REVIEW OF THE DESCRIBED NEARCTIC SPECIES OF THE *CRASSICORNIS* GROUP OF *ANAPHES S.S.* (Hymenoptera: Mymaridae)

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Abstract *J. ent Soc. Ont.* 135:3-86

The 13 nominal species of the *crassicornis* group of *Anaphes s.s.* (previously known as *Patasson*) in North America are redescribed and keyed. Primary types are illustrated and the biology of several economically important species is summarized. Host-induced morphological variation is a problem in defining the species. Crossing experiments between nominal species reared from various economically important hosts are needed to determine whether similar morphological species are biologically distinct or not, as follows: *Anaphes conotracheli* reared from *Conotrachelus* spp. with *A. pallipes* reared from *Cylindrocopturus adspersus* and *Rhagoletis pomonella*; *A. luna* reared from *Hypera* spp. (especially *H. postica*) with *A. victus* reared from *Listronotus oregonensis* and with *A. sordidatus* reared from *Tyloderma foveolatum*; *A. pullicrurus* reared from *Chaetoctema denticulata* with *A. cotei* reared from *Listronotus oregonensis*. Molecular studies may also help resolve species limits. Hosts are still unknown for *A. brunneus*, *A. confertus*, and *A. longiclava*. *A lectotype* is designated for *A. luna*.

Résumé

Les 13 espèces nominales décrites du groupe *crassicornis* du genre *Anaphes s.s.* (autrefois connu sous le nom de *Patasson*) d'Amérique du nord sont redécrites et une clé d'identification est présentée, tout cela basé sur l'étude des types primaires. Les types primaires sont illustrés et un sommaire de la biologie de diverses espèces d'importance économique est présentée. La variation morphologique causée par l'hôte est un problème pour définir les espèces. Des essais de croissement entre les espèces nominales, élevées de divers hôtes d'importance économique, sont nécessaires pour déterminer si les espèces morphologiquement semblables sont biologiquement différentes ou non. Les croisements devraient être faits comme suit: *Anaphes conotracheli* élevées de *Conotrachelus* spp. avec *A. pallipes* élevées de *Cylindrocopturus adspersus* et *Rhagoletis pomonella*; *A. luna* élevées de *Hypera* spp. (surtout *H. postica*) avec *A. victus* élevées de *Listronotus oregonensis* et avec *A. sordidatus* élevées de *Tyloderma foveolatum*; *A. pullicrurus* élevées *Chaetoctema denticulata* avec *A. cotei* élevées de *Listronotus oregonensis*. Des études moléculaires pourraient aussi aider à résoudre les limites entres espèces. Les hôtes demeurent toujour inconnus pour *A. brunneus*, *A. confertus*, et *A. longiclava*. Un lectotype est désigné pour *A. luna*.

Introduction

Most of the biological literature on Mymaridae involves species of only two genera, *Anaphes* Haliday and *Anagrus* Haliday, because they are important for the biological control of pests of several major crops (Huber 1992, Chiappini *et al.* 1996). About 235 species of *Anaphes* have been described but few have host records associated with them. Chrysomelidae or Curculionidae are the most commonly reported hosts, but some *Anaphes* species have been reared from other families in Coleoptera, Diptera, Hemiptera or Hymenoptera (Symphyta). The several taxonomic treatments of *Anaphes* have resulted in a somewhat complicated nomenclatural history as discussed by Debauche (1948), Annecke and Doutt (1961), Schauff (1984a), and Huber (1992). Huber (1992) divided the genus into two subgenera, *Anaphes* (*Anaphes*) and *Anaphes* (*Yungaburra*), based on differences in male antennae. Males of species of *Anaphes* (*Yungaburra*) have each of the 11 flagellomeres bearing at least one longitudinal sensillum whereas males of *Anaphes s.s.* apparently have only 10 flagellomeres because Fl_1 is extremely reduced and lacks longitudinal sensilla. Huber (1992) subdivided *Anaphes* (*Yungaburra*) into three species groups (the *amplipennis* and *nitens* groups, and an unnamed group) and *Anaphes s.s.* into two species groups, the *fuscipennis* group and the *crassicornis* group, based on the number of claval segments in the female antennae. Species of the *crassicornis* group are separated by their two-segmented clava from species of the *fuscipennis* group, which have a one-segmented (entire) clava. Huber (1992) reviewed the nine described species of the *fuscipennis* group in North America; the described species of the *crassicornis* group in North America are reviewed here. Species in the latter group have previously been classified either in their own genus, *Patasson* (e.g. Kryger 1934), or as a subgenus of *Anaphes* (e.g. Debauche 1948). In the Nearctic region, the *crassicornis* group includes 13 nominal species: nine catalogued under *Patasson* by Burks (1979), *A. pallipes* (Ashmead) catalogued under *Anaphes* by Burks (1979) and transferred to the *crassicornis* group by Huber (1992), and three additional species described by Huber in Huber *et al.* (1997). Eight of the species [*A. calendrae* (Gahan), *A. conotracheli* Girault, *A. cotei* Huber, A. *diana* (Girault), *A. luna* (Girault), *A. listronoti* Huber, *A. pullicrurus* Girault, and *A. victus* Huber] have been reared from economically important pests. *Anaphes luna* was imported from Europe for biological control and released in Utah where it successfully established and spread. *Anaphes diana* was also imported from Europe and was released in Delaware, Idaho and Kentucky but field establishment is uncertain (Yeargan 1985). The remaining four species [*A. brunneus* (Doutt), *A. gerissophaga* (Doutt), *A. longiclava* (Doutt), and *A. confertus* (Doutt)] are known from only one or a few specimens, either reared from hosts of no economic importance or not reared and without known hosts. Despite their economic importance and abundance, the taxonomy of *crassicornis*-group species is difficult and most of the species cannot easily be identified.

As a first step to try to resolve the problem of species identifications, the described species occuring in the Nearctic region are keyed and redescribed, and their type specimens are illustrated. The total number of *Anaphes* species occuring in America north of Mexico can only be guessed at. Only three collections (CNCI, UCRC, USNM, acronyms explained below) have considerable numbers of *Anaphes* specimens (several thousand individuals in total) and most would have to be slide mounted for detailed studied before a reasonable estimate could be made. Based on my current knowledge of the genus I think the number of North American morphospecies is perhaps around two or three times the number already described, i.e. 40-50 species in total, more or less divided equally between the two species groups. Comparison with other zoogeographical regions is not helpful for determining the size of the North American fauna because none of their faunas (except Europe) have been studied systematically. The European situation presents a major problem because of the typological species concept used by the single author who described most of the approximately 160 nominal species from relatively few localities. Most of his species are likely synonyms of one another.

Materials and Methods

Morphological terms used and measurements, given in micrometers (µm), are as described in Huber (1992) and Gibson (1997). All the features mentioned in the species diagnoses must be taken into account when comparing a specimen; if only some features match and others do not it is likely that the specimen does not belong to the species in question. Descriptions include the mean and, in parentheses, the range and number of specimens measured. Primary types were measured separately (Table I). Their measurements are not included in the species statistics, thus permitting independent comparison with non-type material. Where possible, qualitative features were used to identify species, but there seem to be few such features in species of *Anaphes* so considerable reliance was placed on measurements and ratios. The relative length of tarsomere 1 to 2 has not been used before. Using slide-mounted specimens, each tarsomere is measured from its base to the proximal point of insertion of the next tarsomere (Fig. 34). The apical tarsomere is measured to the point of insertion of the pretarsus. The pretarsus is not included in total tarsal length. The 'ovipositor length' (Fig. 41) was measured from the basal loop to the apex of the sheaths instead of to the apex of the ovipositor itself because the ovipositor apex is not always clearly visible when it is hidden by the sheaths. The true ovipositor length is acutally slightly less than the length measured from the apex of the sheaths. For measurements to be exact, structures being measured must have both end-points in focus at the same time. This was not the case for some measurements because of the poor quality of most of the slide-mounted specimens available for study. Thus a certain amount of unavoidable inaccuracy occurs that increases the range for a given structure. In particular, absolute body measurements taken from slide-mounted specimens are somewhat inaccurate because the specimens usually had the head collapsed or mounted obliquely. Approximate head length was added to the separate measurements of mesosoma and metasoma to obtain total body length. Because most specimens, either representing different species or the same species reared from different hosts, were mounted in the same way, comparison of measurement among specimens shows the relative changes in size reasonably well.

Because of small sample sizes (less than 30) the sample standard deviation, which is slightly larger than the standard deviation, was calculated. Species limits based on ranges and deviations are thus somewhat broadened and greater overlap among the measurements of different species occurs. Until many more, well prepared slide-mounted specimens of each species become available for measurement the limits of variation cannot be defined more accurately.

Photographs of wings and antennae were made with a digital camera attached to a compound microscope. The species of the *crassicornis* group are so similar that long descriptions are simply repetitious. The descriptions consist mainly of measurements and, together with the diagnoses, should suffice to recognize a particular species. Abbreviations used are: Fl_1-Fl_6 = funicle segment 1 to 6, FWL/FWW = forewing length/forewing width, LMC = longest marginal cilia of forewing or hind wing.

Specimens were borrowed from the following institutions.
CASC - California Academy of Science, San Francisco. W. Pulawski.
EMEC - Essig Museum of Entomology, University of California, Berkeley. R. Zuparko.
CNCI - Canadian National Collection of Insects, Ottawa. J. Huber.
INHS - Illinois Natural History Survey, Urbana. K.C. McGiffin.
UCRC - University of California, Riverside. S. Triapitsyn.
USNM - National Museum of Natural History, Washington, DC. M.E. Schauff.

Variability in *Anaphes* species

Females are the most commonly collected sex and the only known sex for some species. Therefore, mymarid taxonomy is based almost exclusively on females, and only females can be identified fairly reliably using morphological features alone. Males are usually ignored unless they can be definitely associated with corresponding females. Sexual variation is therefore not a problem to consider in mymarid taxonomy. Another kind of variation occurs when individuals of a gregarious species, e.g. *A. calendrae*, presumably obtain varying amounts of nutrients from the single egg in which they develop, resulting in overall size differences. The source of variation with the greatest influence in modifying morphology appears to be the host. Different host species may cause qualitative as well as quantitative morphological changes in their parasitoids. For example, in *A. iole* Girault not only are specimens reared from smaller hosts smaller in size but loss of longitudinal sensilla on Fl_4 occurs, with a concomitant change it its proportions (Huber and Rajakulendran 1988). Evidence is presented below that two nominal *Anaphes* spp., *A. pallipes* and *A. conotracheli*, reared from *Cylindrocopturus adspersus* LeConte and *Conotrachelus* spp., respectively, may be a single species. The differences between these two putative species are similar to those found for *A. iole* reared from its different hosts. If the length of a structure varies continuously between two extremes (e.g. *A. calendrae*, as described below) depending on host size, this can be more easily taken into account when characterizing the limits of variation in a species than a disjunction in qualitative features. In the later case, one may easily, but incorrectly, propose two or more species (as was probably done by some authors working on the European fauna) unless the biology and host range are known or crossing experiments can be performed to demonstrate conspecificity. Conversely, morphologically almost identical species that are biologically different are known to occur, e.g. *A. sordidatus* Huber and *A. listronoti* Huber (Huber *et al.* 1997). The lack of host information and difficulty of doing crossing experiments with most described *Anaphes* species greatly hinders a proper understanding of species limits in the genus.

Key to females of described Nearctic *crassicornis*-group species of *Anaphes*

1 Back of head with occipital suture short, bent inward and pointing ventromedially towards occipital foramen (diverging strongly away from outer orbit of eye) (Figs. 31, 32); forewing with posterior margin hyaline for most of its length until mid-point of wing apex, with at most only a short brown section along ventral margin towards apex (Figs. 16, 19, 26) 2

\- Back of head with occipital suture long, straight, pointing ventrally (not diverging strongly from outer orbit of eye) (Fig. 30); forewing with posterior margin and entire apical margin brown, similar to anterior margin (Figs. 17, 18, 20-25, 27-29) 4

2(1) Fl_2 of antenna at most 3.3 times as long as wide and at most 1.8 times as long as Fl_1; ovipositor at least 1.8 times hind tibial length 3

- Fl_2 of antenna at least 4.4 times as long as wide and at least 2.2 times as long as Fl_1 (Fig. 1); ovipositor at most about 1.6 times hind tibial length .... *brunneus* (Doutt)

3(2) Fl_4 with 2 longitudinal sensilla .... *conotracheli* Girault

- Fl_4 at most with 1 but usually without longitudinal sensilla .... *pallipes* (Ashmead)

4(1) Ovipositor arising posterior to base of gaster(ovipositor/hind tibia ratio at most 0.9) ... 5

- Ovipositor extending at least to base of gaster and often under mesosoma towards head (ovipositor/hind tibia ratio greater than 1.0) 6

5(4) Fl_4 almost quadrate, without longitudinal sensilla (Fig. 3) .... *confertus* (Doutt)

- Fl_4 at least twice as long as wide, usually with 1 or 2 longitudinal sensilla (Fig. 6) (European species, establishment in North America uncertain) .... *diana* Girault

6(4) Fl_2 without longitudinal sensilla and somewhat narrower than Fl_3 7

- Fl_2 with 1 or 2 longitudinal sensilla on one or both antenna and about same width as Fl_3 . 12

7(6) Forewing narrow, its length/width ratio greater than 7.3 (Figs. 20, 22, 27) 8

- Forewing broader, its length/width ratio less than 6.5 (Figs. 17, 23-25, 28, 29) 10

8(7) Setae on vertex between ocelli and on thorax conspicuous, long and erect, the four setae between ocelli at least half as long as distance between posterior ocelli, the two on midlobe of mesoscutum extending to posterior margin of mesoscutum (assuming they are laying flat) and the one on each axilla extending past posterior margin of anterior scutellum (Fig. 41) .... *gerrisophaga* (Doutt)

- Setae on head and thorax shorter and mostly inconspicuous, the four setae between ocelli at most as long as anterior ocellar diameter 9

9(8) Fl_2 long and slender, its length/width ratio at least 4.8, and the remaining segments also relatively long and slender (Fig. 5) .... *cotei* Huber

- Fl_2 shorter and broader, its length/with ratio at most 3.5, and the remaining segments also relatively shorter and broader (Fig. 13) .... *pullicrurus* (Girault)

10(7) Hind leg with tarsomere 1 almost 1.5 times as long as tarsomere 2 .... *calendrae* (Gahan)

- Hind leg with tarsomere 1 slightly shorter than tarsomere 2 11

11(10) Forewing length/width ratio at least 5.7; body length 413-603 µm [specimens from original 1911 introduction] .... *luna* Girault (part)

- Forewing length/width ratio at most 5.4 (4.6 in holotype); body length 413 (holotype; the single paratype not measurable) .... *longiclava* (Doutt)

12(6) Ovipositor length averaging 434 µm (374-511, n=13) .... *listronoti* Huber, *sordidatus* Huber

[Note: these species cannot be separated morphologically (see Huber *et al.*,1997); *sordidatus* has been reared from *Tyloderma foveolatum* (Say) whereas *listronoti* has been reared from *Listronotus oregonensis* (LeConte)].

- Ovipositor length less than 350 µm for Texan and Michigan populations, and averaging 365 mµ (351-380, n=5) for Quebec population .... *victus* Huber ?and *luna* Girault (part)

Anaphes brunneus (Doutt)

(Figs. 1, 16, 35)

Anaphoidea brunnea Doutt, 1949: 159 (original description).
Patasson brunnea; Burks, 1958: 63 (catalog).
Patasson brunneus; Peck, 1963: 32 (catalog, hosts); Burks, 1979: 1030 (catalog).
Anaphes brunneus; Huber, 1992: 73 (list).

Type material. HOLOTYPE ♀ (EMEC), examined. On slide labelled: 1."by sweeping native vegetation. Forestville, Sonoma Co., Calif. April 16, 1947 R.L. Doutt". 2. "*Anaphoidea brunnea* Doutt ♀ Type" (red label). The holotype is in fairly good condition, with the right pair of wings and right foreleg detached, and with the head detached and positioned laterally and one antenna detached. Measurements are given in Table I. PARATYPES: same data as holotype (2 ♀, USNM, EMEC); Contra Costa Co., El Cerrito, 6.iii.1948, R.L. Doutt (1 ♀, EMEC).

Diagnosis. Occipital suture short, angled inwards towards dorsal margin of occipital foramen (as in Figs. 31, 32); forewing clear on posterior margin to mid-point of wing apex (Fig. 16); Fl_2 at least 4.3 times as long as apical width (Fig. 1).

Anaphes brunneus, A. pallipes, A. conotracheli and the Palearctic *A. pectoralis* are all closely related based on the short, angled occipital suture and the clear hind margin of the forewing. They also share these two features with *A. iole* of the *fuscipennis* species group. *Anaphes brunneus* differs from *A. pallipes* and *A. conotracheli* by its longer Fl_2, the longest funicle segment. Except for the antennal and ovipositor proportions, specimens of *A. brunneus* and those of *A. conotracheli* appear to be identical so the species may be synonymous. More, preferably reared, specimens from hosts in western North America are required so variation can be assessed adequately to determine if the species are really the same.

Description. Female. *Colour* (from uncleared type slides). Dark brown with antennae and legs beyond coxae lighter. Forewing (Fig. 16) with posterior margin hyaline almost to apex of wing.

Body length. 484 (428-535, n=4, from slide-mounted types). Body length is approximate because the specimens cannot be measured accurately due to breakage and poor orientation.

Head. Width 170 (n=1). Occipital suture short, angled inwards towards dorsal margin of occipital foramen (as in Figs. 31, 32). Ocellar setae as long as about half diameter of anterior ocellus.

Antenna. Scape with ventral margin almost straight, with faint, oblique striations on inner surface. Fl_5 and Fl_6 each with 2 longitudinal sensilla (Fig. 1). Fl_1 with base about two-thirds width of apex. Fl_3 with 1 (holotype) or 2 (paratypes) longitudinal sensilla. Fl_4 without longitudinal sensilla in holotype and one paratype, and with1 longitudinal sensillum in remaining two paratypes. Measurement of antennal segments are given in Table II.

Mesosoma. Pronotum and mesonotum with short, inconspicuous setae.

Wings. Forewing length 671 (626-721, n=3), width 146 (132-160), FWL/FWW 4.7 (4.55-4.75), LMC 145 (140-150), their length about equal to forewing width; marginal space 90 (84-97), medial space triangular, cubital line of setae closest to posterior margin near the retinacular seta and further away distally, with a distinct gap of about one setal length between the cubital line and posterior margin of wing. Hind wing length 649 (610-705, n=3), width 29 (n=1), with 5-10 microtrichia medially on blade in apical half, LMC 117 (103-131, n=3).

Legs. Foretibia with 8-10 sensilla chaetica. Hind tarsomere 1 slightly shorter than tarsomere 2 (Table I).

Metasoma. Ovipositor length 342 (n=1), 1.62 times length of hind tibia, extending under mesosoma at least to level of base of mesocoxa and usually to base of forecoxa. Gaster with rather blunt apex (Fig. 35).

Male. Unknown.

Distribution. USA (CA).

Material examined. Only the four specimens of the type series were examined. One specimen from TX, Jim Wells Co., La Copita Res. Station, north fence pasture S2, 23.iii.1990, G. Zolnerowich (1♀ on card, CNCI) may be this species but more material is needed from this locality for slide mounting to be certain.

Hosts and Biology. Unknown.

Anaphes calendrae (Gahan)

(Figs. 2, 17, 33, 36)

Anaphoidea calendrae Gahan, 1927: 32 (original description); Marlatt, 1929: 11 (shipment to Hawaii); Satterthwait, 1931: 171 (hosts, life cycle, biology); Williams, 1929a: 227 (release in Hawaii); Williams, 1929b: 29 (introduction into Hawaii); Williams, 1931: 216 (release in Hawaii); Clausen, 1940: 101 (host mention); Doutt, 1949: 160 (key); Vaurie, 1951: 39 (host list); Thompson, 1958: 569 (host list).

Patasson calendrae; Peck, 1951: 414 (catalog, hosts); Peck, 1963: 32 (catalog, hosts); Beardsley, 1964: 340 (insectary rearing); Bianchi, 1964: 346 (release in Hawaii, laboratory hosts); Davis and Krauss, 1964: 395 (release in Hawaii); Davis, 1968: 16 (release in Hawaii); Funasaki, 1969: 285 (release in Hawaii); Davis and Chong 1969: 320 (release in Hawaii); Anonymous 1970: 34 (propagation in Hawaii); Burks, 1979: 1030 (catalog); Collins and Grafius, 1983: 1 (hosts); Clausen, 1978: 274 (importation and release in USA, failed establishment in Hawaii); Huber, 1986: 198 (mention of failed establishment in Hawaii).

Patasson calandrae; Tooke, 1955: 112 (incorrect subsequent spelling).

Anaphes calendrae; Annecke and Doutt, 1961: 49 (key); Huber, 1992: 73 (list); Beardsley and Huber, 2000: 10 (Hawaiian records).

Anaphes (*Patasson*) *calendrae*; Beardsley, 2000: 209 (establishment and probable hosts in Hawaii).

Type material. HOLOTYPE ♀ (USNM), examined. On slide labelled: 1."*Anaphoidea calendrae* Gahan Type & allotype Type No. 29454 U.S.N.M. [red label]". 2." Webst. Gr. # 24117 Progeny of # 24106 bred through eggs of *Calendra destructor.* Kirkwood, Mo. A.F Satterthwait". The holotype is in good condition, uncleared and mounted laterally with the head partially in face view. Its measurements are given in Table I. Three female and one male paratypes are on the same slide as the holotype, which is circled in black. PARATYPES. I examined 38 of the 40 slides and 11 of the 12 original point-mounted specimens listed by Gahan (1927). The specimen(s) from Borschertown, Missouri, were not found. One card-mounted specimen was cleared and mounted in Canada balsam. All paratypes have the same type number as the holotype slide.

Diagnosis. Hind tarsomere 1 distinctly longer than tarsomere 2 (Fig. 33); ovipositor/hind tibia ratio at least 2.1, with the ovipositor extending under mesosoma to apex of forecoxa (Fig. 36).

Description. Female. Colour. Body dark brown. Legs brown except for yellowish base and apex of femora, entire tibiae and basal three tarsomeres. Antenna brown, with scape and pedicel sometimes yellowish. Forewing (Fig. 17) margined with brown along both margins but paler along posterior margin, and with a uniform brown suffusion on blade except for clear longitudinal streak in medial space.

