face and mesosoma coarsely and deeply sculptured or foveolate … ..... *Dolichoderus plagiatus*
    5. Antennal scapes glabrous, but if elongate setae are present, then only several ascending ones on the apical portion of each segment; surface sculpture of face with shallow foveae, never coarse; mesosoma with at least the pronotum efoveolate.
        6. Head, mesosoma, and gaster sparsely pubescent with elongate setae; body either concolorous dark-brown or faintly bicolored, if faintly bicolored, then head dark brown ... *Dolichoderus pustulatus*
        6. Head dorsum, mesosoma, and anterior segments of gaster glabrous; body strongly bicolored, head and mesosoma reddish, the gaster dark brown ..... *Dolichoderus mariae*
4. Posterior face of propodeum not C-shaped; having a coconut to marshmallow-like scent when nest or individuals are disturbed.
    7. Mandibles with coarse teeth throughout their inner length; mandibles large, more than 3 mm in length; coloration black; a wetland specialist ..... *Tapinoma* sp. *#1*
    7. Mandibles with course teeth concentrated anteriorly; mandibles small, less than 3 mm in length; coloration pale to dark brown; a ubiquitous species ..... *Tapinoma sessile*

2. Terminal abdominal segment with an acidopore. FORMICINAE.
    8. Antennal segments 9; a tiny species ..... *Brachymyrmex depilis*
    8. Antennal segments 12.
        9. Mesosoma evenly convex in profile; body bicolored, the mesosoma reddish, the head and gaster black ..... *Camponotus novaeboracensis*
        9. Mesosoma not evenly convex in profile, the propodeum distinctly lower than the rest of the mesosoma; body of uniform color or if bicolored, then mesosoma not evenly convex in profile.
            10. Mesosoma appearing strongly constricted, cinched like a belted waist; body shiny ..... *Prenolepis imparis*
            10. Mesosoma not strongly constricted laterally or at all; body shiny to dull.
                11. Ocelli essentially absent.
                    12. Maxillary palps consisting of 3 segments; odor strong and citronella-like when nest or individuals are disturbed .... *Lasius claviger*

12. Maxillary palps consisting of 6 segments; odorless or with a weak citronella-like odor when nest or individuals are disturbed.
    13. Maxillary palps with segments appearing subequal in length; compound eyes large; never odoriferous when disturbed; coloration brown to dark brown.
        14. Mandibles each with a basal tooth offset or removed from the array of teeth of the inner margin; antennal scapes beset with erect pubescence throughout …….. ……. *Lasius pallitarsis*
        14. Mandibles without a basal tooth removed from the array of teeth of the inner margin; antennal scapes not beset with erect pubescence throughout, elongate ascending hairs present apically ……. *Lasius alienus*
    13. Maxillary palps with segments not appearing subequal in length, the apical and subapical segments notably shorter than the intermediate and basal ones; compound eyes small; odoriferous or not when disturbed; coloration pale yellow to dark orange.
        15. Compound eyes vestigial, each consisting of 6 or less facets (ommatidia) ……. *Lasius flavus*
        15. Compound eye with 10 or more facets.
            16. Gastral tergites not notably pubescent, at least one of tergites 2-4 medially glabrous with elongate and sparse hairs along posterior border, the surface glossy or mirror-like ……... ……. *Lasius speculiventris*
            16. Gastral tergites notably pubescent, the surface not mirror-like.
                17. First gastral tergite with elongate erect hairs (in central portion of segment), their lengths subequal to or slightly longer than the median width of a hind tibia; a species of fen and sphagnum bog systems …….. *Lasius minutus*
                17. First gastral tergite with short erect hairs, their lengths up to half the width of the median portion of a hind tibia; a species of fens, prairies, woodlands, and old fields ……. ……. *Lasius umbratus*

11. Ocelli well-developed.
    18. Median-apical portion of the clypeus emarginate (sinuate) or shallowly notched, especially on larger individuals.
        19. Apex of the petiolar node blunt and hairless or with a short hair or two; dorsal angle between the mesonotum and propodeum about 130°, the vertex evocative of the seat of a horse saddle; mesosoma essentially glabrous, the pronotum with a hair or two; body weakly bicolored, the head and mesosoma reddish to reddish yellowish and gaster medium brown ..... *Formica subintegra*
        19. Apex of the petiolar node sharp or edge acute, beset with short hairs; dorsal angle between the mesonotum and propodeum notably more than 130°, the vertex not resembling the seat of a horse saddle; mesosoma sparsely beset with short hairs; body strongly bicolored, the head and mesosoma deep reddish and gaster dark brown to black ..... *Formica rubicunda*
    18. Median-apical portion of the clypeus not emarginate.
        20. Occipital margin heart shaped, the median portion distinctly concave.
            21. Pronotum beset with elongate, erect hairs .... *Formica ulkei*
            21. Pronotum lacking elongate, erect hairs..... ..... *Formica exsectoides*
        20. Occipital margin straight or slightly convex, not heart shaped.
            22. Propodeum subangulate in profile.
                23. The ventral surface of head beset with sparse erect hairs seen in profile; mesosoma and petiolar node beset with numerous short erect hairs; body coloration brown ..... *Formica montana*
                23. The ventral surface of head not beset with erect hairs; mesosoma and petiolar node essentially without short erect hairs; body coloration black.
                    24. The third gastral tergite beset with a dense array of appressed hairs, the surface essentially hidden ..... *Formica subsericea*
                    24. The third gastral tergite beset with a sparse array of appressed hairs, the shiny surface

well exposed.