Body length. 467-941µm (n=31, from slide-mounted specimens). Individual size varies considerably depending on host size, as follows (smallest to largest): mean = 538 (467-555, n=5) ex. *S. minimus*; mean = 583 (480-804, n=6) ex. *Sphenophorus parvulus*; mean = 659 (595-757, n=7) ex. *S. pertinax*; mean = 704 (623-749, n=5) ex. *S. costipennis*; mean = 788 (764-808, n=5) ex. *S. callosus*; mean = 896 (857-941, n=3) ex. *S. maidis*.
Head. Width 195-329 (n=18) (see Table XII for measurments from different host species). Occipital suture straight (as in Fig. 30).
Antenna. Inner surface of scape with very faint, slightly oblique reticulations. Fl_3-Fl_6 each with 2 longitudinal sensilla (Fig. 2). Base of Fl_1 distinctly narrower than apex. Length of antennal segments (greatest range, across specimens reared from all hosts): scape 91-158, pedicel 38-67, Fl_1-Fl_6 16-36, 32-96, 34-102, 37-87, 37-80, 37-74, clava 84-126 (see Tables III-IX for measurements from different host species).
Mesosoma. Pronotum and mesonotum with short setae.
Wings. Forewing length 436-882, width 60-141, FWL/FWW 6.26-7.83, LMC 104-146 and 1.1-1.6 times as long as wing width (depending on host from which specimens were reared), microtrichia of blade relatively long, with the apex of one distinctly overlapping base of the next; marginal space 84-169 (extremely variable, depending on host from which specimens were reared); medial space relatively long and narrow, somewhat rectangular; cubital line of setae uniformly separated by about a setal length from posterior margin of wing. Hind wing (Fig. 17) with 0-6 microtrichia medially on blade in apical half (see Tables X and XI for measurements of fore- and hind wings, respectively, from different host species).
Legs. Foretibia with one row of about 7 thick and another row of about 7 more slender sensilla chaetica. Hind tarsomere 1 about 1.32 (1.28-1.37, n=3) times as long as tarsomere 2.
Metasoma. Ovipositor length 2.09-2.64 times hind tibial length, extending under mesosoma to apex of forecoxa (see Table XII for measurements from different host species). Gaster elongate and somewhat pointed apically (Fig. 36), with a gap between cercus and apex about equal to length of cercus.
Male. Total length of flagellum 746 (556-858, n=9). Length of antennal segments (n=8-11): scape 110 (90-116), pedicel 48 (43-53), Fl_1 10 (7-11), Fl_2 72 (53-83), Fl_3 77 (59-92), Fl_4 75 (56-88), Fl_5 74 (55-90), Fl_6 73 (56-86), Fl_7 71 (56-81), Fl_8 72 (51-85), Fl_9 71 (50-83), Fl_{10} 70 (52-81), Fl_{11} 76 (57-89). Fl_6 length/width ratio averaging 3.67, with 5 longitudinal sensilla. Males were reared from *S. destructor*, *S. pertinax* and *S. venatus vestitum* only
Variation. There is apparently little structural variation among specimens reared from different hosts. The greatest variation is in body size, with some of the largest individuals (ex. *S. maidis*) being twice as long as some of the smallest (ex. *S. minimus* and *S. parvulus*)
Distribution. USA (FL, HI, MO, MS, OH) .
Material examined (all in USNM unless otherwise indicated). **CANADA. Ontario.** Toronto, Etobicoke, Islington Ave., Barclay Terrace mansion, vii-viii.2004, YPT, S.V. Libenson (2♀♀ on cards, CNCI). **USA. Florida.** Broward Co.: Fort Lauderdale, vii.1968, H. Nakao and R. Suzukawa, ex. *Sphenophorus venatus vestitus* (9♀♀, 1♂). **Hawaii.** Oahu: Honolulu, laboratory reared, 2.ii.1968. J.W. Beardsley (1♀, 1♂, BPBM); University of Hawaii Campus, Gilmore Hall, 27.iv.1986, L. LeBeck (1♂, CNCI); Hilo Coast, Kolekole Beach Park, 19.x.1983, D.M. LaSalle (1♀, CNCI). **Mississippi.** Grenada Co.: Grenada, 23.vi.1922, H.E. Roberts, ex. *S. destructor* (1♀), 16-22.vi.1922 (1♂); Washington Co.: Greenville, 15.vi.1922, A.F. Satterthwait,

ex. *S. destructor* (1♀), 15-22.vi.1922, J.L.E. Laverdale, ex *S. destructor* (1♀). **Missouri.** St. Louis Co.: Kirkwood, lab. reared, no date, A.F. Satterthwait, ex. *S. destructor* (5♀♀, 1♂); Kirkwood, no date, ex. *S. destructor* A.F. Satterthwait (1♀); Kirkwood Station, 3.vii.1924, ex. *S. parvulus* on timothy in field (5♀♀), 4 and 23.vii and 1 and 2.viii.1924, A.F. Satterthwait, ex. *S. parvulus* in lab. (12♀♀); Kirkwood Station, 3 and 4.viii.1924, A.F. Satterthwait, ex. *S. callosa* (4♀♀) and 3 with no date, ex. *S. callosa*; Kirkwood, 1-4.viii.1924, A.F. Satterthwait, ex. *S. pertinax* (17♀♀, 4 ♂); Kirkwood, 3.vii.1924, A.F. Satterthwait, ex. *S. minimus* in field on *Agrostis alba* (8♀♀, 1 ♂); Kirkwood, 14, 15, and 17.viii.1924, A.F. Satterthwait, ex. *S. minimus* (5♀♀); Kirkwood, 18, 20, 22, and 25.viii.1924, A.F. Satterthwait, ex. *S. costipennis* (18♀♀, 1♂); Kirkwood, no date, A.F. Satterthwait, ex. *S. maidis* (3♀♀); Webster Groves, 10.viii.1922, H.E. Roberts, ex. *S. parvulus* (3♀♀); Webster Groves, 9.vii.1923, H.E. Roberts, ex. *S. callosa* (1♀), 2-23 and 10-22.vii.1922, H.E. Roberts, ex. *S. callosa* (2♀♀); Webster Groves, 22.vii.1924, A.F. Satterthwait (1♀♀); Webster Groves, 15.vii.1925, H.E. Roberts, ex. *S. minimus* (4♀♀, 1♂). **Ohio.** Wayne Co.: Wooster, O.A.R.D.C., 21.vi.1976, C. Frost (5♀♀, 3♂♂).

Hosts and Biology. *Anaphes calendrae* is a gregarious parasitoid of *Sphenophorus* species (Curculionidae: Rhynchophorinae), commonly known as billbugs (Vaurie 1951). Up to nine individuals have been reared from a single host egg. Usually seven larvae (one male and six females) develop per host egg and there are four to seven broods per year (Satterthwait 1931). The original series from which laboratory rearings were initiated was field collected at Kirkwood [Station] from the egg of *S. parvulus* (Gyllenhal) on timothy and from eggs of *S. ?minimus* Hart. The species was reared through several generations on different *Sphenophorus* hosts at the Webster Groves field laboratory. Satterthwait (1931) found that *A. calendrae* destroyed 75% of *S. minimus* and *S. parvulus* eggs in white bent grass, *Agrostis alba*. Other field collected hosts were *S. callosus* (Gyllenhal) and *S. destructor* Chittenden. Under laboratory conditions, *S. costipennis* Horn, *S. australis* Chittenden, *S. maidis* Chittenden, *S. necydaloides* Chittenden, and *S. venatus* (Say) were successfully parasitized (Vaurie 1951). *Anaphes calendrae* was introduced into Hawaii in an attempt to control *Sphenophorus cariosus* (Olivier) (Beardsley 2000). Under insectary conditions, *A. calendrae* was reared on *S. cariosus* and *S. venatus vestitus* Chittenden and it is presumed that these hosts are also attacked in the field (Beardsley 2000). Over 74,000 specimens from Florida and Missouri were successfully propagated for release in Hawaii (Anonymous 1970). A prior attempt to establish *A. calendrae* against the New Guinea sugarcane weevil, *Rabdocnemis obscura* Boisduval, in Hawaii failed so this species is probably not a host, despite being cited as such by Thompson (1958). Nevertheless, it is capable of parasitizing *R. obscura* eggs in the laboratory (Bianchi 1964).

Anaphes confertus Doutt

(Figs. 3, 18, 37)

Anaphoidea conferta Doutt, 1949: 155 (original description).
Patasson conferta; Burks, 1958: 63 (catalog).
Patasson confertus; Peck, 1963: 32 (catalog); Burks, 1979: 1030 (catalog).
Anaphes conferta; Schauff, 1984b: 216 (comparison with *diana*)
Anaphes confertus; Huber, 1992: 155 (list).

Type material. HOLOTYPE ♀ (CASC), examined. On slide labelled: 1. "by sweeping native vegetation Oakville, Napa Co., Calif. May 3, 1948 R.L. Doutt". 2."*Anaphoidea conferta* Doutt ♀ Type" (red label). 3."California Academy of Sciences Entomology Type No.17134" (on back of slide). The holotype is in rather poor condition, mounted laterally, with head ventral side up, detached and broken, wings except left hind wing detached, antennae detached from head and one broken into two pieces at pedicel, and right hind leg detached. Measurements are given in Table I.

Diagnosis. Scape (Fig. 3) strongly convex ventrally, at most about 3.5 times as long as wide; pedicel longer than Fl_1 and Fl_2 together; funicle segments at most 1.5 times as long as wide; clava longer than Fl_4 – Fl_6 together; ovipositor less than 0.9 times length of hind tibia, not produced under mesosoma (Fig. 37).

Description. Female. *Colour.* Body brown. Antenna and legs pale brownish-yellow. Forewing (Fig.18) narrowly brown along entire margin.

Body length. 498 (465-525, n=4, from critical point dried specimens).

Head. Width 202 (180-215, n=4). Occipital suture straight (as in Fig. 30). Ocellar setae at least as long as diameter of anterior ocellus.

Antenna. Scape with ventral margin strongly convex, its inner surface with faint, obliquely transverse reticulations. Pedicel longer than Fl_1 and Fl_2 together. No funicle segment more than 1.5 times as long as wide (or exceptionally so). Fl_1 as wide at base as at apex. Fl_3, Fl_5 and Fl_6 each with 2 longitudinal sensilla (Fig. 3). Clava longer than Fl_4 – Fl_6 together. Measurements are given in Table XIII.

Mesosoma. Pronotum with long, fine setae. Mesonotum moderately long setae.

Wings. Forewing length 722 (664-758, n=4), width 114 (103-125), FWL/FWW 6.43 (6.05-7.10), LMC 168 (159-174), their length at least one-fifth greater than forewing width; marginal space 107 (80-143), medial space narrow, cubital line of setae uniformly close to posterior margin of wing. Hind wing length 683 (628-712, n=4), width 33 (29-37), with 6-17 microtrichia medially on blade in apical half, LMC 130 (72-133).

Legs. Foretibia with 9-12 sensilla chaetica. Hind tarsomere 0.86 times (n=1) as long as tarsomere 2.

Metasoma. Ovipositor not extending forward under mesosoma (Fig. 37), its length 179 (169-187, n=3), at most 0.9 times length of hind tibia. Gaster blunt apically (Fig. 37).

Male. Unknown.

Distribution. Canada (BC, ON), USA (AZ, CA, GA, TX).

Material examined. 13 ♀♀ (3 on slides). **CANADA. British Columbia:** Upper Carmanah Valley, UTM 10U CJ 803006, 12-27.viii and 16-30.vii.1991, N. Winchester, TZ MT5 (2♀♀, CNCI). **Ontario:** 6 km NNE Egansville, Shaw Forest, 45°138'N 77°04'W, 1-8.vii.1993, H. Goulet ♀ M. Sharkey, FIT (1♀, CNCI). **USA. Arizona.** Cochise Co.: 12 km S. Sierra Vista, Ramsay Canyon, 10.vi.1987, B.V. Brown, Malaise, oak/pine (1♀, CNCI); Santa Cruz Co.: Patagonia, 31°32'52"N 110°46'03"W, 10-15.v, and 1-5.vi.1994, B. Brown ♀ E. Wilk (4♀♀, CNCI). **California.** Santa Barbara Co.: Santa Barbara, Lu Vista Road, 1-4.iv.1982, S. Miller, pan trap (1♀, CNCI); Santa Cruz Island between Alamos Canyon and Centinela, 21.iii.1982, J.T. Huber, sweeping (1♀, UCRC); Stanislaus Co.: Newman, 21.iv.1949, sweeping low vegetation near Merced River, R.L. Doutt (1♀, EMEC). **Georgia.** Liberty Co.: St. Catherines Island, 6-10.iv.1995, A. Sharkov, MT, road between Windmill and Gator Pond (1♀, UCRC). **Texas.**

Brazos Co.: College Station, 14.iii-2.iv.1987, R. Anderson, post oak savannah (1♀, CNCI).
Hosts and Biology. Unknown.

Anaphes conotracheli **Girault**
(Figs. 4, 19, 32, 38)

Anaphes conotracheli Girault, 1905: 220 (original description); Johnson and Girault, 1906: 5 (distribution, percent parasitism); Quaintance, 1906: 327 (parasitism rate); Girault, 1907: 29 (host); Pierce, 1908: 43 (host); Girault, 1909: 171 (removal to *Anaphoidea*); Brooks, 1910: 110 (parasitism rate); Viereck 1910: 637 (host); Brooks, 1911: 137 (parasitism rate); Ogloblin, 1939: 144 (mention): Richards and Davies, 1977: 1225 (mention); Huber *et al.*, 1997: 969 (incorrect host record).

Anaphes (*Anaphoidea*) *conotracheli*; Viereck, 1916: 447 (redescription); Snapp, 1930: 77 (host).

Anaphea conotracheli; Solomon, 1985: 12 (host).

Anaphoidea conotracheli; Girault, 1910: 248 (redescription, comparison with *pullicrurus* and *sordidata*, collection localities); Pierce, 1910: 453 (example of simple endoparasitism); Girault, 1911a: 216 (comparison with *diana*); Girault, 1911b: 148 (transfer from *Anaphes* to *Anaphoidea*); Girault, 1911e: 323 (list); Girault, 1912: 153 (comparison with *A. linnaei*); Quaintance and Jenne, 1912: 140 (distribution, life cycle, parasitism rate); Marcovitch, 1916: 140 (host); Girault, 1917: 93 (host); Brooks, 1918: 14 (parasitism rate); Washburn, 1919: 184 (host); Britton, 1920: 323 (list); Porter, 1922: 165 (percent parasitism); Girault, 1929: 12 (key); Alden, 1930: 19 (mention); Dozier *et al.*, 1932: 38 (parasitism rate); Doutt, 1949: 160 (key); Soyka, 1949: 359 (German translation of original description); Garman *et al.*, 1953: 7 (host); Jackson, 1956: 145 (incorrect host record); Thompson, 1958: 569 (host list); Collins and Grafius, 1983: 1 (host).

Anaphoides conotracheli; Dozier and Williams, 1929: 36 (host).

Anaphoidia conotracheli; Moultrie, 1952: 19 (host).

Patasson conotracheli; Peck, 1951: 414 (catalog, hosts); Peck, 1963: 32 (catalog, hosts); Burks, 1967: 214 (*luna* deleted as a synonym); Burks, 1979: 1030 (catalog); Arnett, 1985: 435 (host); Davidson and Lyon, 1987: 426 (hosts).

Anaphes sp. possibly *conotracheli*; Tedders and Payne, 1986: 986.

Patasson (*Anaphoidea*) *conotracheli*; Garman and Townsend, 1952: 3, 63 (hosts).

Type material. HOLOTYPE ♀ (USNM), examined. On card point labelled as follows: 1. "♂". 2." on *Conotrachelus nenuphar* eggs". 3."Arundel. Md. v.20.1905". 4."A.A. Girault Collector". 5."♀ Type No. 8433 U.S.N.M." 6."*Anaphes conotracheli* Girault". The specimen has the head and antennae missing. The date of capture of this specimen was incorrectly cited by Girault (1905) as v.16. Clearly, he mixed up the dates and places of capture for the specimens from Arundel, MD, and Tryon, NC (collected on 20.v). PARATYPES. One female and 5 males under one coverslip on slide labelled 1."*Anaphes* species on eggs Cono. nenuphar Ft. Valley, Ga. V.10.1905, Quaintance Coll Girault reared 4♂ 2♀ No. 44104 Balsam no. 60 [crossed out] 31434". 2."Homotype ♀ Plesiotype". 2."*Anaphoidea conotracheli sordidata* [crossed out] (Girault) Cotypes. 44104." Girault (1905) described *A. conotracheli* from 40 specimens and stated: "type deposited in the United States National Museum". I treat this as a valid holotype designation according ro article 73.1.1 of the ICNZ (1999), particularly because only one specimen is labelled "type" and several (but not all) the others mentioned by Girault are labelled as paratypes. I slide-mounted three (2♀ and 1♂) of the original point-mounted specimens and used one paratype from Fort Valley, Georgia, for the measurements given in Table I.

Diagnosis. Occipital suture angled inwards towards dorsal margin of occipital foramen (Fig. 32); Fl_3-Fl_6 usually each with 2 longitudinal sensilla; forewing with part of posterior margin hyaline medially, preceded and followed by a narrow dark margin and another short, clear area on posteroapical curve almost to apex that abruptly changes to a dark margin along anteroapical curve (Fig. 19); ovipositor extending forward under mesosoma at least to the apex of forecoxa and basal loop very tight, with dorsal arm almost parallel to ventral arm (Fig. 38).

Among the described Nearctic species of the *crassicornis* group the oblique occipital suture and dark and light border of the posterior margin of the forewing distinguish *A. brunneus*, *A. conotracheli*, and *A. pallipes* from the remaining described species, which all have a straight occipital suture and uniformly dark posterior margin of the forewing. The only feature that apparently distinguishes *A. conotracheli* from *A. pallipes* is the presence in *A. conotracheli* of 1 or, usually, 2 longitudinal sensilla on Fl_4 (none in *A. pallipes*). *Anaphes pallipes* is also smaller than *A. conotracheli*. The only features that distinguish *A. conotracheli* from *A. brunneus* are the relatively shorter and broader Fl_2, with a ratio of at most 3.3 (at least 4.4 in *A. brunneus*), and the ovipositor/hind tibia ratio of at least 1.8 (1.62 in *A. brunneus*).

Description. Female. *Colour* (from four point-mounted paratypes). Body brown. Legs almost white except coxae, femora in middle, and tarsomere 4 light brown. Forewing (Fig. 19) with posterior margin clear to apex of wing or at least distinctly lighter brown than anterior margin, except for a short brown section subapically.

Body length. 536 µm (460-620, n= 11, from slide-mounted specimens from GA, MD, VA).

Head. Width 221 (189-238, n=12). Occipital suture short, angled inwards towards dorsal margin of occipital foramen (Fig. 32)

Antenna. Inner surface of scape and pedicel with distinct, oblique cross striations. Fl_3, Fl_5 and Fl_6 each with 2 longitudinal sensilla, Fl_4 usually with 2 sensilla (Fig. 4) but sometimes (one third of the specimens measured) with 1 sensillum. Measurements are given in Table XIV.

Mesosoma. Pronotum and mesonotum with short, inconspicuous setae.

Wings. Forewing length 661 (592-704, n=14), width 141 (124-154), FWL/FWW 4.70 (4.43-5.15), LMC 127 (108-140); marginal space 107 (80-143), medial space triangular; cubital line of setae closest to posterior margin of wing near retinacular seta, then diverging away until separated by at least one setal length from posterior margin. Hind wing length 644 (633-671, n=10), width 29 (24-32), with 0-4 (usually only with 1) microtrichia medially on blade in apical half, LMC 106 (90-115).

Legs. Foretibia with 8-11 sensilla chaetica. Hind tarsomere 0.76 (0.70-0.82, n=10) times as long as hind tarsomere 2.

Metasoma. Ovipositor length 420 (365-470, n=14), 1.95 (1.8-2.1) times as long as hind tibia. Gaster appearing relatively short compared to mesosoma.

Male. Total length of flagellum 717µm (650-796, n=10). Length of antennal segments (n=10): scape 87 (77-92), pedicel 44 (37-50), Fl_1 8 (7-9), Fl_2 65 (58-73), Fl_3 73 (63-80), Fl_4 70 (60-77), Fl_5 71 (62-79), Fl_6 71 (62-80), Fl_7 71 (60-80), Fl_8 71 (61-78), Fl_9 72 (62-81), Fl_{10} 72 (65-82), Fl_{11} 71 (67-84). Fl_6 length/width ratio averaging 2.73, with 5 longitudinal sensilla. Gaster appearing very short relative to mesosomal length.

Variation. Females sometimes have only 1 longitudinal sensillum on Fl_4 [2 specimens from

Blacksburg, VA, ex. *Hypera nigrirostris* (Fabricius) (slide in USNM) and some specimens from Ste. Clotilde, QU, ex. *Conotrachelus geminatus* (LeConte) (slides in CNCI)]. This segment is consequently slightly shorter and narrower than Fl_3. However, the series of specimens from Monticello, collected by Dozier, neatly bridges the gap between *A. pallipes* and *A. conotracheli* because one female has both Fl_4 with 2 longitudinal sensilla, and the other two females have one Fl_4 without longitudinal sensilla and one with 1 longitudinal sensillum. Probably only one species is involved, with larger individuals parasitizing the larger eggs of *Conotrachelus* and smaller individuals parasitizing the smaller eggs of *Cylindricopturus*. The differences in the specimens reared from these two host genera parallels the differences found for *A. iole* and one of its synonyms reared from large and small mirid hosts. In the latter case, experimental support showed only one species was involved so the synonymy could be made with certainty (Huber and Rajakulendran 1988). Until such support is available for *A. conotracheli* and *A. pallipes* I retain the two species as distinct, mainly because a relatively large body of literature is associated with *A. conotracheli*. If crossing experiments show that the species are the same (as I suspect) then the name *A. pallipes* would have priority.

Comments. Normally, the most common species from an area are collected first and usually described soon after. Passive collecting methods, such as pan or Malaise trapping that yield large amounts of material, were unknown or not used in Ashmead's and Girault's time. Rather, collecting consisted of sweeping and, in Girault's case, searching panes of glass in greenhouses etc., or else host eggs were searched for and parasitoids reared from them. Thus, species, particularly economically important ones, that tend to search for hosts on aerial parts of plants (e.g. *Cylindrocopturus adspersus* on sunflower, *Conotrachelus nenuphar* on plum) would most likely be collected first, before species that search for host eggs near or at ground level. It is therefore not coincidental that the first two *Anaphes* species described from North America were *A. pallipes* and *A. conotracheli*, precisely those species of *Anaphes* most likely to be collected by sweeping, searching glass panes, or rearing eggs laid in easily accessible locations.

Distribution. Canada (QC), USA (DC, GA, IL, MD, VA, WV). In addition, Johnson & Girault (1906) reported *A. conotracheli* from CT, KY, NC, and TX.

Material Examined. 46♀♀ and 35♂♂ (42 on slides). **CANADA. Quebec.** Ste. Clotilde, vii, 20.vii, viii, and 1-23.viii.1990, S. Côté (33♀, 24♂, CNCI). **USA. District of Columbia.** No. 1100 and 1271, A.A. Girault [no date or locality given, possibly those bred at Washington as mentioned in original description] (1♀, 1♂, and 1 specimen in egg, USNM). **Georgia.** Peach Co.: Fort Valley, 9.v.1905, A.L. Quaintance and 9.vi.1924, O.J. ?Snaph (4♀, 1♂, USNM). **Illinois.** Cook Co.: Chicago, Clayton Smith Forest Preserve, 31.vii.1989, J.D. Pinto (1♀, CNCI); Effingham Co.: SSW. Mason, 7.ix.1993, J.D. Pinto (1♂, CNCI); Piatt Co.: Monticello, swept from vegetation along Sangamon river, 31.vii.1932, H.L. Dozier (3♀, 4 ♂, USNM). **Maryland.** Anne Arundel Co.: 16.v.1905, A.A. Girault (1♀, 1♂, USNM). *Virginia.* Fairfax Co.: Vienna, 16.v.1913, R.A. Cushman (1♀, 2♂, USNM); exact locality not given, 25.iv.1921, sent in by W.J. Schoene of Blacksburg (2♀, 6♂, USNM). **West Virginia.** Upshur Co.: French Creek, no date, E.E. Brooks (5♀, 1♂, USNM).

Hosts and Biology. *Conotrachelus geminatus* on *Bidens cernua* L., *C. nenuphar* (Herbst) (plum curculio) (Girault 1905), *Craponius inaequalis* (Say) (grape curculio) (Porter 1922). *Hypera nigrirostris* (lesser clover leaf weevil). Specimens reared from *C. geminatus* collected in the field at Ste. Clotilde, QC, were successfully maintained for eight generations on *Listronotus oregonensis* eggs in a laboratory colony at St-Jean-sur-Richelieu. No *A. conotracheli* were ever found on the latter host in the field.

Quaintance (1906) reported 60-70% egg parasitism of *C. nenuphar* on peaches in Georgia, and Johnson and Girault (1906) reported 16-70% parasitism. Brooks (1918) reported 39.5% egg parasitism of *C. inaequalis* on grapes. Marcovitch (1916) reported the sawfly *Aprosthena zabriskei* Webster & Malley (Argidae) on *Portulaca oleracea* L. as a host. The two specimens were identified by Girault but vouchers were not seen. If correctly identified, this would be the first published record of an *Anaphes* species reared from a species of Hymenoptera. Tedders and Payne (1986) recorded a species of *Anaphes*, possibly *conotracheli*, from *C. schoofi* Papp but voucher specimens were not seen. Garman and Townsend (1952) listed *Conotrachelus nenuphar* (Curculionidae) and *Rhagoletis pomonella* (Walsh) (apple maggot) (Tephritidae) as hosts. The host record of *C. anaglypticus* (Say) on *Thalictrum pubescens* Pursh. by Huber *et al.* (1997) is incorrect.

Comments. The references to *A. conotracheli* by Porter and Alden (1921), Porter (1922), Schauff (1984a: 48), probably Porter (1928), Charlet and Balsbaugh (1984), and Solomon (1985) refer to *A. pallipes* as defined under that species below. I examined voucher specimens and compared them to the type of *A. pallipes*. Bakkendorf (1934) reared a species in Europe from dytiscid and chrysomelid eggs which he referred to as *A. conotracheli* but the specimens he reared from *Agabus* (Dytiscidae), and almost certainly also those reared from Chrysomelidae, are very likely misidentified and probably represent two species, neither of them *A. conotracheli*. Jackson (1956) noted that specimens she reared from *Agabus* sp. were not the same as *A. conotracheli*.

Anaphes cotei Huber

(Figs. 5, 20, 39)

Anaphes cotei Huber *et al.*,1997: 970 (original description).

Type Material. HOLOTYPE ♀ (CNCI), examined (see Huber 1997), from CANADA: Nova Scotia, Great Village.

Distribution. Canada (NS).

Diagnosis. Statistics of the antennal segments are given in Table XV to complement the description in Huber *et al.* (1997) and for comparison with the antennal descriptions of the other species redescribed here. Type measurements are given in Table I. The species is most similar to *A. pullicrurus*. *Anaphes cotei* has a relatively narrow forewing (Fig. 20) as in *A. pullicrurus* (Fig. 27) but the inner surface of the scape has bluntly pointed, oblique scales with slightly thickened apices, as in *A. gerrisophaga* (scales not clearly visible in *A. pullicrurus*). The antenna (Fig. 5) has 2 longitudinal sensilla on Fl_4, as in *A. pullicrurus* (Fig. 13) but each funicle segment is relatively longer and more slender than in *A. pullicrurus*.

Anaphes diana (Girault)

(Figs. 6, 21, 40)

Anaphoidea diana Girault, 1911a: 215 (original description); Girault, 1914b: 109 (contrast with *luna*); Girault, 1929: 12 (contrast with *conotracheli*); Soyka, 1949: 362 (description, comparison with *conotracheli*); Schauff, 1984b: 214 (mention).

Anaphes diana; Schauff, 1984b: 214 (diagnosis); Schauff 1984a: 48 (types examined); Yeargan, 1985: 528 (release in Delaware and Kentucky); Aeschlimann, 1986: 164 (distribution, parasitism rate); Huber, 1986: 197 (biocontrol in Australia); Aeschlimann *et al.*, 1989: 418 (rearing, release and recovery in Australia); Worner *et al.*, 1989: 1086 (climate tolerance limits); Aeschlimann, 1990: 3 (thelytokous and arrhenotokous populations); Dysart, 1990: 307 (release and recovery in USA); Chiriac and Poiras, 1995: 39 (occurrence in Moldova); Pagliano, 1995: 35 (Italian checklist).

Anaphes (*Anaphes*) *diana*; Baquero and Jordana, 2002: 79 (distribution, hosts).

Anaphes (*Patasson*) *diana*; Fitton *et al.*, 1978: 110 (British checklist); Viggiani, 1994: 474 (male genitalia).

Patasson diana; Richards and Waloff, 1965: 202 (host); Aeschlimann, 1975: 407 (mention); Collins and Grafius, 1983: 1 (host).

Anaphes (*Patasson*) *lameerei* Debauche, 1948: 182 (original description); Hincks, 1960: 213 (diagnosis, British distribution); Fitton *et al.*, 1978: 110 (checklist); Schauff, 1984b: 214 (synonymy with *A. diana*); Yeargan, 1985: 528 (old name for *diana*).

Anaphes lameerei; Hellén, 1974: 27 (redescription, distribution); Schauff, 1984a: 48 (types examined).

Patasson lameerei; Aeschlimann, 1975: 405 (host, distribution, parasitism rate); Dysart and Bingham, 1976: 29 (introduction into USA); Aeschlimann, 1977: 111 (life history); Hopkins, 1978a: 1 (life cycle, release in Australia, rearing difficulties); Leibee *et al.*, 1979: 354 (development rate); Aeschlimann, 1980: 146 (parasitism rate); Bloem, 1980:1 (biology);Yeargan and Shuck, 1981: 119 (longevity, reproductive rate); Bloem and Yeargan, 1982a: 37 (temperature effects on survival); Bloem and Yeargan, 1982b: 93 (host finding behavior); Collins and Grafius, 1983: 1 (host); Aeschlimann, 1986: 164 (synonymy quoted); Aeschlimann *et al.*, 1989: 418 (release in Australia); Worner *et al.*, 1989: 1085 (synomymy mentioned).

Type Material. LECTOTYPE ♀ (USNM), examined. On slide labelled: 1."Fred Enock Preparer Order Hymenoptera Family Mymaridae Genus *Eustochus* Species *atripennis* ♀". 2."A fairy fly. Spot Lens 2 inch to 1/2 inch. Type 13,663 [in pencil] *Anaphoidea diana* Gir. [in ink]". 3. "PARALECTOTYPE *Anaphoidea diana*, des. Schauff-83". The lectotype is in good condition but uncleared, and mounted dorsal side up with appendages spread out. Measurements are given in Table I. PARALECTOTYPE ♂ (USNM) same data as holotype. *Anaphoidea diana* Gir. Type No. 13663 U.S.N.M." 4. "Paralectotype Schauff-83".

DIAGNOSIS. Fl_2 at most 2.7 times as long as broad and 1.7 times as long as Fl_1 (Fig. 6); ovipositor shorter than hind tibial length and not extending to base of gaster (Fig. 40).

DESCRIPTION. female. *Colour.* Dark brown; scape and pedicel lighter, especially ventrally, legs lighter except usually tibiae and femora medially. Forewing (Fig. 21) with posterior margin uniformly brown.

Body length. 387µm (322-434, n=10).

Head. Width 192 (187-204, n=10). Occipital suture straight (as in Fig. 30).

Antenna. Fl_3, Fl_5 and Fl_6 each with 2 longitudinal sensilla (Fig. 6), Fl_4 usually with 1 but sometimes (one third of specimens measured) with 1 sensillum, and occasionally (one fifth of specimens measured) without sensilla. One specimen had no longitudinal sensilla on one antenna and 1 on the other. Measurements are given in Table XVI.

Mesosoma. Pronotum and mesonotum with short, inconspicuous setae.

Wings. Forewing length 559 (529-618, n=10), width 75 (68-82), FWL/FWW 7.53 (7.17-

8.63), LMC 125 (117-140); marginal space 98 (74-125), medial space triangular, cubital line of setae next to posterior margin of wing for entire length. Hind wing length 548 (507-604, n=10), width 23 (21-26), with 1-8 microtrichiae medially on blade in apical half, LMC 100 (91-109).

Legs. Foretibia with about 9-11 sensilla chaetica. Hind tarsomere 1 about 0.77 times as long as hind tarsomere 2.

Metasoma. Ovipositor length 126 (115-148, n=14), 0.64 (0.61-0.67) times as long as hind tibia. Gaster shorter than mesosoma (0.86: 1) and bluntly rounded apically.

Male. Total length of flagellum 698 (624-749, n=8) (paralectotype flagellum 652 long). Length of antennal segments (n=7 or 8): scape 85 (80-92), pedicel 41 (38-47), Fl_1 5 (4-5), Fl_2 59 (52-65), Fl_3 66 (58-73), Fl_4 70 (61-75), Fl_5 72 (66-76), Fl_6 70 (63-75), Fl_7 72 (66-75), Fl_8 71 (64-76), Fl_9 73 (65-79), Fl_{10} 68 (59-74), Fl_{11} 72 (64-80). Fl_6 length/width ratio averaging 3.68, with 5 longitudinal sensilla.

DISTRIBUTION. Europe, southwestern Asia (Aeschlimann 1986), Canada (QC). Importations of *A. diana* into the US were made in the mid 1970's. Releases were made in USA (DE, ID, KY) but establishment is uncertain (Yeargan 1985).

MATERIAL EXAMINED. 90 ♀♀ and 46 ♂♂ (60 on slides). **CANADA. Quebec.** no locality given, 28.vii.1979, M.E. Schauff & E.E. Grissell (2♀, CNCI). **FRANCE. Hérault:** Lattes, 23.iii.1976, ex. *Sitona humeralis* (1♀, 1♂, CNCI); Montpellier, ex. lab. culture at CSIRO lab., 1977 (6♀, 6♂, CNCI); St. Gely-du-Fesc, iii.1984 (43♀, 20♂, CNCI); Vestrie, 13.iv.1976 (1♂, CNCI); Viols-Le-Fort, 21.iii.1976 (1♀, CNCI).**USA. Idaho.** Latah Co.: Moscow, 12vi.1979, D.J. Schotzko, ex. lab. colony on *Sitona lineatus* (4♀, CNCI). **Kentucky.** Fayette Co.: Lexington, 12.vi.1980, K.A. Bloem, ex. lab. colony on *Sitona hispidulus* (51♀, 26♂, CNCI, USNM).

Hosts And Biology. *Sitona hispidulus* (Fabricius), the clover root curculio (Yeargan, 1985), *S. humeralis* Stephens, and *S. lineatus* (Aeschlimann, 1980).

Aeschlimann (1986) reported 1.9-23.9% parasitism in *Sitona* populations sampled in various countries. The species was also able to complete development in *S. cylindricollis* Fåhraeus and *S. flavescens* (Marsham) in the laboratory (W. Day, Newark, Delaware, personal communication). One generation takes about 11-13 days at 26.7°C (Leibee *et al.* 1979). Both thelytokous and bisexual populations may occur at the same locality (Aeschlimann 1990). Dysart and Bingham (1976) imported field collected *A. diana* from Département of Yvelines, France, into North America. It was first released against the local *Sitona* spp., primarily *S. hispidulus*, in an alfalfa field at the Beneficial Insects Laboratory, Newark, Delaware, during spring, 1976, and again in 1977. In total, 4009 adults were released. Laboratory reared, parasitized host eggs were also sent to cooperators in Moscow, ID, Urbana, IL, and Lexington, KY, for rearing and release. In 1978 and 1979, 7396 and 409 *A. diana*, originating from France and Austria, were released at Newark and, in 1979, another 1000 adults from France were released in Fayette Co., KY. By 1986, after several years of recovery attempts from field-collected *S. hispidulus* eggs, only three specimens had been found, suggesting that it had established, albeit at an extremely low parasitism rate. The two specimens from Nova Scotia (CNCI, point-mounted) appear to be *A. diana* but are slightly larger. They are tentatively treated as this species. The two Quebec specimens almost certainly are *A. diana.* It would be useful to rear specimens from eggs of *Sitona* in Quebec and Nova Scotia and cross them with European specimens (or North American lab. colonies obtained from Europe) reared from *Sitona* to determine if they are indeed the same species. If they are the same then the species probably already occured in North America prior to deliberate introductions into the USA. This would not be surprising as the host plants were deliberately introduced long ago as forage crops and at least five species of *Sitona* (*cylindricollis*, *hispidulus*, *lineatus*, *lineellus* (Bonsdorff), and *tibialis* (Herbst)) were accidentally introduced and established in North America.

Anaphes gerrisophagus (Doutt)

(Figs. 7, 22, 41)

Anaphoidea gerrisophaga Doutt, 1949: 156 (original description).
Patasson gerrisophaga; Burks, 1958: 63 (catalog).
Patasson gerrisophagus; Peck, 1963: 34 (catalog, host); Burks, 1979: 1030 (catalog).
Anaphes gerrisophagus; Huber, 1992: 74 (list).
Anaphes pullicrura; Scotland, 1940: 325 (misidentification, list).

Type Material. HOLOTYPE ♀ (CASC), examined. On slide labelled: 1. "Ex. *Gerris* eggs Lake Britton Shasta Co., Calif. 29 June 1947 R L Usinger." 2."*Anaphoidea gerrisophaga* Doutt ♀ Type" (red label). 3.(on back of slide) "California Academy of Sciences Entomology Type No. 17135". The holotype is in good condition, dorsal side up, with head detached and face up. Its measurements are given in Table I. PARATYPE ♀ (EMEC), examined. Labelled 1."On window El Cerrito, Calif. June 11, 1948 R.L. Doutt." 2."*Anaphoidea gerrisophaga* Doutt ♀ Paratype". The paratype is in good condition, dorsal side up, with left wing and right antenna detached.

Diagnosis. Forewing very narrow, FWL/FWW greater than about 8.3 (Fig. 22). Vertex, pronotum and mesonotum with long, strong setae (Fig. 41). *Anaphes pullicrurus* and *A. cotei* also have relatively narrow wings (FWL/FWW up to 8.59) but the setae on the vertex and mesonotum are short and inconspicouous (the head setae on the holotype of *A. pullicrurus* are missing so their size is unknown). The narrow wings of *A. gerrisophaga* also resemble those of *A. sinipennis* Girault (in the *fuscipennis* species group), but the clava in *A. sinipennis* is entire and bluntly rounded apically instead of being divided and more pointed.

Description. Female. *Colour* (from uncleared type slides). Brown with antennae and legs slightly ligher. Forewing (Fig. 22) narrowly brown along posterior margin but slightly lighter than along anterior margin. Medial space appearing as a lighter longitudinal line between anterior, posterior and apical infuscate areas of disc.

Body length. 503µm (378-594, n=8, from critical point dried specimens).

Head. Width 172 (145-198, n=7). Occipital suture straight (as in Fig. 30). Ocellar setae at least half as long as distance between posterior ocelli (distinctly longer than diameter of anterior ocellus).

Antenna. Scape with ventral margin slightly, evenly convex, and inner surface with faint curved oblique striations, some with slight thickenings medially. Fl_5 and Fl_6 each with 2 longitudinal sensilla (Fig. 7); Fl_3 with 2 longitudinal sensilla in most specimens but one specimen with only 1 longitudinal sensillum on one antenna and 2 longitudinal sensilla on the other; Fl_4 either without or with 2 longitudinal sensilla. The holotype has 1 longitudinal sensillum on one antenna and none on the other. Measurements are given in Table XVII.

Mesosoma. Pronotum and mesonotum with conspicuous, long and erect setae (Fig. 41).

Wings. Forewing length 632µm (472-838, n=13), width 67 (55-100), FWL/FWW 9.21 (8.37-10.04), LMC 133 (93-172), their length about twice forewing width; marginal space 106

(67-167), medial space long and narrow, somewhat rectangular and extending medially about halfway along wing, cubital line of setae uniformly close to posterior margin. Hind wing length 613 (467-793, n=13), width 22 (16-29, n=14), with 6-8 microtrichia medially on blade in apical half, LMC 108 (87-135).

Legs. Foretibia with about 4-7 sensilla chaetica. Hind tarsomere 1 1.05 (1.00-1.08, n=3) times as long as tarsomere 2.

Metasoma. Ovipositor length 270 (212-344, n=11), 1.31 (1.05-1.43, n=11) times length of hind tibia, extending under mesosoma to base of mesocoxa (Fig. 41).

Male. Total length of flagellum 803. Length of antennal segments (n=1, specimen from Ithaca, NY, on *Lemna*): scape (not measureable), pedicel 41, Fl_1 5, Fl_2 79, Fl_3 81, Fl_4 81, Fl_5 83, Fl_6 82, Fl_7 76, Fl_8 78, Fl_9 82, Fl_{10} 80, Fl_{11} 82. Fl_6 length/width ratio averaging 4.32, with 5 longitudinal sensilla.

Variation. *Anaphes gerrisophaga* appears to be quite variable in size. Small specimens have no longitudinal sensilla on Fl_4 and the length/width ratio of Fl_2 can be small compared to that of large specimens. Although only two host species are known, other host eggs of varying sizes are likely parasitized as well, which would account for the size variation. Some of the numerous other insects, especially Coleoptera, and Diptera, and other Hemiptera associated with *Lemna* (Scotland 1939, 1940) are likely hosts and perhaps a variety of Odonata (Zygoptera) are as well. A complex of species may be involved, all collected near or on water and on different hosts. Because the kind of flagellomere variation that occurs among these specimens is similar to that found in *A. pallipes* (large specimens have longitudinal sensilla on Fl_4, small ones do not, and somewhat intermediate conditions occur), I prefer to treat them all as one species until crossing experiments with specimens reared from different hosts show otherwise.

Distribution. Canada (MB, ON, QC), USA (CA, MD, NY, VT). Probably widespread in the Nearctic region wherever water and host eggs occur. Specimens examined were mostly collected near or on water using yellow pan traps placed at the water's edge or on rocks emerging from the water. Specimens with narrow wings that might be referrable to *A. gerrisophaga* were seen from Hawaii (2♀♀, UCRC) and the Northwest Territories (1♀, UCRC). More material (for slide mounting) is needed from these areas to determine their identities more reliably.

Material examined. 24♀♀ and 1♂ (15 on slides). **CANADA. Manitoba:** 2 mi. E. Elma on hwy. 11, 31.vii.2000. M. Iranpour, pond (2♀♀, CNCI); hwy. 12, Piney, 11.viii.2000, M. Iranpour, ditch (3♀♀, CNCI). **Ontario:** Carlsbad Springs, Mer Bleue bog, 12.vii.1980, 14-23.vi.1982, A. Davies (3♀♀, CNCI); 2 km SE. Innisville, 45°13'N 76°115'E, 5-12 ♀ 12-19.vi.1991, L. Masner, J. Denis, aquatic pan trap (2♀♀, CNCI); London, 24-27.vii.1981, A. Tomlin (1♀, CNCI); Nepean, Jock River at hwy. 16, 9-10.viii ♀ 23-24.ix.1999, L. Masner, YPT on boulders in river (2♀♀, CNCI); Oxford Mills, 22-29.vi, 36.vii, 13-20.vii, 27.vii, 24-31.viii, 21-28.ix, 28.ix-12.x.1973, L. Masner (38♀♀, 3♂♂, CNCI); St. Lawrence Is. Nat. Park, Genadier I., 11.vi.1975, in marsh under *Salix* (1♀, CNCI); **Quebec.** Bouchette area, Gatineau River, 18-19.ix.1999 (2♀♀, CNCI); Ancienne Lorette, aviation field [near Quebec City], coll. 13.ix.1973, em. 19.ix.1973, and coll. 1.x.1971, em. 4, 10 ♀ 22.x.1971, ex. *Lestes disjunctus* in *Eleocharis obtusa*, J.-P. Laplante (5♀♀, 2♂♂, CNCI); Gatineau Park, sweeping along parkway, 13.vi.1980, L.& R. Masner (1♀, CNCI); Lac Roddick outlet, 6 km N. Bouchette, 9-10.ix.2000, L. Masner (2♀♀, CNCI); Ste. Foy, host egg coll. 7.ix.1971, em. 10.ix.1971, ex. *Lestes disjunctus* in *Eleocharis obtusa*, J.-P. Laplante (1♀, CNCI); **USA. Maryland.** Prince Georges Co.: Laurel, Patuxent Wildlife Research Center, 6-13.vii.1979, Malaise trap on powerline cut, M. Schauff (3♀♀, USNM). **New York.** Tompkins Co., Ithaca, viii.1938 ♀ summer, 1939 M.B. Scotland, on *Lemna* (5♀♀, 1♂, USNM). **Vermont.** Rutland Co., Danby, 3 mi. E. Green Mtn. National Forest, 31.vii.1979, M. Schauff & E. Grissell (3♀♀, USNM).

Hosts and Biology. The only host records are for the holotype from an egg of *Gerris* sp. (Gerridae), and a series from *Lestes* (Lestidae) eggs in *Eleocharis obtusa.*

Comments. The forewings of the holotype are not positioned flat, hence appear to be slightly narrower than they actually are, which explains the unusually high length/width ratio for the holotype (Table I). The paratype, collected on a window pane, is not conspecific with the holotype and is therefore excluded from the redescription given above.

Some specimens (USNM) identified as *A. pullicrurus* by A. Gahan and H. Dozier fit *A. gerrisophaga* better. These include the series reared at Ithaca from *Lemna* by M. Scotland and a male from Muncie, IL, collected by Dozier. The Dozier male is much larger than the single male reared by Scotland and the thoracic setae are relatively shorter (the ocellar setae are not clearly visible). Otherwise it seems to fit *A. gerrisophaga* better than *A. pullicrurus* because FWL/FWW is 8.83, closer to the ratio for the male reared from an unknown host in *Lemna*, which is 9.38.

Anaphes listronoti Huber

(Figs. 8, 23, 42)

Anaphes n.sp.; Boivin 1994: 233 (cold hardiness).

Anaphes listronoti (nomen nudum); Cormier *et al.*, 1996: 1376 (seasonal ecology, distribution);

Anaphes listronoti Huber *et al.*, 1997: 963 (original description); van Baaren *et al.*, 1997: 189 (description of first instar larva); Vigneault *et al.*, 1997: 548 (olfactometry); van Baaren and Boivin, 1998a: 525 (mention); Cormier *et al.*, 1998: 1596 (sexual pheromone emission); van Baaren and Boivin, 1998b: 9 (host discrimmination behavior); van Baaren *et al.*, 1999: 1 (antennal sensilla); Boivin and van Baaren, 2000: 471 (larval agression and mobility); Brodeur and Boivin, 2004:34 (mention).

Since Huber *et al.* (1997) described *A. listronoti*, several additional papers on this species were published, making it biologically one of the best known mymarids. These papers are listed above, together with a few that were incompletely cited or missed previously.

Type material. HOLOTYPE ♀ (CNCI), examined (see Huber *et al.* 1997), from CANADA: Quebec, Ste. Clotilde.

Diagnosis. Occipital suture straight (as in Fig. 30), ovipositor extending well under gaster (Fig. 42), forewing (Fig. 23) with posterior margin narrowly brown at least distally, Fl_2 (Fig. 8) with 1 or 2 longitudinal sensilla, gregarious in eggs of *Listronotus oregonensis.* Morphologically, *A. listronoti* is apparently indistinguishable from *A. sordidatus.* Biologically, the species can be distinguished because *A. sordidatus* is a solitary parasitoid in *Tyloderma foveolatum* and will not cross with *A. sordidatus* in the laboratory.

Statistics of the antennal segments are given in Table XVIII to complement the description in Huber *et al.* (1997) and for comparison with the antennal descriptions of the other species redescribed here. Since the original description, two new morphological features have been found to separate *A. listronoti* from *A. victus. Anaphes listronoti* females have 6-9 sensilla chaetica type 4 on the clava compared with 10-12 on the clava of *A. victus* (van Baaren *et al.* 1999). Unfortunately, these are not clearly visible on dried or slide-mounted specimens so the feature cannot be used for routine determination. The first instar mymariform larvae of *A. listronoti* show no visible segmentation in contrast to those of *A. victus*, which are clearly segmented (van Baaren *et al.* 1997).

Distribution. Canada (ON, QC), ?USA (MI).

Anaphes longiclava (Doutt)

(Figs. 9, 24, 43)

Anaphoidea longiclava Doutt, 1949: 158 (original description).

Patasson longiclava; Burks, 1958: 63 (catalog); Peck, 1963: 34 (catalog); Burks, 1979: 1030 (catalog).

Anaphes longiclava; Schauff, 1984b: 216 (comparison with *diana*).

Anaphes longiclavus; Huber, 1992: 74 (list, incorrect species spelling).