25. Exclusive of the posterior border of erect hairs, the first gastral tergite with at least 10 short erect hairs ….. *Formica glacialis*

25. Exclusive of the posterior border of erect hairs, the first gastral tergite with fewer than 10 short erect hairs ……... ……. *Formica subaenescens*

22. Propodeum rounded in profile, not subangulate.

26. The combined length of the 2nd and 3rd funicular segments up to 1.2× the length of the 1st; ventral surface of head beset with at least one elongate hair.

27. Antennal scape beset with short erect hairs throughout ..……... *Formica lasioides*

27. Antennal scape not beset with short erect hairs throughout, with a few elongate ascending hairs in the apical portion ……. ……... *Formica neogagates*

26. The combined length of the 2nd and 3rd funicular segments much more than 1.2× the length of the 1st; ventral surface of head typically glabrous, rarely with an elongate hair.

28. Mesosoma glabrous or with fewer than 6 hairs ..…….. *Formica pallidefulva*

28. Mesosoma pubescent, with considerably more than 6 hairs ..…….. *Formica incerta*

1. With two petiolar nodes. MYRMICINAE.

29. Petiole seemingly attached to the dorsal surface of the first gastral tergite; gaster appearing heart shaped from above …….. *Crematogaster cerasi*

29. Petiole not appearing to be attached to the dorsal surface of the first gastral tergite; gaster not appearing heart shaped from above.

30. Antennal segments 10; ants minute; body lemon-yellow to brownish; propodeal spines absent ……. *Solenopsis molesta*

30. Antennal segments more than 10; ants medium to large; body variously colored; propodeal spines present.

31. Antennal segments 11.

32. Propodeal spines short, their length less than the intervening space separating them at their base, the shape between the two

spines and their intervening propodeal margin quadrate .... *Temnothorax ambiguus*

32. Propodeal spines elongate, their length more than the intervening space separating them at their base, the shape between the two spines and their intervening propodeal margin V to U shaped ..... *Temnothorax curvispinosus*

31. Antennal segments 12.

33. Propodeum with 4 spines, two long and two short ....*Myrmecina americana*

33. Propodeum with 2 spines of essentially equal length.

34. Anterior node of the petiole elongate (with an elongate peduncle); profile of the thoracic dorsum not continuous, presenting a step-like pattern.

35. Antennae with a 3-segmented club; worker caste dimorphic, comprised of major workers with massive heads and cordate occipital margins (this caste type typically resides within the nest) and minor workers with normal heads ..... *Pheidole pilifera*

35. Antennae without a differentiated club; worker caste with heads normal and not separated into distinct subcastes.

36. Basal portion of antennal scape with an elongate lobe-like process ..... *Aphaenogaster treatae*

36. Basal portion of antennal scape without a lobe-like process.

37. Funicular segments concolorous throughout..... ..... *Aphaenogaster rudis*

37. Funicular segments not concolorous, the apical segments lighter in tonality.

38. Propodeal spines pointing upward; body reddish to reddish-brown .... *Aphaenogaster fulva*

38. Propodeal spines pointing toward gaster; body black to dark-brown .... *Aphaenogaster picea*

34. Anterior node of the petiole not elongate; profile of the thoracic dorsum continuous, without a step-like pattern.

39. Basal portion of antennal scape not angulate.

40. First gastral tergite impunctate; dorsal surface of

petiole and postpetiole smooth; species of sphagnum bog and fen systems ..... *Myrmica lobifrons*

40. First gastral tergite with distinct shallow punctures, the punctures much wider than the hair arising from each; dorsal surface of petiole and postpetiole strongly textured; species of woodlands, oak barrens, and savannas.
    41. Rugae on anterior portion of mesosoma acute; in dorsal view, propodeal spines short, their lengths less than the distance separating their tips ..... *Myrmica pinetorum*
    41. Rugae on anterior-dorsal portion of mesosoma flattened and textured; in dorsal view, propodeal spines long, their lengths more than the distance separating their tips ..... *Myrmica punctiventris*

39. Basal portion of antennal scape angulate or possessing a distinct bend.
    42. Scape below the bend without a transparent flange.
        43. Dorsal portion of the scape angulate at the bend, without a distinct spoon-shaped process ..... *Myrmica fracticornis*
        43. Dorsal portion of the scape with a distinct spoon-shaped process.
            44. Spoon-shaped process well-developed, large and robust, occurring distinctly above the bend in profile ..... *Myrmica americana*
            44. Spoon-shaped process vestigial, occurring slightly below the bend in profile ..... *Myrmica* "af-eva"
    42. Scape below the bend with a transparent flange along one side, a continuation of the dorsal process at the bend.
        45. The dorsal portion of the scape distinctly compressed or narrowed at the bend; thoracic sculpture rugose or with an intersecting network of ridges; lateral sections of the clypeus without a well-developed anterior ridge partially enclosing the antennal insertions ..... *Myrmica detritinodis*

45. The scape neither compressed nor narrowed at the bend; thoracic sculpture comprised of thick parallel ridges; lateral sections of the clypeus with a well-developed anterior ridge partially enclosing the antennal insertions.
    46. Lobes of the frontal carinae essentially obsolete in frontal view and not obscuring the insertions of the antennal scapes; spoon-shaped process at the bend well-developed … ….…. *Myrmica* "af-smi"
    46. Lobes of frontal carinae well-developed and obscuring the insertions of the antennal scapes in frontal view; spoon-shaped process at the bend not as robust …. *Myrmica* "af-scu"

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