Type material. HOLOTYPE ♀ (EMEC), examined. On slide labelled: 1. "by sweeping native vegetation Morgan Hill, Calif. July 2, 1947 R.L. Doutt". 2. "*Anaphoidea longiclava* Doutt ♀ Type" (red label). The type is in rather poor condition with body mounted laterally, head detached and mounted vertically, left eye torn away from vertex which, together with occiput, is slightly torn, left antenna and right antenna beyond pedicel broken off and positioned elsewhere on slide, and both forewings, right hind wing and left foreleg detached and positioned elsewhere on slide. Its measurements are given in Table I. PARATYPE ♀ (EMEC) labelled 1. "by sweeping Salix Rio Nido, Calif. May 28, 1947 R.L. Doutt". 2."*Anaphoidea longiclava* Doutt ♀ Paratype" (yellow label). The head with one antenna and body were remounted under two 6-mm coverships on the original slide after clearing in KOH.

Diagnosis. Occipital suture straight (as in Fig. 30), ovipositor longer than metatibia and extending under mesosoma to base of mesocoxae (Fig. 43), Fl_2 without longitudinal sensilla (Fig. 9), hind leg with tarsomere 1 slightly shorter than tarsomere 2, FWL/FWW at most 5.4 (4.6 in holotype); body length 413.

The small body size and relatively broader forewing distinguish *A. longiclava* from *A. luna* and *A. diana*. *Anaphes longiclava* is the smallest described native Nearctic species of the genus, only slightly larger than the introduced *A. diana* and equal to exceptionally small specimens of *A. luna*.

Description. Female. *Colour.* (From uncleared type slides). Brown with antennae and legs, especially tarsi lighter. The holotype is generally lighter in colour than the paratype. Forewing (Fig. 24) with a narrow brown margin in half of posterior margin.

Body length. 413μm (holotype).

Head. Width 188 (n=1). Occipital suture straight (as in Fig. 30). Ocellar setae as long as about half diameter of anterior ocellus.

Antenna. Scape with ventral margin moderately rounded, with extremely faint oblique striations on inner surface. Fl_3, Fl_5 and Fl_6 each with 2 longitudinal sensilla, Fl_4 with 1 longitudinal sensillum (Fig. 9). Fl_1 with base slightly narrower than apex. Measurement are given in Table XIX.

Mesosoma. Pronotum and mesonotum with moderately long setae.

Wings. Forewing length 533 (n=1), width 115, FWL/FWW 4.63, LMC 149, their length about 1.3 times forewing width; marginal space 97, medial space triangular, cubital line of setae closest to posterior margin near the retinacular seta and further away distally, with a gap of about one setal length between the cubital line and posterior margin of wing. Hind wing length 500 (n=1), width 23, with 3 microtrichia medially on blade in apical half, LMC 178.

Legs. Foretibia with 8 sensilla chaetica. Hind tarsomere 1 slightly shorter than tarsomere 2 (Table I).
Metasoma. Ovipositor length (n=1) 1.14 times length of hind tibia, extending slightly under mesosoma to level of base of mesocoxa (Fig. 43).
Male. Unknown.
Distribution. USA (CA).
Material Examined. Only the two type specimens were examined.
Hosts and Biology. Unknown. The holotype was collected by sweeping native vegetation and the single paratype by sweeping *Salix.*
Comments. The wing proportions of the holotype and paratype of *A. longiclava* are quite different (FWL/FWW 4.63 and 5.32, respectively) and I am not sure if they belong to the same species. In the absence of a series of specimens variation cannot be adequately assessed.
Specimens of an *Anaphes* sp. (in CNCI) similar in body length to *A. longiclava* were reared from *Tanysphyrus lemnae* (Fabricius) (Curculionidae) in Florida. They have a body length of about 310µm, a small Fl_4 without longitudinal sensilla, and the ovipositor up to 1.7 times as long as the hind tibia. They may be *A. longiclava* but until specimens are reared from *T. lemnae* from California and more specimens are reared from this host in Florida and elsewhere to determine variation and geographic distribution more completely I hesitate to name the Florida specimens as *A. longiclava.* Otherwise, a host would now be known for *A. longiclava.*

Anaphes luna (Girault)

(Figs. 10, 25, 34, 44)

Anaphoidea luna Girault, 1914a: 87 (nomen nudum, host); Girault, 1914b: 109 (original description); Silvestri, 1915: 80 (egg morphology and development); [Girault,] 1916: 40 (host); Chamberlin, 1924a: 3 (original releases in North America); Chamberlin, 1924b: 627 (oviposition, distribution); Howard, 1927: 14 (further importations from Europe); Girault, 1929: 12 (synonymy under *conotracheli*); Essig and Michelbacher, 1933: 69 (hosts, introduction into USA); Kaufmann, 1939: 421 (German record); Clausen, 1940: 102 (host, egg parasitism); Kaufmann, 1941a: 110 (hosts); Kaufmann, 1941b: 83 (host); Hamlin *et al.*, 1949: 58 (liberation and first recovery); Doutt, 1949: 160 (citation of previous synonym); Clausen, 1956: 116 (importation, parasitism rate); Tooke, 1955: 103 (1 larval instar according to Silvestri); Baccetti, 1957: 110 (hosts, oviposition); Baccetti, 1958: 197 (host); Thompson, 1958: 569 (host); Nasr, 1998: 17 (life cycle abstract).

Anaphes luna; Gould, 1986 (biology); Huber, 1986: 197 (biocontrol mention); Pagliano and Navone, 1995: 35 (Italian checklist); Radcliffe and Flanders, 1998: 233 (parasitism rate, distribution).

Anaphes (*Patasson*) *luna*; Viggiani, 1994: 474 (male genitalia).

Patasson luna; Peck, 1963: 32 (?separate from *conotracheli*); Shaw and Ziener, 1964: 138 (reared in western Massachusetts); Shaw and Miller, 1965: 1131 (reared in western Massachussetts); Streams and Fuester, 1966: 331 (abundance, survival); Burks, 1967: 214 (removal from synonymy under *conotracheli*); Brunson and Coles, 1968: 6 (percent parasitism, release in Utah); Petty, 1968: 129 (first rearing in Illinois); Mailloux and Pillon, 1970: 607 (recovery in Quebec); Miller, 1970: 440 (mention); Niemczyk and Flessel, 1970: 247 (parasitism rate); Miller and Guppy, 1972: 45 (rearing record: Harrow, ON); Ellis, 1973: 1060 (parasitism rate); Aeschlimann, 1975: 407 (biological control mention); Dysart and Day, 1976: 2 (introduction history, distribution, parasitism rate); Harcourt *et al.*, 1977: 1522 (parasitism rate); Clausen, 1978: 267 (importation, release, life cycle); Hopkins, 1978b: 5 (summary of recoveries by state, parasitism rate); Burks, 1979: 1030 (catalog); Schaber, 1981: 169 (Alberta record); Collins and Grafius, 1983: 1 (host); Day, 1983: 41 (biology); Hogg and Kingsley, 1983: 54 (parasitism rate); Bryan *et al.*, 1993: 26, 35 (distribution map, summary of establishment).

Mymar luna; Poinar and Gyrisco, 1963: 534 (parasite emergence from egg); El M'Sadda, 1967: 13 (parasitism rate); Niemczyk and Flessel, 1970: 247 (parasitism rate).

Type material. LECTOTYPE ♀ (USNM), here designated. On slide labelled: 1."*Anaphoidea luna* Gir. Types and Paratypes Type No. 15452 U.S.N.M. [red label]". 2."6655 Mymarid Parasite of *Phytonomus* (from shipment from Italy by Fiske) Salt Lake City Apr. 8 1911. T. H. Parks". The lectotype is uncleared and mounted in lateral view at the edge of the coverslip and ringed by a faint blue line. The head is collapsed but otherwise in good condition. Measurements are given in Table I. *A lectotype* is designated to fix the name by eliminating the possibility of confusion with similar species and because the original introduction of *A. luna* probably included more than one species. PARALECTOTYPES. Two females and three males on same slide as lectotype, all uncleared, intact, and mounted in lateral view near the edge of the coverslip.

Diagnosis. Fl_2 without longitudinal sensilla. FWL/FWW less than 6.5. Ovipositor length 285 (252-335, n=6), extending under mesosoma only to about apex of mesocoxa. Body length about 413-603. The only described Nearctic species that has this combination of features is *A. longiclava*, a much smaller species that could only be confused with very small specimens of *A. luna.*

This species is diagnosed (and redescribed) only from the specimens introduced in 1911 to avoid the problem of antennal variation (discussed below). Even so, it is difficult to diagnose *A. luna* because it has no remarkable features and seems to be quite variable. Specimens introduced from Europe in 1926 and those reared from *Hypera postica* in North America after that date may or may not be the same and are discussed below.

Description. Female. *Colour* (from uncleared slides). Dark brown with antennae and legs beyond coxae lighter. Forewing (Fig. 25) narrowly brown along posterior margin but lighter than along anterior margin. Girault (1914b) described the species as "black, the scape, pedicel and proximal three tarsal joints dusky lemon yellow, the trochanters and knees [i.e., junction of femora and tibiae] pallid . . . cephalic tibiae lighter".

Body length. 501 (≈413-603, n=10, from slide-mounted specimens). Body length is based on the original series from Portici and Salt Lake City (collected in 1911).

Head. Width 203 (n=1). Occipital suture straight (as in Fig. 30). Ocellar setae a little shorter than diameter of anterior ocellus.

Antenna. Scape with inner surface with very faint oblique striations. For specimens from original 1911 introduction, Fl_3, Fl_5 and Fl_6 each with 2 longitudinal sensilla (Fig. 10); Fl_4 with 0-2 longitudinal sensilla. For specimens collected in North America since 1926 introductions, Fl_2, Fl_3, Fl_5 and Fl_6 each with 2 longitudinal sensilla (Fig. 10); Fl_4 usually with 2 longitudinal sensilla on each antenna, rarely with 2 and 1, 1 and 1, 1 and 0, or even 0 and 0 longitudinal sensilla. Measurements are given in Table XX (specimens from original introduction into North America) and Table XXI (specimens reared from field-collected *Hypera postica* in North America).

Mesosoma. Pronotum and mesonotum with short, inconspicuous setae.
Wings. Forewing length 652 (536-780, n=7), width 102 (85-137), FWL/FWW 6.40 (5.70-7.13), LMC 141 (123-161), their length about 1.4 times forewing width; marginal space 100 (72-124), medial space triangular, cubital line of setae uniformly close to posterior margin with a gap of about half a setal length between the cubital line and posterior margin of wing. Hind wing length 623 (531-750, n=7), width 28 (24-34), with 0-12 microtrichia medially on blade in apical half, LMC 115 (105-130).
Legs. Foretibia with 9-11 sensilla chaetica. Hind tarsomere 1 0.92 (0.86-0.98, n=2) times as long as tarsomere 2 (Table I).
Metasoma. Ovipositor length 285 (252-335, n=6), 1.38 (1.25-1.50) times as long as hind tibia, and extending under mesosoma at least to apex of mesocoxa or as far forward as middle of forecoxa (Fig. 44).
Male. Total length of flagellum (n=3) 206 (175-232). Length of antennal segments (n=2 to 5): scape 101 (100-103), pedicel 43 (41-44), Fl_1 5 (4-6), Fl_2 61 (56-65), Fl_3 65 (56-76), Fl_4 64 (47-69), Fl_5 65 (49-72), Fl_6 64 (55-72), Fl_7 63 (53-68), Fl_8 64 (51-71), Fl_9 64 (50-71), Fl_{10} 61 (50-68), Fl_{11} 63 (55-67). Fl_6 length/width ratio averaging 3.12 (2.69-3.58), with 4 (?5) longitudinal sensilla.
Variation. *Anaphes luna* is either a single very variable species or a complex of species. If it is a complex, many of the papers citing the name *luna* may not actually apply to *A. luna* (as described above, based on the type specimens). For example, vouchers of *A. luna* from the Ph.D. study by Gould (1986) may represent a different species. The Gould specimens differ from the type series in that Fl_2 bears 1 or 2 longitudinal sensilla on each funicle, as in *A. victus*, *A. sordidatus* and *A. listronoti*. Alternately, *A. luna* may simply be a very variable species, especially in the number and position of longitudinal sensilla on Fl_2 and Fl_4. Evidence for this is provided by specimens examined from material collected since 1958 in the northeastern US and Canada. Among these, some specimens also had 2 longitudinal sensilla on Fl_2 but every combination was found at least once, i.e. 2/1, 2/0, 1/1, 1/0, 0/0. Similarly, most specimens had 2 longitudinal sensilla on Fl_4 of each antenna but the various combinations (except 2/0) were found in at least one individual. Such variation may occur at the same place and time. A slide with five females and a male reared on 19.v.1973 at Ithaca, NY, shows considerable variation in antennal sensilla, with Fl_2 bearing 0/0, 1/0, or 1/2 longitudinal sensilla and Fl_4 bearing 0/1, 1/1, or 2/2 longitudinal sensilla. Specimens reared from alfalfa in Europe also show such variation, e.g., two slides of *A. luna* bearing six uncleared females from Arles, France, 6.i.1966 and ii.1966, alfalfa stems, F. Gruber (USNM). Two of the specimens have Fl_2 bearing 2/1 longitudinal sensilla, two have 0/0 longitudinal sensilla and two have 1/0 longitudinal sensilla. All but one of the specimens collected in February have 2/2 longitudinal sensilla of Fl_4 and the one collected on 6.i has 2/1 longitudinal sensilla. The specimens were not reared from known host eggs so the possibility exists that the six specimens emerged from different hosts in the alfalfa stems, which may account for the differences in antennal morphology. However, it is more likely that all the specimens emerged from alfalfa weevil eggs.
Crossing experiments need to be made between *A. luna* reared from alfalfa weevil and *A. victus* and *A. listronoti* reared from carrot weevil and *A. sordidatus* reared from *Tyloderma foveolatum* to see if they are conspecific or if they are biologically distinct. Possibly, one of the species (probably *A. victus*, which has a similar ovipositor length and is solitary) described by Huber *et al.* (1997) is a synonym of *A. luna*. It would also be interesting to cross *A. luna* reared from

H. postica with specimens reared from *H. eximia* on *Rumex* to confirm that they are the same species. I am not completely certain that they are.

Distribution. Europe, Canada (AB, ON, PE), USA (DE, IL, IN, MD, MI, MO, NJ, NY, UT, WV, WI). In 1928, when *A. fuscipennis* (as *A. pratensis*) was shipped from Utah to Indiana the shipment may have included some *A. luna*. Since then, *A. luna* has apparently become widely distributed in the northeast and north central USA (Radcliffe and Flanders 1998). Dysart and Day (1976) provided a detailed map of county localities. Bryan *et al.* (1993) stated that *A. luna* had not been redistributed but that it was well established in the USA and Canada.

Material examined. 133 ♀♀ and 50 ♂♂ (142 on slides) in USNM unless otherwise indicated. All *crassicornis*-group specimens reared from *Hypera postica* in North America are included here though possible they represent a complex of species, as discussed above. **CANADA. Alberta.** Lethbridge, 10.v.1978, B.D. Schaber (1♀, CNCI). **Ontario.** Ottawa, 22.vi.1970 (1♂, CNCI). **Prince Edward Island.** South Bay, 22.vii.1971 (1♀, 2♂, CNCI). **USA. Delaware.** New Castle Co.: New Castle, 20.ii.1961, A.H. Mason (1♀). **Illinois.** Crawford Co.: Trimble, 28.xii.1967, J. deWitt (1♀, 1♂); De Kalb Co.: De Kalb, vii.1968, J.B. Litsinger (7♀, 2♂); Mason Co.: near Havana, 4.vi.1974, D. Oldfield, ex. *Bathyplectes curculionis* (1♀, 2♂). **Indiana.** LaGrange Co.: Howe, 23.iv.1981, Chmiel (2♀); Tippecanoe Co.: West Lafayette, Purdue University, 15.x.1967, culture, R.C. Anderson (4♀, 3♂). **Maryland.** Beltsville, 11.vi.1962, J. Huggens (4♀, 1♂). **Michigan.** Ingham Co.: near East Lansing, 7.vii.1970, R.A. Casagrande (8♀, 2♂). Missouri. Cooper Co.: Bel Air, 4.v.2000, ex. *Hypera eximia* on pale dock, B. Puttler (3♀, 1♂, CNCI). New Jersey. Warren Co.: Hainsburg, spring 1963, D.R. Barnes (4♀, 1♂). **New York.** Dutchess Co.: Fishkill, 19.v. and vi.1959, S. Poinar (6♀, 1♂). Tompkins.: Ithaca, 19.v.1973, R. van Driesch (5♀, 1♂); Myers, 9.vii.1958, G. Poinar (1♀, 1♂). **Utah.** Cache Co.: Logan, vii.1972, D.W. Davis (8♀, 1♂); Salt Lake Co.: Salt Lake City, 3.iv.1911, from Portici, Italy, W.J. Fiske (Wesbster No. 6655) (3♀, 1♂), 6.iii.1911, hatching from *Phytonomus* [=*Hypera*] eggs, T.H. Parks (2♀, 1♂, 1 unknown sex); same locality except no date, T.H. Parks (1♀, 1♂); same locality, 12.vi.1911, T.H. Parks, on *Phytonomus* reared through Utah eggs (7♀, 4♂, 1 adult in egg). **West Virginia.** Preston Co.: 21.xi.1968, C.K. Dorsay (10♀, 2♂), iii.1969, J.E. Weaver (23♀, 8♂). **Wisconsin.** Columbia Co.: Arlington, 19.v.1969, D. Litsinger (9♀, 1♂); Dane Co.: Madison, ex. lab. culture, spring, 1985, W. Gould (27♀, 10♂, CNCI); Green Co.: Jefferson Township, 15.v.1980, D.B. Hogg (5♀, ?7♂).

Hosts and Biology. Curculionidae are the only confirmed hosts and include in North America the alfalfa weevil, *Hypera postica* (Gyllenhal) on alfalfa and *H. eximia* (LeConte) on pale dock (*Rumex ?orbiculatus* Gray), and in Europe and North Africa the Egyptian alfalfa weevil, *H. brunneipennis* (Boheman), *H. trilineata* Marsham, possibly *H. punctata* (Fabricius), *H. variabilis* Herbst (Kaufmann 1941a), *H. zoilus* Scopoli (Baccetti 1957), and *Hypera* [as *Donus*] *crinitus* (Boheman). Baccetti (1958) was uncertain if the species he reared from *H. crinitus* was *A. luna*. One of the slides, bearing the number 6655 with specimens reared in Salt Lake City has host eggs labelled as *Phytonomus* [= *Hypera*] *murinus* F., which does not occur in N. America. The specimens from near Havana, IL, supposedly reared from *Bathyplectes curculionis* (Thomson) (Ichneumonidae) clearly are incorrectly associated with this host. They must have been reared from eggs of *Hypera postica*. Three slides of *Anaphes*, labelled s.l. # 3007, reared from *Hypera punctata* by Chamberlin, do not appear to be *A. luna*, which places doubt on Kaufmann's (1941a, b) host record from Europe.

Dysart and Day (1976) and Clausen (1978) summarized the biology of *A. luna*. Clausen (1940) noted that in fresh alfalfa only eggs near the oviposition puncture can be reached for parasitism, but the female wasp can enter dry stems so the entire egg mass is then susceptible to parasitism. At least two generations per year occur. Females lay one or two eggs inside a host egg and egg parasitism seldom exceeds 5% both in Europe (e.g., El M'Sadda 1967) and North America (Radcliffe and Flanders 1998), though Brunson and Coles (1968) reported 10% parasitism. Nasr (1998) provided an abstract of the life cycle of *A. luna* from *H. brunneipennis* in Egypt. A series of slides each labelled "ex. egg *Hypera postica*" (Jefferson Township, Green Co., WI) and each with either one female or one male specimen of *A. luna* seems to confirm Clausen's (1978) statement that the species is solitary. But six slides each labelled "ex. alfalfa weevil egg" (Preston Co., WV), have five specimens per slide, and one has six specimens. Each of these slides has one or two males and the remainder are females. The species (if it is indeed the same species – I cannot tell, based on morphology) may therefore sometimes be gregarious (or else two species are involved).

Introductions into North America. The original releases of at least 1740 adults of *A. luna* from Italy were made near Salt Lake City from 1911-13 but the releases failed to become established (Chamberlin 1924a). New importations and releases were made from 1925-1928 (Brunson and Coles 1968) and included both *A. luna* and *A. fuscipennis* (as *A. pratensis*). According to Hamlin *et al.* (1949), the two species were released together because they could not be distinguished when alive. The first recovery was in 1926, but of *A. fuscipennis* not *A. luna*, which apparently failed to become established. In addition to the type slide, five slides of specimens in the USNM with the same catalog number (Webster No. 6655) as the type slide were examined. Four are dated 1911 (3 April to 12 June, depending on slide) and one has no date. The specimens on these slides are evidently from the original introduction of *A. luna* into North America but do not form part of the type series. They are important because they contain three species, presumably all from material obtained originally from Portici, Italy. The undated slide bears one female of *A. fuscipennis* as well as a male and female of *A. luna*. The slide dated 3 April bears two females and two males of *A. luna*, and one female of a small specimen with ovipositor extending almost to the head and Fl_1-Fl_3 without longitudinal sensilla. It is very poorly oriented and its identity is unknown but it is very likely not a specimen of *A. luna*. Another set of releases was made from 1925-1928, again from material from Italy. Five slides of voucher specimens (USNM) from the 1925-1928 introductions, labelled S.L. Sta. [St. Louis Station] #3007 and dated either 14 or 24 May, 1926, were examined. Three of these slides bear specimens reared from *Hypera punctata*. These appear not to be *A. luna* but key instead to a species close to *A. leptoceras* Debauche in Debauche (1948). The remaining two slides, labelled as "ex.stems alfalfa" contain *A. luna*. In 1933-34, *A. luna* from France was released in California. According to Dysart and Day (1976), *A. luna* was apparently mixed with *A. fuscipennis* (as *A. pratensis*) in all these introductions, so its early spread cannot be accurately assessed. If the specimens on these two sets of slides are representative of what was released in North America in 1911-1913 and 1925-1928 then at least two more species besides *A. fuscipennis* and *A. luna* may have become established on alfalfa weevil in North America. If so, that may account for the considerable variation seen in *A. luna* (see Variation, above).

Fischer *et al.* (1961), van den Bosch (1964), Clancy (1969), and Clausen (1978) refer to a *Patasson* sp. reared from *Hypera brunneipennis* (Boheman) in Iran and Egypt that was released in California but apparently, and from a taxonomic viewpoint, luckily, did not become established.

Perhaps the species they referred to is the same as *A. luna* but I have not seen voucher specimens to verify this. In retrospect, it is impossible to know exactly how many species ultimately became established in North America from shipments originating from the Old World.

Biological control. Many of the numerous references on *A. luna* mention this species in connection with biological control of the alfalfa weevil. Although *A. luna* had a relatively small role in the successful control of alfalfa weevil in northeastern North America, it nevertheless contributed, and still contributes, to the overall reduction in damage by this pest. Continued search for races of *A. luna*, or very similar species of *Anaphes* that are more adapted to the drier conditions of the southern USA where alfalfa weevil or Egyptian alfalfa weevil are still important pests, may result in further introductions of *Anaphes* species. *Anaphes luna* has been recorded from Egypt (Nasr 1998) and Sicily (Pagliano and Navone 1995), both Mediterranean areas, so a suitable race or species for successful introduction into southern USA must exist. If further introductions of *Anaphes* spp. are made, it is essential, from a taxonomic viewpoint, that sufficient voucher specimens (at least 10 males and 10 females, killed directly in at least 70% ethanol) be preserved in major institutions for species confirmation. The doubt surrounding the identity of *A. luna* because of the release of a mixture of two or more species during the first half of the 1900's, poor identifications, and too few, poor quality, voucher specimens should not be repeated.

Comments. Girault (1929) incorrectly synonymized *A. luna* under *A. conotracheli*. Doutt (1949) accepted Girault's (1929) synonymy and therefore did not include *A. luna* as a separate species in his key to North American species. Poinar and Gyrisco (1963), El M'Sadda (1967) and Collins and Grafius (1983) also mistakenly treated the two names as synonyms, presumably following Girault. Peck (1951) classified *A. luna* under *A. conotracheli* but then (Peck 1963) noted that it should perhaps be regarded as a distinct species. Burks (1967) correctly removed it from synonymy after examining the types.

At least one other species of *Anaphes* (belonging to the *fuscipennis* species group) was reared from alfalfa weevil (Indiana, Harrison Co. 20.ii.1967, R.C. Anderson, 1♀ and 1♂ on slide, USNM). This species appears to be undescribed and is likely to be found normally on a host other than alfalfa weevil or it may be rare.

Anaphes pallipes **(Ashmead)**

(Figs. 12, 26, 31, 45)

Alaptus pallipes Ashmead, 1887: 193 (original description); Girault, 1908: 186 (description quoted); Girault, 1910: 243 (removal from *Alaptus*).

Anaphes pallipes; Girault, 1911c: 186 (mention); Girault, 1911e: 278 (redescription); Girault, 1929: 13 (key); Burks, 1979: 1029 (catalog); Huber and Rajakulendran, 1988: 899 (correction of Girault misidentification).

Mymar pallipes; Peck, 1951: 416 (catalog); Peck, 1963: 40 (catalog).

Anaphoidea conotracheli; Porter and Alden, 1921: 62 (emergence, parasitism rate, host), Porter, 1928: 28 (parasitism rate). Misidentification.

Anaphes conotracheli; Porter, 1922: 165 (percent parasitism); Schauff, 1984a: 48 (host). Misidentification.

Type material. HOLOTYPE ♀ (USNM), examined. Originally mounted in balsam under one coverslip on slide labelled: 1. "*Alaptus* 13807 [pencil] *pallipes* Ashm. Jacksonville, Fla Type". 2."

(Alaptus) *Anaphes pallipes* Ashm. ♀ Type No. 13807 U.S.N.M. [red label]". The holotype was in poor condition, uncleared and mounted laterally with face head up (Fig.45). One forewing was detached and obliquely positioned at some distance from body. The remaining wings, clava of left antenna, Fl_6 and clava of right antenna, tarsus of right foreleg and left middle leg, trochanter of right middle leg, and right hind leg were missing. I successfully removed the specimen from the original slide, cleared it in KOH and remounted it under two coverslips so that critical diagnostic features could be observed. Measurements are given in Table I.

Ashmead (1887) miscounted the antennal segments on the holotype, evidently not realizing that the clava from each antenna was missing. He mistook the last flagellar segment for a clava and therefore counted only five flagellomeres. This explains why he placed the species in *Alaptus*. Because of his mistake his description of the antenna is inaccurate and misleading.

Diagnosis. Occipital suture short and oblique, pointing ventromedially towards occipital foramen (Fig. 31). Inner surface of scape and pedicel with distinct, oblique cross striations. Flagellum with longitudinal sensilla on Fl_3, Fl_5 and Fl_6 but none on Fl_4, which is consequently shorter and narrower (Fig. 45). Two specimens from Zilker Park have only 1 (0?) longitutinal sensillum on Fl_3 and Fl_6 of at least one flagellum (Fig. 12). The only described Nearctic species that could be confused with *A. pallipes* is *A. conotracheli*. Specimens of *A. pallipes* are smaller than *A. conotracheli* in all measurements, probably due to the smaller host from which they have been reared. As mentioned under *A. conotracheli*, the species are probably the same. Because of the considerable literature on *A. conotracheli* I do not synonymize it under *A. pallipes* until crossing experiments or molecular data can confirm their conspecificity.

Description. Female. *Colour* (from critical point dried specimens). Body brown; legs almost white except for coxae, femora medially, and tarsomere 4 which are light brown. Forewing (Fig. 26) with posterior margin clear to apex of wing or at least distinctly lighter brown than anterior margin, except for a short brown section subapically.

Body length. 433µm (396-515, n=9, from critical point dried specimens).

Head. Width 180 (167-199, n=8). Occipital suture short, angled inwards towards dorsal margin of occipital foramen (Fig. 31).

Antenna. Inner surface of scape with distinct cross striations almost at right angles to length of scape. Fl_5, Fl_6 and usually Fl_3 each with 2 longitudinal sensilla (Fig. 12, 45). Measurements given in Table XXII.

Mesosoma. Pronotum and mesonotum with short, inconspicuous setae.

Wings. Forewing length 508 (442-559, n=10), width 106 (88-128), FWL/FWW 4.71 (4.34-5.27), LMC 120 (90-128); marginal space 88 (71-104), medial space triangular, cubital line of setae closest to posterior margin just beyond retinaculum, then diverging so posterior row of setae about one setal length from posterior margin. Hind wing length 496 (428-552, n=11), 23 (20-27), without microtrichia (one specimen with 1 microtrichia) medially on blade in apical half, LMC 92 (85-102).

Legs. Foretibia with 7 or 8 sensilla chaetica. Hind tarsomere 1 0.71 times length of tarsomere 2 (0.67-0.75, n=3).

Metasoma. Ovipositor length 307 (269-347, n=9), 2.0 (1.9-2.1) times as long as hind tibia, extending under mesosoma at least as far as apex of forecoxa (Fig. 45).

Male. Total length of flagellum 576 (546-609, n=4). Length of antennal segments (n=2 to 6):

scape 72 (69-75), pedicel 39 (38-43), Fl_1 6 (6-8), Fl_2 52 (46-56), Fl_3 55 (48-60), Fl_4 53 (45-60), Fl_5 55 (51-60), Fl_6 56 (47-61), Fl_7 56 (46-61), Fl_8 58 (55-59), Fl_9 58 (55-59), Fl_{10} 59 (57-60), Fl_{11} 61 (56-63). Fl_5 length/width ratio averaging 2.5 (2.4-2.8), with 5 longitudinal sensilla.

Distribution. Canada (ON), USA (CT, FL, IL, ND, TX).

Material examined. 21♀♀ and 15♂♂ (20 on slides). **CANADA. Ontario.** Ottawa, 12.viii.2003, J.R. Vockeroth, in bus shelter (1♀, CNCI). **USA. Connecticut.** New Haven Co.: Wallingford, viii.1920, Porter and Allen (2♀♀, 2♂♂, slides Q. no.1611). **Illinois.** Cook Co.: Chicago, Clayton Smith Forest Preserve, 31.vii.1989, J.D. Pinto, sweeping (1♀, CNCI); Effingham Co.: SSW. Mason, 7.ix.1993, J.D. Pinto (1♂, CNCI). **North Dakota.** Cass Co.: 4 mi. N. & 4. mi. W. Casselton Vining's sunflower plot, 15, 20, 22 & 26.vii and 5 & 9.viii.1982, L.D. Charlet & T.A. Gross, ex. *Cylindrocopturus adspersus* on *Helianthus annuus* L. (9♀, 7♂, CNCI). **Texas.** Travis Co.: Austin, Zilker Park, 8.x.1983, J.B. Woolley (8♀, 5♂, CNCI).

Hosts and Biology. The specimens from *Cylindricopturus adspersus* mentioned by Schauff (1984a) as being *A. conotracheli* are treated here as *A. pallipes*. The specimens from Connecticut, determined as *A. conotracheli* by Gahan, were reared from *Rhagoletis pomonella* Walsh (Tephritidae) by Porter and Alden (1921). Porter (1922) and Porter (1928) reported up to 25% and 30% parasitism of *R. pomonella* at Wallingford, CT.

Comments. The homotype and plesiotype no. 44,225 (from Centralia, IL) that Girault (1911e: 279) designated and referred to as *A. pallipes* actually belongs to *Anaphes iole* of the *fuscipennis* species group (Huber and Rajakulendran 1988, Huber 1992). As pointed out by Underhill (1926: 17) the occurrence of *A. pallipes* reared from cages containing *Gnorimoschema operculella* Zeller is doubtful. No mymarids are reliably known to parasitize lepidopterous eggs so this reference to *A. pallipes* is almost certainly incorrect. *Anaphes pallipes* probably has a wide North American distribution, based on the little material seen so far. The host genera *Cylindrocopturus* and *Rhagoletis* are widespread and further rearings from any species in these genera may yield *A. pallipes*.

Anaphes pullicrurus (Girault)

(Figs. 13, 27, 46)

Anaphoidea pullicrura Girault, 1910: 252 (original description); Girault, 1911a: 216 (comparison with *diana*); Girault, 1911d: 187 (additional specimen); Girault, 1911e: 288 (mention); Girault, 1914b: 109 (comparison with *luna*); Frison, 1927: 227 (holotype data listed); Gahan, 1927: 32 (comparison with *calendrae*); Girault, 1929: 12 (key, synonymy under *conotracheli*); Doutt, 1949: 160 (previous synonymy under *conotracheli* cited); Poos, 1955: 559 (host record); Webb, 1980: 118 (holotype listed).

Patasson pullicrura; Peck, 1951: 415 (catalog); Peck, 1963: 34 (catalog); Burks, 1979: 1030 (catalog).

Anaphes pullicrurus; Huber 1992: 76 (list).

Type material. HOLOTYPE ♀ (INHS), examined. On slide labelled:1."No. 41686. *Anaphoidea pullicrura* Gir ♀ Centralia Illinois Type. Ag. 26 1909 xylol balsam. Girault s. 1485". 2. "TYPE ♀ *Anaphoidea pullicrura* Girault" [red label]. The specimen is uncleared, in fairly good condition, mounted laterally, with both hind wings, and Fl_6 + club of right antenna detatched and positioned away from the body, and tarsomeres 2-4 of the left hind leg missing. Holotype measurements are given in Table I. PARATYPE. The female collected on 30 August was examined and appears to be conspecific with the holotype. It is on a slide that also bears a male of *A. ?iole*, a female of *Anagrus* sp., and a female of *Camptoptera pulla*. Girault described *A. pullicrurus* from four females "on the panes of a small window" at Centralia, IL, on 26 and 30 August and 5 September, 1909. Two slides bearing only part of the series from which Girault described the species were located. The paratype female collected on September 5 is lost (D. Webb, Illinois Natural History Survey, pers. comm.). The fourth paratype female is also apparently lost, unless it is the male of *A. ?iole*. It is unlikely, however, that Girault would have confused this female for a male.

Diagnosis. Forewing narrow (FWL/FWW 7.0-8.6), thoracic setae short, inconspicuous; funicular segments relatively short and broad. *Anaphes pullicrurus*, *A. gerrisophaga* and *A. cotei* all have relatively narrow forewings. *Anaphes pullicrurus* differs from *A. gerrisophaga* by its short, inconspicuous thoracic setae and a relatively wider forewing (long, distinct setae and narrower forewing in *A. gerrisophaga*) and from *A. cotei* by Fl_2 and the remaining funicular segments relatively shorter and broader (compare Tables XXIII and XV).

Description. Female. *Colour* (from uncleared, slide-mounted specimens). Body brown; legs lighter, uniformly brown except for base of femora at junction with trochanters. Forewing (Fig. 27) with posterior margin narrowly brown along its entire length. Girault (1910) described the colour in detail and his description is certainly more accurate, as it is based on at least one specimen that was not first slide mounted.

Body length. 460 (450-480, n=4).

Head. Width 167 (paratype) and 197 (specimen ex. *Chaetocnema denticulata*). Occipital suture straight (as in Fig. 30).

Antenna. Inner surface of scape not clearly visible on specimens examined. Fl_3 & Fl_6 each with 2 longitudinal sensilla (Fig. 13). Measurements given in Table XXIII

Mesosoma. Pronotum and mesonotum with short, inconspicuous setae.

Wings. Forewing length 612 (585-634, n=5), width 77 (72-86), FWL/FWW 8.03 (6.99-8.59), LMC 124 (115-135), their length about 1.6 times forewing length; marginal space 79 (74-86), medial space triangular, cubital line of setae closest to posterior margin near the retinacular seta and slightly further away distally, with a gap of about one setal length between the cubital line and posterior margin of wing. Hind wing length 570 (519-593, n=5), width 23 (20-25), with 0-4 microtrichia medially on blade in apical half, LMC 176 (173-203).

Legs. Foretibia with 8-10 sensilla chaetica. Hind tarsomere 1 0.91 (0.83-0.95, n=5) times as long as tarsomere 2.

Metasoma. Ovipositor length 296 (272-312, n=5), extending under mesosoma past base of mesocoxa (Fig. 46)

Male. Unknown. See comments below. A male identified as *A. pullicrura* collected by sweeping a creek bed in Muncie, IL has the same wing proportions as *A. pullicrura* but is much larger. It is discussed under *A. gerrisophaga*.

Distribution. USA (IL, VA).

Material examined. 5 ♀♀, all on slides. **USA. Illinois.** Montgomery Co.: Litchfield, 13.vii.1910, A. Girault (1♀, USNM); Champaign Co.: Urbana, 9.vi.1910 and 5.v.1911, A. Girault (2 ♀♀, USNM). **Virginia.** Fairfax Co.: Arlington experimental farm, no date, F.W. Poos, ex. *Chaetocnema denticulata* (2♀♀, USNM).

Hosts and Biology. *Chaetocnema denticulata* (Illiger) (Chrysomelidae). Poos (1955) noted the maximum developmental time of 11 days in *C. denticulata* eggs exposed to *A. pullicrurus* in the laboratory. He reared females only. Apparently, only one individual developed within each host egg, but this was not definitely established.

Comments. Three specimens besides the type series were mentioned by Girault (1910). One female collected June 9 in a greenhouse is on a slide together with six *Anagrus armatus* (Ashmead). The latter species undoubtedly is a misidentification other species of *Anagrus*, as explained by Chiappini *et al.* (1996: 573). It has short, inconspicuous thoracic setae and a FWL/FWWof 6.97 (left wing) and 6.40 (right wing). I treat it as probably *A. pullicrurus*. A male collected July 1, 1910, is on a slide together with seven *Camptoptera pulla* Girault. It appears to belong to *A. gerrisophaga* on the basis of its long, prominent head and thoracic setae but its forewing is too broad to be *A. gerrisophaga*; it has a FWL/FWW of only 6.59 (wings obliquely positioned so width of one wing and length of other wing measured to obtain ratio). The second male that Girault (1910) also collected on July 1 was not found.

On the basis of known hosts, *A. gerrisophaga* should be restricted to near or on water whereas *A. pullicrurus* should be in fields (which of course may be near water so *A. gerrisophaga* could easily disperse into them). The collection locality of the type series of *A. pullicrurus* does not help in determining a natural habitat. Dispersing or wind blown specimens could easily end up in a greenhouse regardless of the host they parasitize or the habitat they normally occupy. More material reared from *Chaetocnema* spp. is needed to search for better characters to define *A. pullicrurus* and assess its variation more thoroughly.

Anaphes sordidatus (Girault)

(Figs. 14, 28, 47)

Anaphoidea sordidatus (Girault, 1909: 167) (original description).

Anaphes sordidatus; Huber *et al.*, 1997: 961 (type material, redescription, literature).

Type material. LECTOTYPE ♀ (INHS), examined (see Huber *et al.* 1997) from USA: Illinois, Centralia.

Diagnosis. Occipital suture straight (as in Fig. 30), ovipositor extending under gaster (Fig. 47), forewing (Fig. 28) with posterior margin narrowly brown at least distally, Fl_2 (Fig. 14) with 2 longitudinal sensilla, solitary in eggs of *Tyloderma foveolatum*. Statistics of the antennal segments are given in Table XXIV to complement the description in Huber *et al.* (1997) and for comparison with the antennal descriptions of the other species redescribed here. Type measurements are given in Table I.

This species cannot be distinguished morphologically from *A. listronoti*. One character that may possibly separate the species is the sculpture of the mesoscutal midlobe posteriorly. The sculpture consists of reticulate sculpture apparently arranged in somewhat longitudinal elliptical pattern compared to a more circular pattern in *A. listronoti*. Biologically, *A. listronoti* differs by being gregarious and having a different host, *Listronotus oregonensis*. The two species do not interbreed in the laboratory (Huber *et al.*, 1997). *Anaphes sordidatus* is similar to *A. victus* (Huber *et al.* 1997) and to specimens of *A. luna* that have Fl_2 with two longitudinal sensilla. Even though there is a difference in ovipositor length between *A. sordidatus* and *A. luna* and they appear to be morphologically distinct, it would be interesting to conduct crossing experiments between them to see if *A. sordidatus* is also biologically distinct.

Distribution. USA (IA, IL).

Anaphes victus Huber
(Figs. 15, 29, 48)

Anaphes victus (nomen nudum); Cormier *et al.*, 1996: 1376 (seasonal ecology, distribution).
Anaphes victus; Huber *et al.*, 1997: 967 (original description); van Baaren and Boivin, 1998a: 525 (genotypic and kin discrimmination); van Baaren and Boivin; 1998b: 10 (host discrimination); van Baaren *et al.*, 1999: 1 (antennal sensilla); van Baaren *et al.*, 1999: 67 (larval competition, sex allocation); Boivin and van Baaren, 2000: 1 (larval agression and mobility); Boivin and Nénon, 2003: 768 (effect of host egg chorion on parasitism); Boivin *et al.*, 2004: 641 (searching behavior).

Type material. HOLOTYPE ♀ (CNCI), examined (see Huber *et al.* 1997) from CANADA: Quebec, Ste. Clotilde.

Diagnosis. Occipital suture straight (as in Fig. 30), ovipositor extending under gaster (Fig. 48), forewing (Fig. 29) with posterior margin narrowly brown at least distally, Fl_2 (Fig. 15) with 1 or 2 longitudinal sensilla, solitary in eggs of *Listronotus oregonensis.* The ovipositor is shorter than in *A. sordidatus*, and *A. listronoti* which is morphologically the most similar species to *A. victus.* Possibly, *A. victus* is the same as *A. luna*, as discussed under the latter.

Statistics of the antennal segments (Tables XXV and XXVI) are given to complement the description in Huber *et al.* (1997) and for comparison with the antennal descriptions of the other species redescribed here. Type measurements are given in Table I. See diagnosis of *A. listronoti* for additional features to separate it from *A. victus.*

Distribution. Canada (QC), USA (MI, TX).

Comments. This solitary species (only one adult emerges from one host egg) is very similar to specimens reared from *Hypera postica* since the mid-1950's and identified as *A. luna.* Crossing experiments betwen *A. victus* from *L. oregonensis* on carrot and *A. luna* from *H. postica* on alfalfa should be undertaken to see if they are the same species.

Table I. Measurements (in µm) of primary types of nominal *crassicornis*-group species of *Anaphes* for North America. Abbreviations used: HT=holotype; L=length; LMC=longest marginal cilia of wings; LT=lectotype; Macro. dist.=distance between macrochaetae of marginal vein; ovip.=ovipositor; PT=paratype; Troch.=trochanter; W=width. Many measurements could not be made because parts were missing or not clearly visible. Measurements of structures positioned obliquely are not accurate, and are indicated by “ ”.

Nominal species	Type	Head W	Mesosoma		Ovip. L	Ovip./hind tibia
			W	L		
1. *pallipes*	HT	193	-	220	330	≈2.06
1a. *pallipes* (remounted)		≈204	-	215	311	1.9
2. *sordidatus*	LT	-	-	285	494	1.71
3. *luna*	HT	-	-	247	300	1.32
4. *calendrae*	HT	≈232	-	≈257	614	≈2.17
5. *brunneus*	HT	-	-	≈222	313	≈1.47
6. *confertus*	HT	≈215	-	248	184	0.89
7. *gerrisophagus*	HT	≈172	128	218	≈267	-
8. *conotracheli*	PT	233	-	274	452	1.96
9. *longiclava*	HT	≈152	-	191	190	1.18
10. *pullicrurus*	HT	≈170	-	242	304	1.43
11. *diana*	LT	≈217	169	229	≈139	≈0.61
12. *cotei*	HT	248	-	272	440	1.66
13. *listronoti*	HT	251	-	303	484	1.74
14. *victus*	HT	235	-	283	368	1.40

Nominal species	Forewing			Total ven.	Macro dist. L	Stigmal L	Marginal space L
	L	W	LMC				
1. *pallipes*	519	-	-	185	48	29	121
1a. *pallipes*	526	114	131	192	47	28	116
2. *sordidatus*	827	151	131	273	76	34	99
3. *luna*	701	107	149	226	56	31	86
4. *calendrae*	710	98	143	238	63	35	117
5. *brunneus*	620	123	148	193	37	31	88
6. *confertus*	707	118	142	211	52	27	118
7. *gerrisophagus*	636	62	123	215	60	35	100
8. *conotracheli*	669	147	125	241	55	35	116
9. *longiclava*	489	92	134	170	40	29	71
10. *pullicrurus*	604	83	116	217	57	29	91
11. *diana*	648	98	126	223	53	31	106
12. *cotei*	766	94	249	250	69	33	115
13. *listronoti*	789	136	133	275	67	40	131
14. *victus*	709	127	127	238	62	35	70

Table I. – continued

Nominal species	Hind wing L	Hind wing W	Hind wing LMC	Ven.L	Forewing L/W
1. *pallipes*	-	-	-	-	-
1a. *pallipes*				4.62	
2. *sordidatus*	805	35	122	272	5.48
3. *luna*	661	21	101	217	6.57
4. *calendrae*	694	28	118	226	7.26
5. *brunneus*	575	27	104	198	5.04
6. *confertus*	658	34	123	207	6.02
7. *gerrisophaga*	625	19	99	193	10.29
8. *conotracheli*	-	31	-	-	4.55
9. *longiclava*	482	21	101	163	5.33
10. *pullicrurus*	587	23	91	199	7.30
11. *diana*	637	28	113	212	6.59
12. *cotei*	736	28	118	236	8.13
13. *listronoti*	-	32	118	-	5.82
14. *victus*	696	28	119	235	5.58

Nominal species	Foreleg Coxa	Foreleg Troch.	Foreleg Femur	Foreleg Tibia	Tarsus Total	Tarsus 1	Tarsus 2	Tarsus 3	Tarsus 4
1. *pallipes*	≈53	38	99	99	≈105	≈30	≈27	≈26	≈24
1a. *pallipes*	≈64	40	≈101	≈102	≈107	31	29	26	≈20
2. *sordidatus*	-	59	184	187	177	53	44	41	37
3. *luna*	-	37	≈137	≈117	133	≈37	35	34	26
4. *calendrae*	≈95	54	180	176	167	51	41	35	32
5. *brunneus*	≈78	36	144	137	137	40	34	35	28
6. *confertus*	85	-	131	118	109	30	27	25	27
7. *gerrisophagus*	67	42	≈140	-	121	35	29	27	30
8. *conotracheli*	87	46	162	≈142	156	44	38	38	35
9. *longiclava*	67	34	119	113	119	31	27	28	33
10. *pullicrurus*	80	43	≈130	129	123	40	29	27	27
11. *diana*	-	≈59	-	155	143	41	36	34	32
12. *cotei*	88	52	167	174	176	60	40	39	46
13. *listronoti*	104	53	≈189	≈174	179	56	43	43	38
14. *victus*	94	≈50	≈167	158	144	41	38	33	32

Table I. – continued

Nominal species	Middle leg				Tarsus				
	Coxa	Troch.	Femur	Tibia	Total	1	2	3	4
1. *pallipes*	50	39	119	≈131	-	-	-	-	-
1a. *pallipes*	38	35	122	≈124					
2. *sordidatus*	75	50	190	-	182	45	54	47	37
3. *luna*	≈62	40	143	≈190	140	32	42	36	29
4. *calendrae*	78	-	≈180	247	179	60	44	41	32
5. *brunneus*	≈47	41	132	177	126	31	34	33	29
6. *confertus*	≈64	35	137	171	118	27	31	30	29
7. *gerrisophagus*	43	36	146	179	126	35	33	29	29
8. *conotracheli*	57	28	154	203	136	32	38	37	29
9. *longiclava*	≈39	-	124	146	-	24	26	17	26
10. *pullicrurus*	47	38	135	187	135	35	36	33	29
11. *diana*	≈50	40	-	219	134	31	36	35	32
12. *cotei*	64	50	175	258	164	49	43	39	32
13. *listronoti*	67	58	≈162	≈247	177	50	46	44	37
14. *victus*	69	57	173	240	145	33	38	39	35

Nominal species	Hind leg				Tarsus				
	Coxa	Troch.	Femur	Tibia	Total	1	2	3	4
1. *pallipes*	82	46	≈135	161	-	-	-	-	-
1a. *pallipes*	78	43	142	165					
2. *sordidatus*	134	71	219	285	194	50	55	48	40
3. *luna*	≈151	61	172	226	140	27	44	40	27
4. *calendrae*	≈125	62	206	285	187	65	44	42	34
5. *brunneus*	85	52	160	196	125	31	33	32	29
6. *confertus*	100	59	161	207	≈139	25	33	38	32
7. *gerrisophagus*	≈74	≈36	-	-	137	38	35	33	30
8. *conotracheli*	103	65	183	231	148	33	42	40	31
9. *longiclava*	76	43	130	161	92	22	23	19	27
10. *pullicrurus*	91	52	155	213	146	35	42	36	35
11. *diana*	≈77	53	-	232	152	36	43	37	37
12. *cotei*	112	64	201	≈263	175	50	48	44	35
13. *listronoti*	117	65	≈214	≈280	191	50	53	49	23
14. *victus*	115	65	200	265	159	35	50	43	35

Table I. – continued

Nominal species	Scape		Pedicel		Funicle article (number of longitudinal sensilla)												Clava			
					1		2		3		4		5		6		Total		1	2
	L	L	L	W	L	W	L	W	L	W	L	W	L	W	L	W	L	W	L	L
1. *pallipes*	≈84	22	40	≈30	22	13	33	16	41	21(2)	33	20	47	28(2)	43	-(2)	-	-	-	-
1a. *pallipes*	≈71	23	41	26	23	13	36	14	43	20(2)	38	17	51	28(2)	-	-	-			
2. *sordidatus*	143	33	52	26	26	17	90	24(2)	84	23(2)	83	22(2)	79	23(2)	72	22(2)	123	41	50(2)	73(4)
3. *luna*	-	-	46	26	22	14	51	14	56	14(2)	50	16(2)	54	15(2)	52	19(2)	91	-	-	-
4. *calendrae*	-	36	53	30	27	17	77	16	74	20(2)	72	24(2)	66	23(2)	64	23(2)	120	39	49(2)	68(4)
5. *brunneus*	-	24	43	24	25	15	59	13	56	17(1)	47	14	56	20(2)	53	20(2)	102	33	35(2)	68(4)
6. *confertus*	-	36	50	26	21	15	28	17	35	20(2)	24	20	32	21(2)	34	22(2)	107	36	34(2)	72(4)
7. *gerrisophagus*	100	27	45	25	20	12	43	12	57	17(2)	47	17(1/0)	53	19(2)	53	21(2)	102	29	43(2)	59(4)
8. *conotracheli*	100	27	47	31	26	16	49	16	63	22(2)	56	23(2)	61	23(2)	58	23(2)	106	35	42(2)	63(4)
9. *longiclava*	≈70	21	41	26	20	13	34	13	45	17(2)	41	16(1)	47	16(2)	45	19(2)	92	26	36(2)	59(4)
10. *pullicrurus*	113	-	46	25	19	14	44	14	58	22(2)	53	22(2)	54	24(2)	52	25(2)	107	37	42(2)	65(4)
11. *diana*	111	30	47	26	23	14	38	16	55	20(2)	59	20(2)	60	20(2)	56	20(2)	122	35	42(2)	79(4)
12. *cotei*	≈150	27	54	26	27	14	79	14	86	18(2)	79	21(2)	77	21(2)	71	23(2)	123	37	53(2)	70(4)
13. *listronoti*	125	33	51	27	31	18	78	18(1)	82	22(2)	81	22(2)	77	22(2)	74	23(2)	122	36	55(2)	67(4)
14. *victus*	125	29	≈44	28	25	16	≈66	16(1)	65	19(2)	65	19(2)	60	21(2)	63	21(2				

TABLE II. Statistics of antennal segments of *Anaphes brunneus*. Means (in micrometers) on top, sample standard deviation in parentheses, and range.

segment	length (L)	width (W)	ratio (L/W)
scape	90 (0.8) 93-106 (n=3)	23 (n=1)	3.86 (n=1)
pedicel	44 (2) 42-46 (n=3)	29 (n=1)	1.48 (n=1)
Fl_1 (n=3)	25(0.6) 24-26	14 (0.9) 13-15	1.82 (0.15) 1.69-1.98
Fl_2 (n=3)	66 (7) 58-70	6 (1.1) 13-15	4.65 (0.29) 4.39-4.96
Fl_3 (n=3)	60 (3.6) 57-64	17 (4.8) 14-23	3.61 (0.80) 2.80-4.39
Fl_4 (n=3)	53 (6) 47-59	16 (1.1) 15-17	3.37 (0.46) 3.1-3.9
Fl_5 (n=3)	60 (3) 57-63	20 (3.2) 18-24	3.04 (0.52) 2.54-3.0
Fl_6 (n=3)	58 (1.2) 56-59	23 (1.5) 21-24	2.58 (0.16) 2.54-2.76
clava (n=2)	108 (3.2) 106-110	33 (4.9) 29-36	3.36 (0.60) 2.92-.3.78

Table III. Statistics of antennal segments of *Anaphes calendrae* females ex. *Sphenophorus costipennis* [adult length 9-13 mm, from Vaurie (1951)]. Means (in micrometers) on top, sample standard deviation in parentheses, and range.

segment	length (L)	width (W)	ratio (L/W)
scape	130 (5.6) 123-138 (n=7)	35 (1.6) 33-38 (n=11)	3.78 (0.20) 3.59-4.18 (n=5)
pedicel	55 (2.8) 52-60 (n=16)	30 (1.8) 28-34 (n=13)	1.87 (0.10) 1.62-1.99 (n=13)
Fl_1	27 (2.4) 22-32 (n=16)	18 (1.1) 16-20 (n=16)	1.53 (0.18) 1.24-1.80 (n=15)

Table III. – continued

segment	length (L)	width (W)	ratio (L/W)
Fl_2	72 (4.8) 66-81 (n=17)	16 (1.0) 14-18 (n=17)	4.39 (0.39) 3.92-4.96 (n=13)
Fl_3	73 (2.9) 70-79 (n=17)	22 (2.5) 18-26 (n=17)	3.38 (0.50) 2.74-4.33 (n=16)
Fl_4	68 (4.7) 64-84 (n=18)	23 (2.3) 19-27 (n=17)	2.99 (0.52) 2.52-4.52 (n=16)
Fl_5	66 (3.4) 58-72 (n=18)	24 (1.6) 21-27 (n=18)	2.74 (0.26) 2.40-3.21 (n=17)
Fl_6	62 (2.4) 56-66 (n=18)	24 (1.6) 22-27 (n=17)	2.57 (0.24) 2.21-2.95 (n=17)
clava	121 (3.6) 113-127 (n=18)	38 (2.7) 32-41 (n=17)	3.18 (0.23) 2.52-3.64 (n=17)

Table IV. Statistics of antennal segments of *Anaphes calendrae* females ex. *Sphenophorus destructor* (adult length 8-11 mm). Means (in micrometers) on top, sample standard deviation in parentheses, and range.

segment	length	width	ratio (L/W)
scape	119 (7.8) 109-122 (n=4)	32 (3.6) 28-36 (n=4)	3.92 (0.32) 3.55-4.14 (n=3)
pedicel (n=7)	54 (1.7) 52-56	29 (2.8) 26-33	1.86 (0.19) 1.6-2.07
Fl_1 (n=7)	27 (2.4) 24-31	17 (1.8) 13-19	1.65 (1.18) 1.43-1.93
Fl_2 (n=7)	70 (11.7) 53-80	16 (1.3) 15-19	4.36 (0.63) 3.54-5.03
Fl_3 (n=7)	70 (8.4) 57-77	21 (2.2) 18-24	3.38 (0.36) 2.89-3.82

Table IV. – continued

segment	length (L)	width (W)	ratio (L/W)
Fl_4 (n=7)	65 (7.8) 53-72	23 (2.1) 21-27	2.90 (0.30) 2.41-3.23
Fl_5 (n=7)	63 (7.1) 52-68	23 (1.3) 20-25	2.79 (0.24) 2.34-3.05
Fl_6 (n=7)	60 (6.7) 50-67	23 (2.3) 19-26	2.59 (0.22) 2.17-2.83
clava (n=7)	118 (7.0) 108-127	38 (2.2) 35-40	3.12 (0.04) 3.07-3.16

Table V. Statistics of antennal segments of *Anaphes calendrae* females ex. *Sphenophorus maidis* (adult length 12-16 mm). Means (in micrometers) on top, sample standard deviation in parentheses, and range.

segment	length	width	ratio (L/W)
scape	149 (11.7) 141-158 (n=2)	40 (3.2) 38-42 (n=2)	3.33 (n=1)
pedicel (n=2)	64 (3.6) 60-67	34 (1.1) 33-35	1.86 (0.16) 1.74-1.97
Fl_1 (n=3)	34 (2.7) 31-36	21 (2.4) 19-23	1.64 (0.31) 1.33-1.94
Fl_2 (n=3)	92 (4.1) 88-96	19 (0.6) 18-19	4.95 (0.17) 4.83-5.15
Fl_3 (n=3)	98 (3.5) 93-102	25 (2.3) 22-27	3.98 (0.24) 3.72-4.20
Fl_4 (n=3)	25 (1.6) 84-87	26 (2.0) 25-29	3.27 (0.22) 3.02-3.44
Fl_5 (n=3)	79 (1.8) 77-80	27 (1.4) 26-28	2.88 (0.19) 2.72-3.09
Fl_6 (n=3)	72 (2.7) 70-74	27 (0.3) 26-27	2.70 (0.04) 2.65-2.74
clava	133 (6.0) 126-136 (n=2)	42 (3.8) 40-45 (n=3)	3.23 (0.28) 3.03-3.43 (n=2)

Table VI. Statistics of antennal segments of *Anaphes calendrae* females ex. *Sphenophorus minimus* (adult length 5-7 mm). Means (in micrometers) on top, sample standard deviation in parentheses, and range.

segment	length	width	ratio (L/W)
scape	103 (7.1) 91-109 (n=6)	30 (2.9) 27-34 (n=6)	3.67 (0.48) 3.33-4.01 (n=3)
pedicel	46 (2.4) 43-49 (n=10)	28 (2.3) 25-33 (n=10)	1.41 (0.18) 1.25-1.85 (n=9)
Fl_1	21 (1.8) 18-23 (n=13)	15 (0.9) 14-17 (n=12)	1.48 (0.15) 1.15-1.70 (n=12)
Fl_2	49 (7.4) 32-59 (n=14)	148 (1.2) 13-17 (n=14)	3.38 (0.47) 2.26-3.94 (n=13)
Fl_3 (n=14)	53 (7.8) 34-64	19 (2.4) 15-22	2.90 (0.36) 1.96-3.49
Fl_4 (n=15)	50 (5.6) 37-59	19 (2.1) 15-23	2.63 (0.26) 2.10-3.04
Fl_5 (n=15)	50 (5.3) 37-56	20 (2.8) 15-25	2.49 (0.26) 2.04-2.83
Fl_6 (n=15)	47 (4.3) 37-53	21 (2.3) 16-24	2.32 (0.20) 1.97-2.66
clava (n=15)	103 (8.2) 84-112	35 (1.9) 31-38	2.96 (0.25) 2.51-3.38

Table VII. Statistics of antennal segments of *Anaphes calendrae* females ex. *Sphenophorus parvulus* (adult length 6-8 mm). Means (in micrometers) on top, sample standard deviation in parentheses, and range.

segment	length	width	ratio (L/W)
scape	103 (9.6) 92-121 (n=7)	29 (3.8) 20-33 (n=9)	3.36 (0.23) 3.41-3.97 (n=5)
pedicel	45 (3.5) 38-52 (n=12)	27 (1.4) 26-29 (n=9)	1.65 (0.10) 1.51-1.84 (n=9)

Table VII. – continued

segment	length (L)	width (W)	ratio (L/W)
Fl_1	22 (4.0) 16-29 (n=13)	15 (1.4) 13-17 (n=14)	1.49 (0.25) 1.18-2.09 (n=13)
Fl_2	52 (9.1) 39-74 (n=16)	16 (2.0) 13-22 (n=16)	3.37 (0.67) 2.36-4.75 (n=15)
Fl_3	56 (5.6) 45-70 (n=17)	19 (1.9) 15-22 (n=16)	3.00 (0.27) 2.60-3.58 (n=16)
Fl_4 (n=17)	52 (5.6) 44-65	20 (2.1) 16-24	2.62 (0.20) 2.31-3.21
Fl_5	51 (5.9) 41-64 (n=17)	21 (1.9) 18-25 (n=15)	2.44 (0.22) 2.13-3.07 (n=15)
Fl_6 (n=17)	48 (5.3) 38-60	21 (2.5) 17-26	2.30 (0.25) 1.94-2.78
clava	105 (7.1) 92-116 (n=17)	35 (3.0)30-40 30-40 (n=15)	3.06 (0.25) 2.68-3.57 (n=15)

Table VIII. Statistics of antennal segments of *Anaphes calendrae* females ex. *Sphenophorus pertinax* (adult length 10.5-17 mm). Means (in micrometers) on top, sample standard deviation in parentheses, and range.

segment	length	width	ratio (L/W)
scape	130 (9.6) 113-134 (n=5)	33 (3.5) 28-37 (n=5)	3.91 (0.16) 3.8-4.02 (n=2)
pedicel (n=9)	53 (3.7) 48-60 (n=9)	28 (2.6) 22-31 (n=9)	1.87 (0.15) 1.72-2.19 (n=9)
Fl_1 (n=11)	26 (1.8) 22-28	16 (1.3) 14-18	1.62 (0.16) 1.34-1.92
Fl_2	70 (9.8) 57-86 (n=12)	16 (1.1) 15-18 (n=12)	4.26 (0.45) 3.79-4.94 (n=11)

Table VIII. – continued

segment	length (L)	width (W)	ratio (L/W)
Fl_3	73 (1.0) 57-85 (n=12)	20 (2.3) 17-23 (n=12)	3.65 (0.68) 2.75-4.95 (n=11)
Fl_4 (n=14)	65 (8.3) 51-77	22 (2.3) 18-24	3.04 (0.44) 2.23-4.05
Fl_5 (n=15)	63 (7.2) 50-73	23 (2.2) 19-26	2.81 (0.22) 2.22-3.52
Fl_6 (n=15)	60 (6.9) 47-67	23 (2.1) 21-27	2.55 (0.17) 2.21-2.84
clava (n=12)	114 (7.7) 101-125	38 (2.1) 35-43	2.98 (0.17) 2.74-3.24

Table IX. Statistics of antennal segments of *Anaphes calendrae* females ex. *Sphenophorus venatus vestitum* (adult length 8-11 mm). Means (in micrometers) on top, sample standard deviation in parentheses, and range.

segment	length	width	ratio (L/W)
scape (n=11)	114 (9.1) 98-123	30 (2.3) 25-34	3.87 (0.17) 3.60-4.11
pedicel (n=11)	50 (2.1) 47-53	28 (1.4) 26-30	1.84 (0.06) 1.72-1.91
Fl_1 (n=11)	24 (2.7) 20-28	15 (0.9) 14-17	1.57 (0.15) 1.34-1.78
Fl_2 (n=10)	56 (7.2) 47-68	15 (0.8) 14-16	3.81 (0.42) 3.25-4.36
Fl_3 (n=10)	59 (5.4) 52-65	19 (1.6) 16-22	3.15 (0.23) 2.78-3.46
Fl_4 (n=10)	55 (4.8) 49-62	19 (1.3) 17-21	2.84 (0.14) 2.60-3.0
Fl_5 (n=10)	54 (4.9) 46-60	21 (1.3) 18-23	2.63 (0.20) 2.32-2.63
Fl_6 (n=10)	51 (4.1) 45-56	22 (1.1) 20-23	2.36 (0.17) 2.11-2.6
clava (n=10)	106 (5.1) 98-113	35 (2.1) 32-38	3.01 (0.15) 2.79-3.38

Table X. Statistics of forewing of *Anaphes calendrae* females ex. various *Sphenophorus* spp. Means (in micrometers) on top, sample standard deviation in parentheses, and range.

host	length	width	ratio (L/W)	LMC	marginal space
costipennis	717 (26.2) 671-761 (n=15)	98 (3.9) 89-106 (n=17)	7.28 (0.27) 6.79-7.81 (n=14)	131 (8.5) 118-143 (n=18)	123 (15.1) 101-154 (n=17)
destructor	703 (39.7) 619-738 (n=7)	99 (6.0) 89-109 (n=7)	7.11 (0.19) 6.80-7.26 (n=7)	133 (8.6) 121-143 (n=7)	112 (6.4) 100-119 (n=8)
maidis	861 (19.1) 847-882 (n=3)	129 (10.3) 122-141 (n=3)	6.68 (0.37) 6.26-6.97 (n=3)	142 (7.3) 133-146 (n=3)	152 (14.9) 140-169 (n=3)
minimus	565 (56.8) 436-634 (n=14)	77 (0.78) 63-86 (n=14)	7.37 (0.27) 6.92-7.80 (n=14)	123 (10.7) 105-124 (n=14)	113 (13.7) 97-137 (n=14)
parvula	598 (50.4) 497-671 (n=13)	76 (9.5) 60-94 (n=16)	7.75 (0.51) 6.69-8.62 (n=13)	122 (9.1) 104-137 (n=16)	115 (16.0) 84-137 (n=16)
pertinax	698 (68.0) 600-794 (n=13)	98 (11.3) 74-117 (n=13)	7.17 (0.32) 6.58-7.66 (n=13)	126 (7.3) 115-134 (n=13)	122 (14.6) 102-149 (n=14)
venustus vestitum	598 (50.8) 535-652 (n=9)	80 (7.6) 68-89 (n=9)	7.54 (0.28) 7.12-7.83 (n=9)	123 (8.6) 109-136 (n=9)	107 (9.7) 95-121 (n=8)

Table XI. Statistics of hind wing of *Anaphes calendrae* females ex. various *Sphenophorus* spp. Means (in micrometers) on top, sample standard deviation in parentheses, and range.

host	length	width	LMC
costipennis	706 (33) 655-750 (n=13)	29 (2.3) 24-32 (n=18)	118 (6.4) 109-136 (n=18)
destructor	685 (42) 598-720 (n=7)	29 (2.1) 26-33 (n=8)	115 (7.0) 105-125 (n=8)
maidis	843 (15.6) 832-854 (n=2)	37 (2.5) 34-38 (n=3)	136 (2.2) 134-139 (n=3)
minimus	532 (39.4) 480-590 (n=12)	24 (2.8) 19-27 (n=15)	104 (9.4) 80-117 (n=15)
parvula	588 (53.5) 503-654 (n=12)	25 (2.5) 19-29 (n=17)	102 (11.6) 71-121 (n=17)

Table XI. – continued

host	length	width	LMC
pertinax	686 (77.0) 594-769 (n=10)	28 (2.2) 25-31 (n=15)	114 (7.6) 104-128 (n=15)
venustus vestitum	580 (53.5) 512-648 (n=8)	24 (1.8) 21-26 (n=9)	104 (7.4) 95-113 (n=9)

Table XII. Body statistics of *Anaphes calendrae* females ex. various *Sphenophorus* spp. Means (in micrometers) on top, sample standard deviation in parentheses, and range.

host	head width	ovipositor length	hind tibial length	ratio (ovipositor L/ hind tibial L)
costipennis	238 (n=1)	605 (16.7) 571-632 (n=17)	277 (8.3) 268-290 (n=17)	2.19 (0.05) 2.12-2.30 (n=17)
destructor	260 (3.2) 257-263 (n=3)	587 (43.1) 512-631 (n=7)	268 (22.6) 247-292 (n=6)	2.14 (0.04) 2.10-2.20 (n=5)
maidis	301 (39.5) 273-329 (n=2)	748 (10.9) 736-751 (n=3)	347 (8.9) 337-353 (n=3)	2.15 (0.02) 2.14-2.18 (n=3)
minimus	215 (n=1)	461 (45.0) 356-516 (n=13)	203 (20.3) 188-236 (n=13)	2.25 (0.06) 2.18-2.37 (n=10)
parvula	199 (5.5) 195-203 (n=2)	493 (55.6) 400-571 (n=19)	216 (25.8) 174-240 (n=13)	2.27 (0.14) 2.09-2.64 (n=12)
pertinax	255 (16.0) 236-263 (n=5)	587 (60.7) 503-693 (n=14)	265 (29.8) 209-304 (n=15)	2.24 (0.06) 2.17-2.41 (n=14)
venustus vestitum	248 (22.1) 229-280 (n=4)	508 (37.4) 458-557 (n=11)	229 (18.4) 205-252 (n=11)	2.22 (0.07) 2.15-2.27 (n=11)

Table XIII. Statistics of antennal segments of *Anaphes confertus*. Means (in micrometers) on top, sample standard deviation in parentheses, number of measurements and range.

segment	length (L)	width (W)	ratio (L/W)
scape (n=3)	110 (5.2) 107-116	36 (4.8) 33-41	2.83 (0.61) 2.38-3.52
pedicel (n=3)	50 (6.3) 45-57	27 (1.3) 25-28	1.89 (0.32) 1.73-2.26
Fl_1	21 (1.5) 20-22 (n=2)	18 (1.9) 17-21 (n=4)	1.2 (0.03) 1.18-1.22 (n=2)

Table XIII. – continued

segment	length (L)	width (W)	ratio (L/W)
Fl_2 (n=4)	25 (4.4) 20-30	20 (1.7) 19-23	1.26 (0.26) 1.04-1.41
Fl_3 (n=4)	34 (3.6) 30-39	23 (2.3) 22-26	1.50 (0.21) 1.27-1.74
Fl_4 (n=4)	25 (2.9) 21-28	21 (1.1) 21-23	1.14 (0.14) 1.0-1.33
Fl_5 (n=4)	33 (3.0) 29-36	24 (2.0) 21-26	1.35 (0.07) 1.28-1.43
Fl_6 (n=4)	33 (2.6) 30-35	26 (3.6) 23-30	1.31 (0.10) 1.17-1.32
clava	115 (12.0) 103-127 (n=3)	41 (2.4) 40-44 (n=4)	2.82 (0.16) 2.63-2.88 (n=3)

Table XIV. Statistics of antennal segments of *Anaphes conotracheli* ex. *Conotrachelus* spp. Means (in micrometers) on top, sample standard deviation in parentheses, and range.

segment	length (L)	width (W)	ratio (L/W)
scape	99 (4.5) 93-106 (n=11)	29 (1.2) 27-31 (n=13)	3.48 (0.19) 3.12-3.76 (n=9)
pedicel	48 (1.4) 45-50 (n=12)	31 (2.2) 26-34 (n=14)	1.49 (0.07) 1.39-1.61 (n=9)
Fl_1	26 (1.7) 23-30 (n=14)	17 (0.8) 15-18 (n=14)	1.58 (0.10) 1.43-1.76 (n=13)
Fl_2	49 (3.3) 41-53 (n=14)	16 (1.0) 16-18 (n=13)	3.00 (0.16) 2.72-3.27 (n=13)
Fl_3	62 (3.2) 54-67 (n=15)	22 (1.7) 20-26 (n=14)	2.87 (0.27) 2.23-3.38 (n=13)
Fl_4	56 (3.3) 50-60 (n=14)	23 (1.5) 21-25 (n=13)	2.46 (0.24) 2.14-2.91 (n=11)

Table XIV. – continued

segment	length (L)	width (W)	ratio (L/W)
Fl_5	60 (2.6) 53-65 (n=15)	25 (2.5) 23-28 (n=15)	2.35 (0.23) 1.82-2.63 (n=12)
Fl_6	58 (2.4) 54-64 (n=15)	26 (2.3) 21-29 (n=15)	2.25 (0.22) 1.97-2.64 (n=12)
clava (n=16)	112 (5.1) 106-120 (n=16)	36 (2.4) 33-41 (n=13)	3.12 (0.23) 2.67-3.41 (n=12)

Table XV. Statistics of antennal segments of *Anaphes cotei* females. Means (in micrometers) on top, sample standard deviation in parentheses, and range.

segment	length (L)	width (W)	ratio (L/W)
scape (n=4)	132 (2.5) 130-136	30 (1.3) 28-31	4.44 (0.15) 4.23-4.58
Pedicel (n=4)	55 (1.6) 54-58	30 (0.91) 29-31	1.84 (0.08) 1.76-1.95
Fl_1 (n=4)	27 (1.3) 26-29	16 (0.4) 16-17	1.67 (0.10) 1.54-1.78
Fl_2 (n=4)	82 (3.9) 78-87	16 (1.6) 15-18	5.17 (0.27) 4.86-5.32
Fl_3 (n=4)	85 (2.4) 83-88	20 (0.8) 19-20	4.27 (0.23) 4.14-4.62
Fl_4 (n=4)	79 (2.6) 76-82	20 (1.2) 19-22	3.87 (0.35) 3.61-4.38
Fl_5 (n=4)	75 (2.3) 72-77	21 (1.7) 19-23	3.56 (0.40) 3.10-4.05
Fl_6 (n=4)	71 (4.0) 62-77	23 (0.9) 22-24	3.13 (0.24) 2.82-3.36
Clava (n=4)	126 (2.0) 123-128	40 (3.7) 35-43	3.21 (0.29) 2.94-3.60

Table XVI. Statistics of antennal segments of *Anaphes diana*. Means (in micrometers) on top, sample standard deviation in parentheses, and range.

segment	length (L)	width (W)	ratio (L/W)
scape (n=8)	106 (3.2) 101-110	25 (2.0) 22-28	4.35 (0.37) 3.66-4.67
pedicel (n=11)	42 (2.3) 39-47	26 (1.3) 23-28	1.66 (0.11) 1.48-1.85
Fl_1 (n=11)	22 (1.8) 19-24	13 (0.5) 13-14	1.61 (0.16) 1.38-1.86
Fl_2 (n=11)	32 (2.2) 31-38	14 (0.8) 13-15	2.30 (0.20) 2.04-2.70
Fl_3 (n=11)	48 (3.6) 41-53	18 (1.9) 15-20	2.72 (0.27) 2.40-3.26
Fl_4 (n=11)	48 (4.1) 43-56	16 (1.9) 13-19	3.04 (0.24) 2.66-3.43
Fl_5 (n=11)	53 (2.2) 49-57	18 (1.8) 16-20	3.02 (0.32) 2.60-3.58
Fl_6 (n=10)	48 (2.5) 45-53	19 (2.5) 15-24	2.57 (0.32) 2.15-3.16
clava (n=10)	109 (5.3) 101-121	27 (1.2) 25-29	4.09 (0.17) 3.87-4.37

Table XVII. Statistics of antennal segments of *Anaphes gerrisophaga*. Means (in micrometers) on top, sample standard deviation in parentheses, and range.

segment	length (L)	width (W)	ratio (L/W)
scape	97 (16) 73-118 (n=13)	23 (5) 17-31 (n=11)	4.10 (0.41) 3.51-4.6 (n=10)
Pedicel	43 (7) 35-57 (n=13)	24 (3) 20-23 (n=14)	1.83 (0.17) 1.68-2.32 (n=12)
Fl_1 (n=14)	21 (3) 17-27	12 (3) 10-15	1.68 (0.16) 1.45-2.03
Fl_2	41 (12) 27-57 (n=15)	13 (2) 10-16 (n=14)	3.33 (0.58) 2.54-4.08 (n=14)

Table XVII. – continued

segment	length (L)	width (W)	ratio (L/W)
Fl_3 (n=14)	54 (12) 37-69	18 (3) 14-22	2.97 (0.35) 2.31-3.48
Fl_4	47 (13) 31-62 (n=14)	19 (8) 12-22 (n=15)	2.79 (0.30) 2.18-3.28 (n=14)
Fl_5 (n=14)	52 (10) 37-72	20(3) 14-24	2.55 (0.22) 2.20-3.04
Fl_6	50 (8) 37-60 (n=14)	20 (2) 17-24 (n=13)	2.47 (0.22) 2.23-3.03 (n=13)
clava	100 (13) 80-116 (n=12)	34 (3) 31-41 (n=14)	2.96 (0.40) 2.35-3.64 (n=11)

Table XVIII. Statistics of antennal segments of *Anaphes listronoti*. Means (in micrometers) on top, sample standard deviation in parentheses, and range.

segment	length (L)	width (W)	ratio (L/W)
scape	117 (9.1) 100-130 (n=10)	32 (2.3) 27-34 (n=7)	3.75 (0.24) 3.45-4.05 (n=5)
pedicel	49 (3.1) 44-55 (n=13)	29 (1.7) 27-33 (n=10)	1.67 (0.08) 1.58-1.82 (n=10)
Fl_1 (n=13)	29 (2.5) 24-32	16 (1.1) 14-18	1.81 (0.16) 1.59-2.19
Fl_2 (n=13)	77 (10.4) 66-99	17 (2.4) 15-22	4.48 (0.51) 3.73-5.36
Fl_3 (n=13)	79 (8.0) 70-98	19 (1.8) 16-22	4.15 (0.48) 3.60-5.32
Fl_4 (n=13)	75 (7.6) 62-82	19 (2.6) 16-23	4.05 (0.59) 3.12-5.37
Fl_5 (n=13)	72 (6.8) 59-86	19 (2.6) 16-24	3.79 (0.50) 3.03-4.71

Table XVIII. – continued

segment	length (L)	width (W)	ratio (L/W)
Fl_6 (n=11)	68 (6.8) 55-80	20 (2.5) 16-25	3.48 (0.48) 2.68-4.17
clava	121 (80) 108-131 (n=11)	36 (3.0) 31-41 (n=8)	3.42 (0.16) 3.23-3.61 (n=8)

Table XIX. Statistics of antennal segments of *Anaphes longiclava*. Means (in micrometers) on top, sample standard deviation in parentheses, and range.

segment	length (L)	width (W)	ratio (L/W)
scape (n=1)	83	25	3.32
pedicel (n=1)	43	29	1.48
Fl_1 (n=1)	17	13	1.31
Fl_2 (n=1)	38	14	2.71
Fl_3 (n=1)	50	20	2.5
Fl_4 (n=1)	46	18	2.26
Fl_5 (n=1)	47	20	2.35
Fl_6 (n=1)	45	21	2.14
clava (n=1)	101	29	3.48

Table XX. Statistics of antennal segments of *Anaphes luna* (from specimens introduced in 1911 to Salt Lake City). Means (in micrometers) on top, sample standard deviation in parentheses, and range.

segment	length (L)	width (W)	ratio (L/W)
scape (n=3)	86 (4.1) 83-93	25 (3.1) 21-29	3.59 (0.39) 3.24-4.01
pedicel	44 (3.3)	26 (1.9)	1.71 (0.09)

Table XX. – continued

segment	length (L)	width (W)	ratio (L/W)
	40-47	24-29	1.65-1.81
	(n=5)	(n=5)	(n=3)
Fl_1	20 (2.8)	13 (1.4)	1.58 (0.22)
	18-25	11-15	1.28-1.95
	(n=7)	(n=7)	(n=6)
Fl_2	46 (9.1)	14 (3.2)	3.19 (0.67)
	36-65	12-21	2.01-4.19
	(n=9)	(n=8)	(n=8)
Fl_3	53 (6.8)	18 (3.9)	3.07 (0.44)
	46-68	14-24	2.49-3.63
	(n=9)	(n=7)	(n=7)
Fl_4	49 (8.3)	16(3.6)	3.17 (0.44)
	40-64	13-22	2.23-3.63
	(n=9)	(n=8)	(n=8)
Fl_5	54 (4.2)	19 (0.3)	2.86 (0.41)
	49-63	15-24	2.42-3.50
	(n=9)	(n=8)	(n=8)
Fl_6	49 (5.4)	20 (3.0)	2.54 (0.49)
(n=8)	42-59	15-23	1.93-3.32
clava	99 (4.7)	35 (4.7)	2.88 (0.08)
	92-113	32-42	2.79-2.98
	(n=7)	(n=7)	(n=6)

Table XXI. Statistics of antennal segments of *Anaphes luna* (from specimens reared from 1958 on at various US localities). Means (in micrometers) and sample standard deviation in parentheses on top, number of specimens measured (in parentheses) and range.

segment	length (L)	width (W)	ratio (L/W)
scape	105 (6.7)	26 (2.3)	4.02 (0.39)
	92-116	21-30	3.63-4.94
	(n=14)	(n=14)	(n=9)
pedicel	45 (2.6)	26 (3.5)	1.68 (0.11)
	39-48	25-29	1.43-1.85
	(n=15)	(n=16)	(n=14)
Fl_1	22 (1.5)	14 (1.3)	1.54 (0.16)

Table XXI. – continued

segment	length (L)	width (W)	ratio (L/W)
	20-24 (n=19)	11-17 (n=20)	1.26-1.84 (n=19)
Fl_2 (n=20)	58 (6.5) 45-71	16 (2.7) 13-21	3.57 (0.53) 2.62-4.64
Fl_3 (n=20)	64 (5.8) 57-73	21 (1.7) 18-24	3.10 (0.35) 2.38-4.0
Fl_4	59 (7.0) 43-66 (n=19)	20 (2.8) 14-23 (n=20)	2.98 (0.18) 2.69-3.33 (n=19)
Fl_5	60 (5.0) 53-65 (n=20)	22 (1.3) 19-24 (n=19)	2.75 (0.26) 2.31-3.19 (n=19)
Fl_6	60 (9.3) 50-60 (n=19)	23 (1.6) 19-25 (n=20)	2.49 (0.21) 2.13-2.8 (n=19)
clava	111 (5.9) 94-119 (n=19)	33 (4.1) 30-33 (n=16)	3.51 (0.19) 3.07-3.75 (n=15)

Table XXII. Statistics of antennal segments of *Anaphes pallipes* females ex. *Cylindrocopturus adspersus* (ND, Cass Co.) and from TX, Austin, Zilker Park. Means (in micrometers) on top, sample standard deviation in parentheses, and range.

segment	length (L)	width (W)	ratio (L/W)
scape (n=6)	76 (4) 70-78	23 (2) 20-24	3.49 (0.19) 3.17-3.72
pedicel (n=9)	41(2) 38-44	26(3) 19-29	1.59 (0.21) 1.33-2.04
Fl_1 (n=10)	20(2) 17-23	13(1) 12-15	1.54 (0.13) 1.27-1.73
Fl_2 (n=10)	33(3) 30-38	14(1) 12-15	2.45 (0.17) 2.00-2.60
Fl_3 (n=10)	45(3) 38-51	17(2) 12-21	2.70 (0.23) 2.45-2.92

Table XXII. – continued

segment	length (L)	width (W)	ratio (L/W)
Fl_4 (n=10)	34(2) 30-39	15(1) 13-16	2.25 (0.17) 2.06-2.52
Fl_5 (n=10)	48(3) 43-53	20(2) 17-23	2.41 (0.15) 2.14-2.71
Fl_6 (n=10)	44(4) 38-51	20(2) 17-22	2.2 (0.13) 2.00-2.36
Clava (n=7)	94(5) 88-97	29(2) 26-31	3.22 (0.21) 2.92-3.48

Table XXIII. Statistics of antennal segments of *Anaphes pullicrurus* females. Means (in micrometers) on top, sample standard deviation in parentheses, and range.

segment	length (L)	width (W)	ratio (L/W)
scape	120 (5.5) 112-124 (n=4)	27 (1.9) 24-29 (n=5)	4.44 (0.19) 4.22-4.65 (n=4)
pedicel	45 (2.8) 43-49 (n=4)	26 (1.1) 25-27 (n=3)	1.78 (0.08) 1.69-1.83 (n=3)
Fl_1	21 (1.8) 19-23 (n=4)	13 (0.6) 13-14 (n=5)	1.55 (0.17) 1.34-1.74 (n=4)
Fl_2 (n=5)	43 (1.3) 42-45	14 (1.3) 12-16	3.14 (0.31) 2.67-3.49
Fl_3	56 (2.0) 53-58 (n=5)	21 (1.0) 20-22 (n=4)	2.64 (0.18) 2.41-2.84 (n=4)
Fl_4 (n=5)	53 (2.0) 51-56	22 (1.5) 21-25	2.41 (0.17) 2.17-2.61
Fl_5 (n=5)	53 (0.9) 52-54	21 (1.7) 20-24	2.58 (0.22) 2.20-2.74
Fl_6 (n=5)	51 (1.6) 49-53	22 (1.4) 20-24	2.32 (0.15) 2.11-2.44
Clava	108 (2.1)	38 (5.1)	2.84 (0.35)

Table XXIII. – continued

segment	length (L)	width (W)	ratio (L/W)
	106-110 (n=4)	33-46 (n=5)	2.40-3.23 (n=4)

Table XXIV. Statistics of antennal segments of *Anaphes sordidatus* females. Means (in micrometers) on top, sample standard deviation in parentheses, and range.

segment	length (L)	width (W)	ratio (L/W)
scape	130 (9.5) 117-142 (n= 5)	34 (2.1) 32-37 (n=6)	3.80 (0.10) 3.69-3.90 (n=5)
pedicel (n=7)	54 (3.2) 49-57	30 (2.1) 27-32	1.77 (0.04) 1.70-1.80
Fl_1 (n=7)	29 (2.6) 26-32	17 (0.9) 16-19	1.72 (0.10) 1.57-1.84
Fl_2 (n=7)	81 (7.9) 71-93	21 (2.2) 17-23	3.97 (0.50) 3.42-4.83
Fl_3	76 (5) 67-81 (n=7)	22 (2.0) 19-24 (n=6)	3.50 (0.42) 3.05-4.17 (n=6)
Fl_4	74 (5.8) 66-82 (n=7)	22 (2.0) 20-25 (n=6)	3.31 (0.37) 2.98-4.0 (n=6)
Fl_5	72 (5.6) 66-80 (n=7)	23 (2.7) 19-25 (n=6)	3.09 (0.37) 2.64-3.72 (n=6)
Fl_6	68 (5.8) 61-75 (n=7)	24 (2.6) 23-27 (n=6)	2.77 (0.25) 2.47-3.19 (n=6)
Clava (n=7)	119 (7.3) 109-129	36 (1.4) 33-37	3.32 (0.26) 2.95-3.73

Table XXV. Statistics of antennal segments of *Anaphes victus* females (from Quebec + Michigan specimens). Means (in micrometers) on top, sample standard deviation in parentheses, and range.

segment	length (L)	width (W)	ratio (L/W)
scape	117 (8.2)	28 (2.2)	4.12 (0.39)
	107-126	26-31	3.54-4.76
	(n=6)	(n=5)	(n=5)
pedicel	53 (5.1)	28 (1.6)	1.80 (0.09)
	48-55	26-30	1.66-1.92
	(n=8)	(n=7)	(n=6)
Fl_1	28 (2.3)	17 (1.2)	1.64 (0.11)
	25-30	15-18	1.41-1.71
	(n=8)	(n=7)	(n=7)
Fl_2	71 (6)	17 (1.3)	3.94 (0.30)
	64-83	17-19	3.59-4.31
	(n=7)	(n=8)	(n=7)
Fl_3	68 (4.2)	21 (2.4)	65 (3.7)
(n=8)	60-75	17-24	61-70
Fl_4	65 (3.7)	21 (2.5)	3.06 (0.32)
(n=8)	61-70	18-24	2.67-3.64
Fl_5	63 (3.8)	22 (2.5)	2.85 (0.28)
(n=8)	57-67	19-25	2.63-3.41
Fl_6	60 (3.3)	22 (3.4)	2.45 (0.24)
(n=8)	55-63	20-29	2.14-2.75
Clava	109 (6.3)	38 (4.0)	2.89 (0.29)
	99-116	34-42	2.66-3.38
	(n=8)	(n=5)	(n=5)

Table XXVI. Statistics of antennal segments of *Anaphes victus* females (from Texas specimens). Means (in micrometers) on top, sample standard deviation in parentheses, and range.

segment	length (L)	width (W)	ratio (L/W)
scape	103 (5.4) 96-112 (n=6)	25 (2.2) 22-28 (n=6)	4.10 (0.24) 3.76-4.36 (n=5)
pedicel (n=7)	46 (1.5) 43-48	26 (1.3) 24-27	1.78 (0.08) 1.73-1.94
Fl_1 (n=7)	22 (2.7) 19-28	14 (1.0) 13-16	1.55 (0.21) 1.27-1.85
Fl_2 (n=7)	51 (5.1) 44-57	15 (0.9) 14-16	3.5 (0.39) 3.03-4.03
Fl_3 (n=7)	58 (2.5) 54-62	19 (1.4) 17-21	3.09 (0.20) 2.91-3.16
Fl_4 (n=7)	55 (3.7) 49-61	20 (1.4) 18-22	2.74 (0.23) 2.50-3.21
Fl_5 (n=7)	54 (3.2) 50-60	20 (1.7) 17-22	2.71 (0.16) 2.47-2.89
Fl_6 (n=7)	51 (2.3) 48-56	21 (1.3) 19-23	2.46 (0.08) 2.33-2.57
Clava	103 (3.5) 98-109 (n=7)	31 (1.0) 30-33 (n=6)	3.20 (0.13) 2.51-3.36 (n=6)

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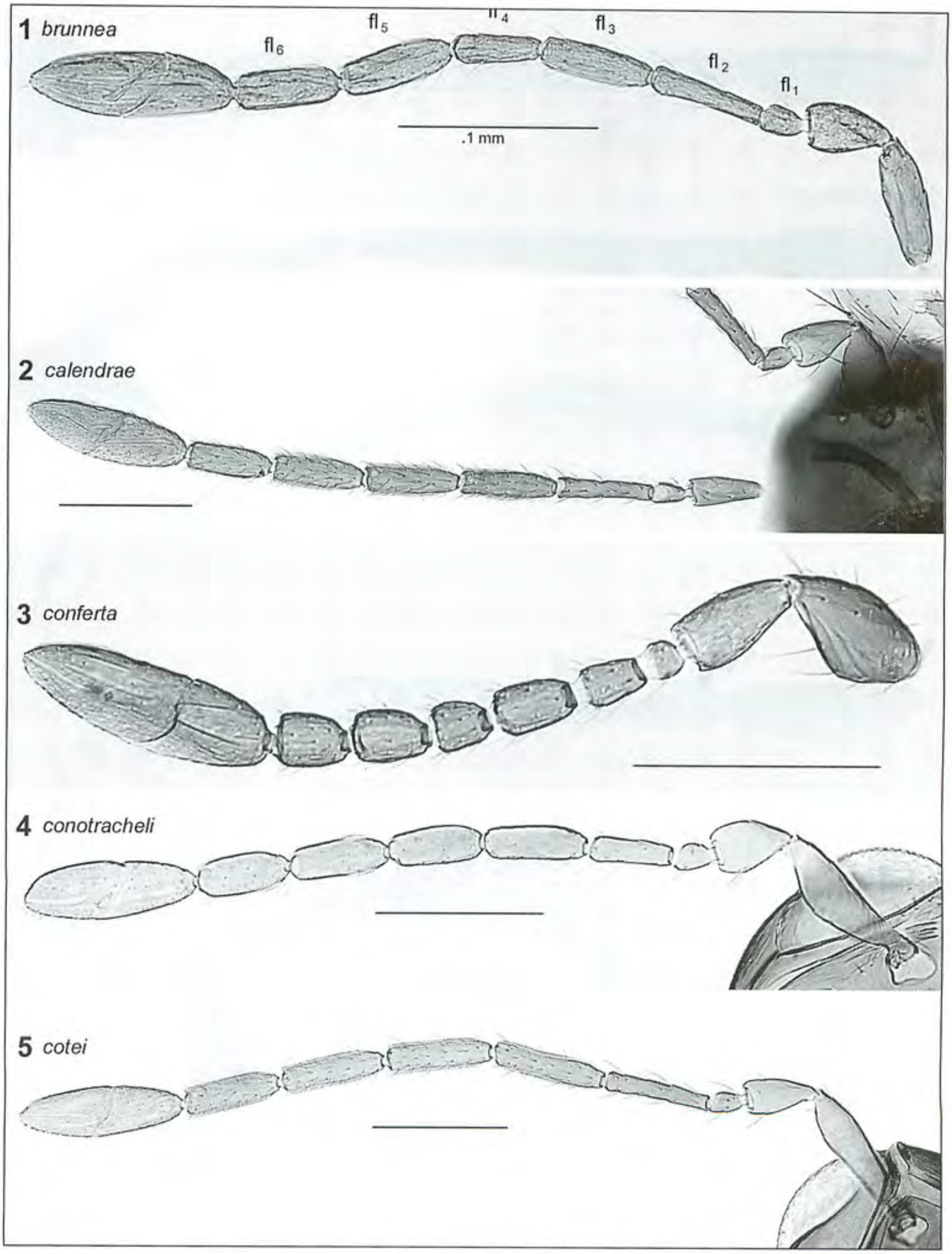
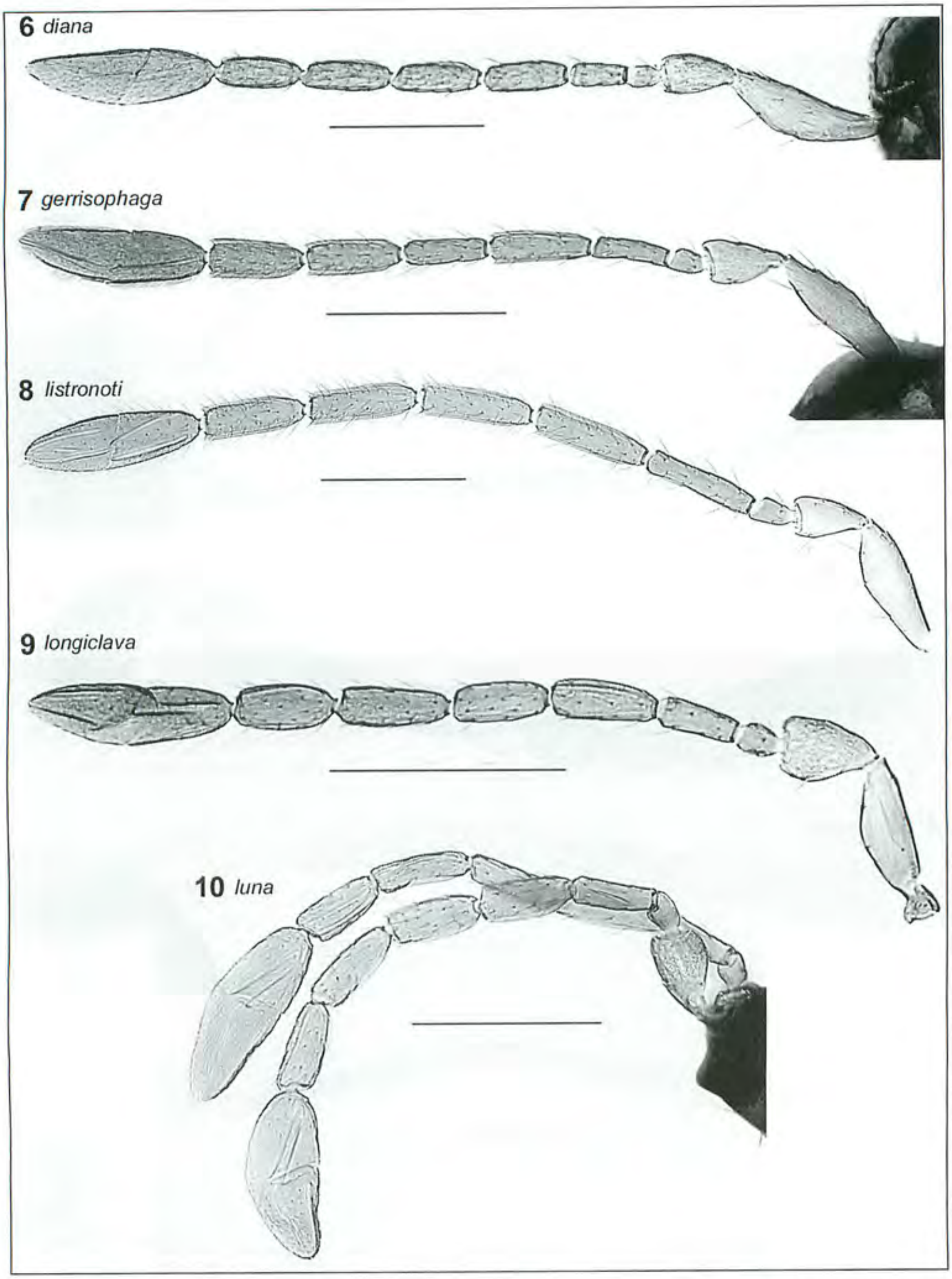
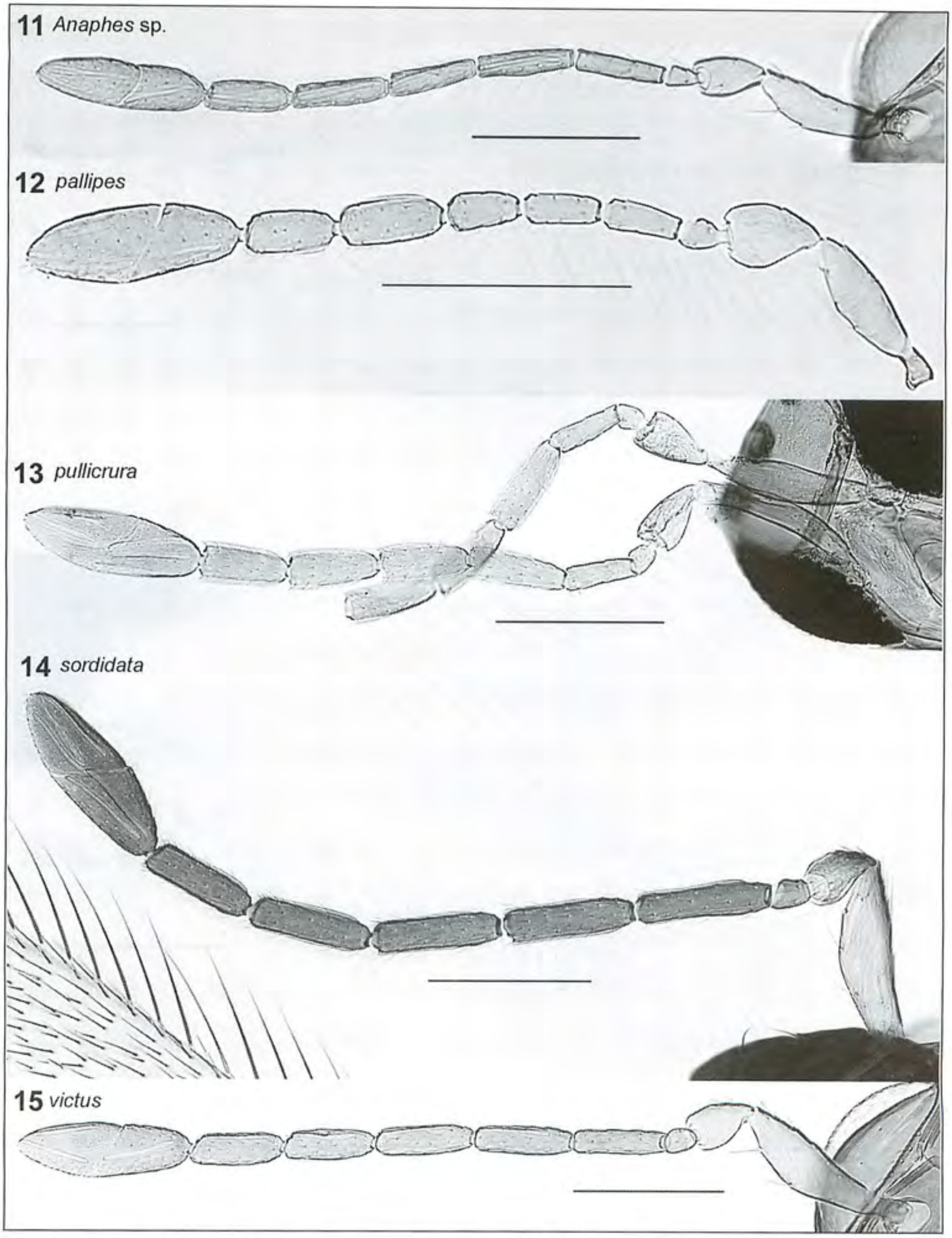


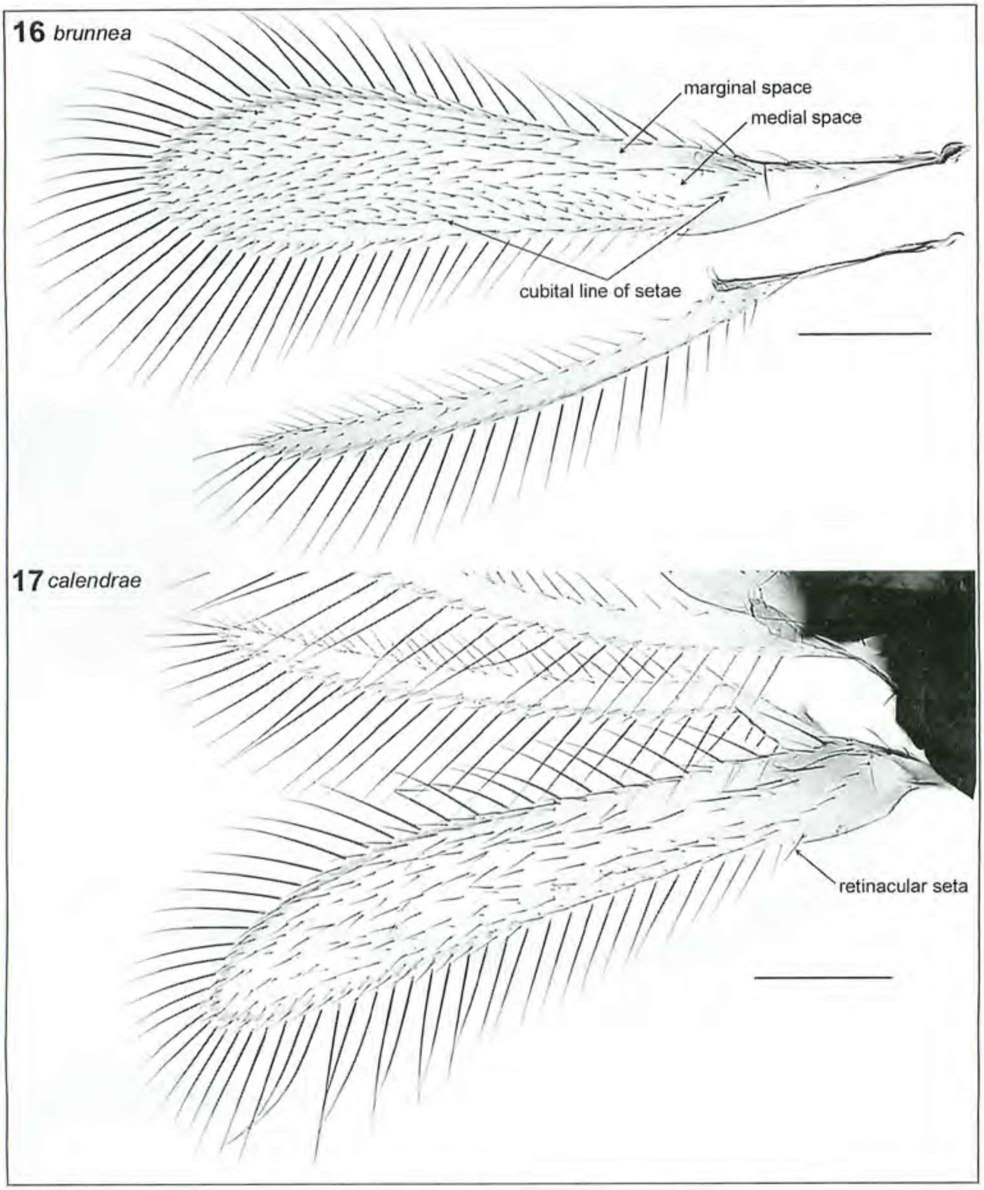
FIGURES 1-5. *Anaphes* spp., female antennae. 1, *brunneus*, holotype; 2, *calendrae*, holotype; 3, *confertus*, holotype; 4, *conotracheli*, paratype; 5, *cotei*, holotype. Scale bars = 0.1mm



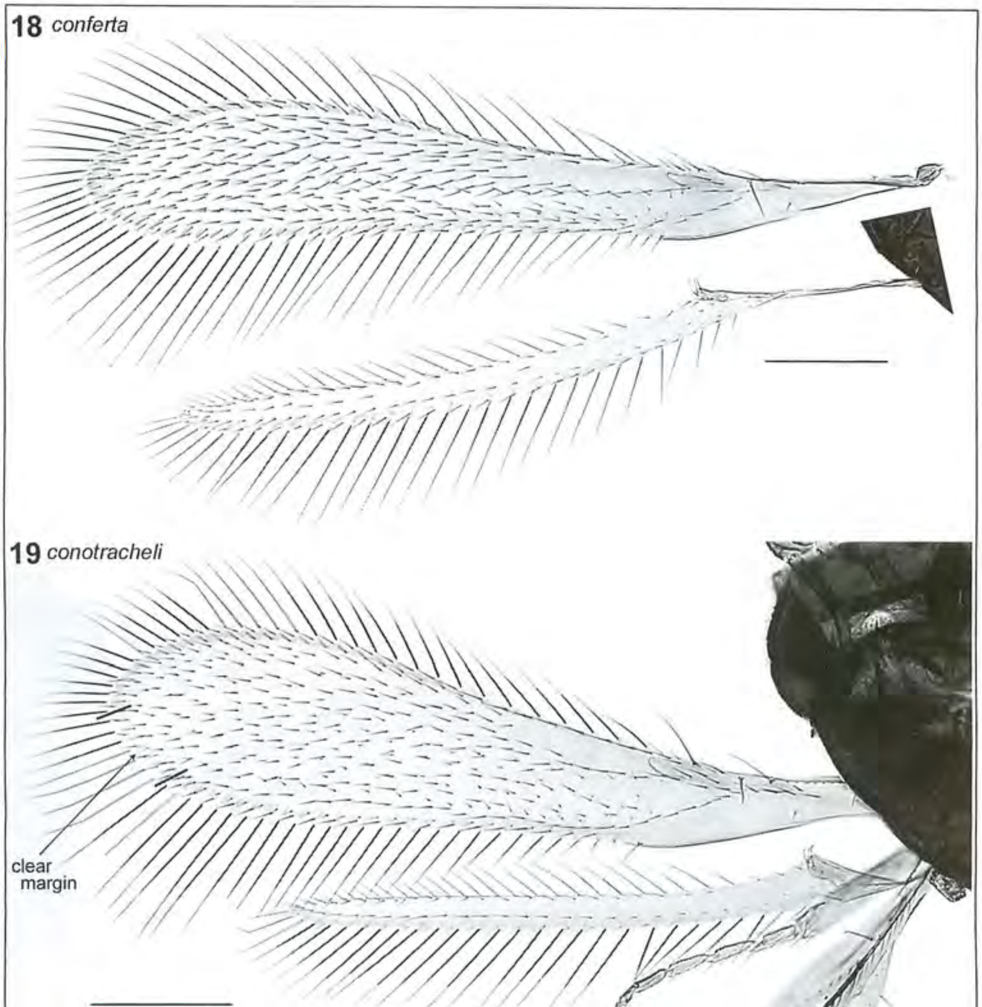
FIGURES 6-10. *Anaphes* spp., female antennae. 6, *diana*, lectotype; 7, *gerrisophaga*, holotype; 8, *listronoti*, holotype; 9, *longiclava*, holotype; 10, *luna*, paralectotype. Scale bars = 0.1mm



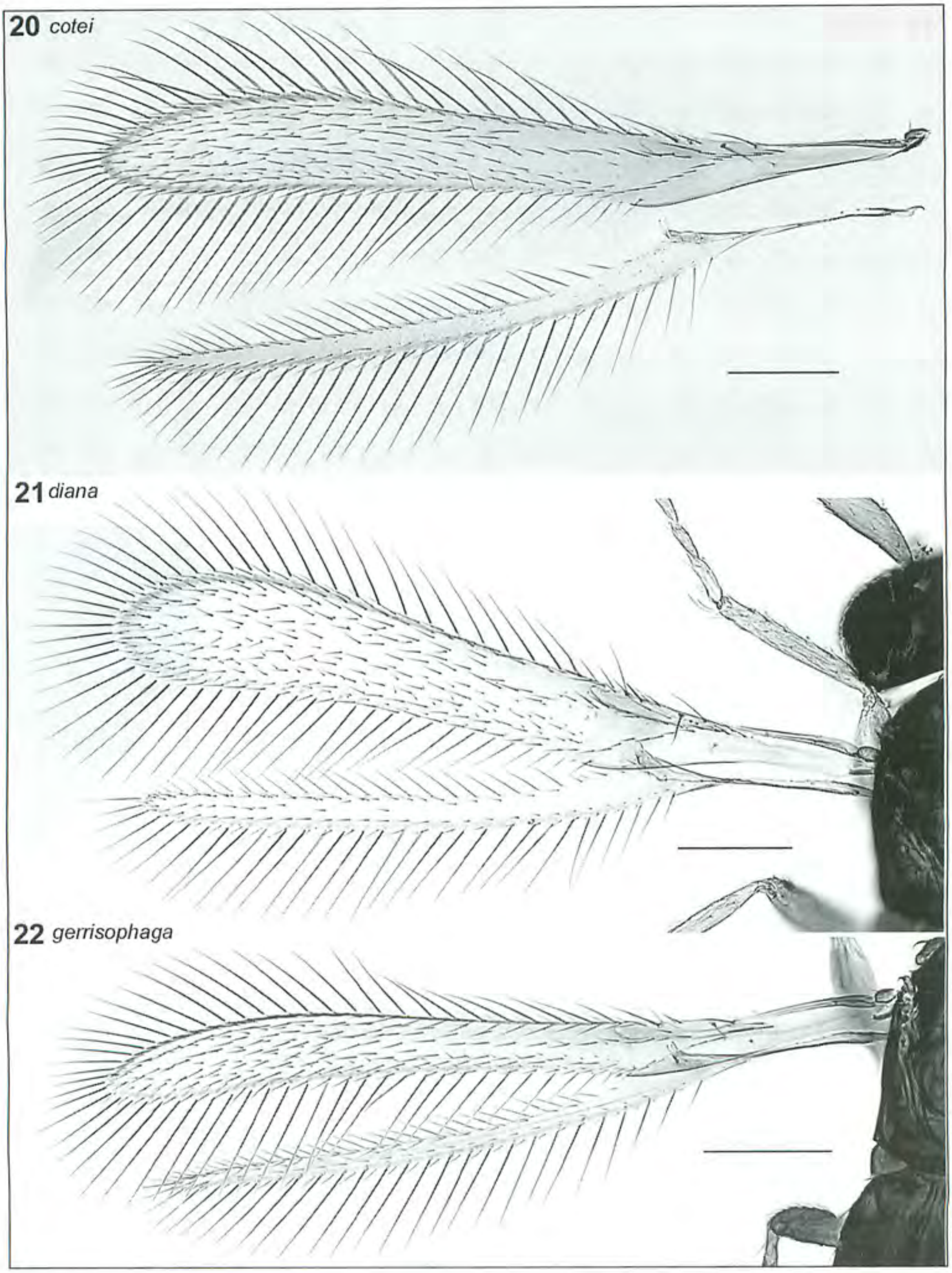
FIGURES 11-15. *Anaphes* spp., female antennae. 11, *A.* sp., not *luna*, ex. lab. culture on *Hypera postica*, WI, spring 1985, W. Gould; 12, *pallipes*, USA, TX, Travis Co., Austin, Zilker Park, 8.X.1983, J.B. Woolley; 13, *pullicrurus*, holotype; 14, *sordidatus*, lectotype; 15, *victus*, holotype. Scale bars = 0.1mm



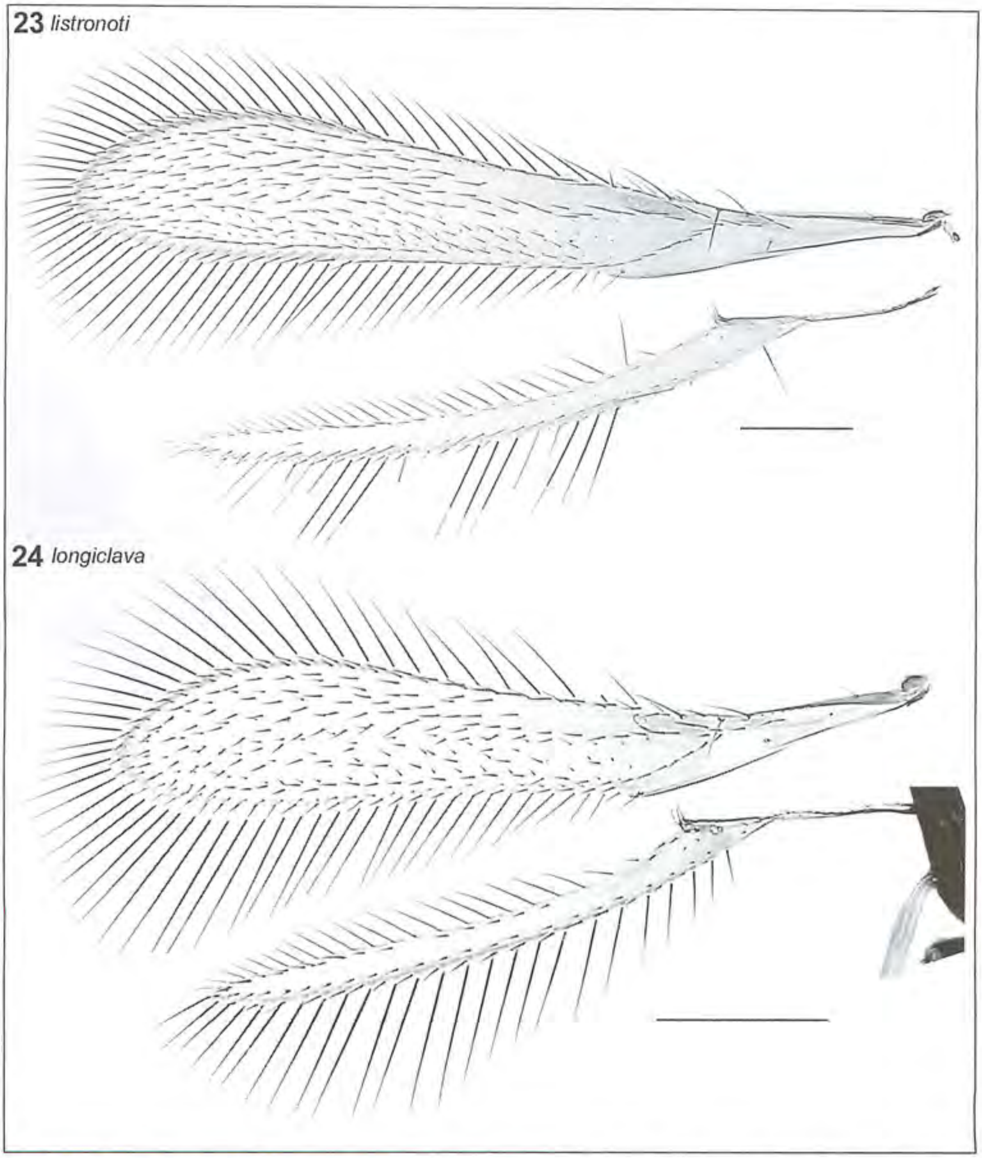
FIGURES 16, 17. *Anaphes* spp., wings. 16, *brunneus*, holotype; 17, *calendrae*, holotype. Scale bars = 0.1mm



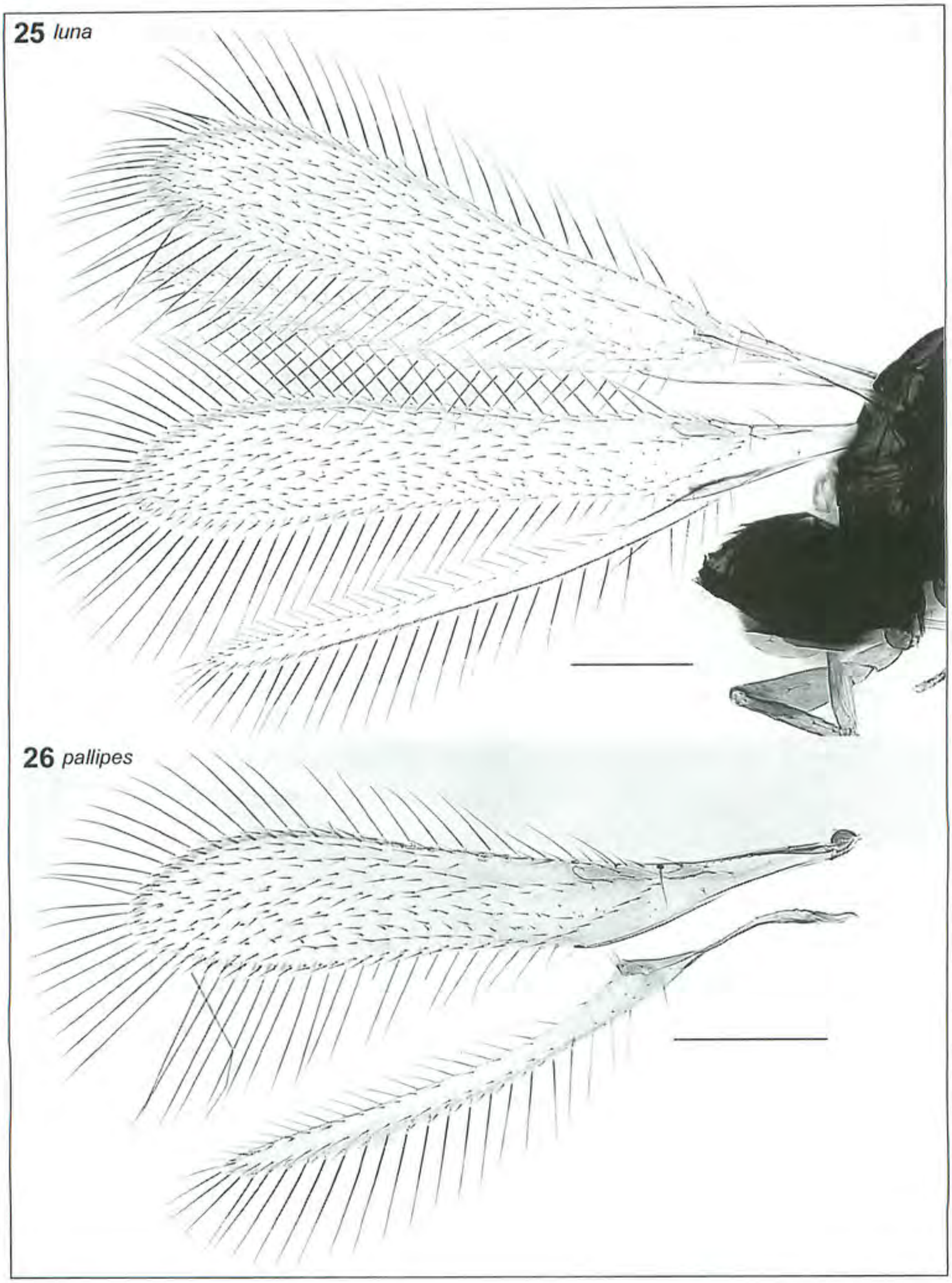
FIGURES 18, 19. *Anaphes* spp., wings. 18, *confertus*, holotype; 19, *conotracheli*, USA: MD, Arundel, #262. Scale bars = 0.1mm



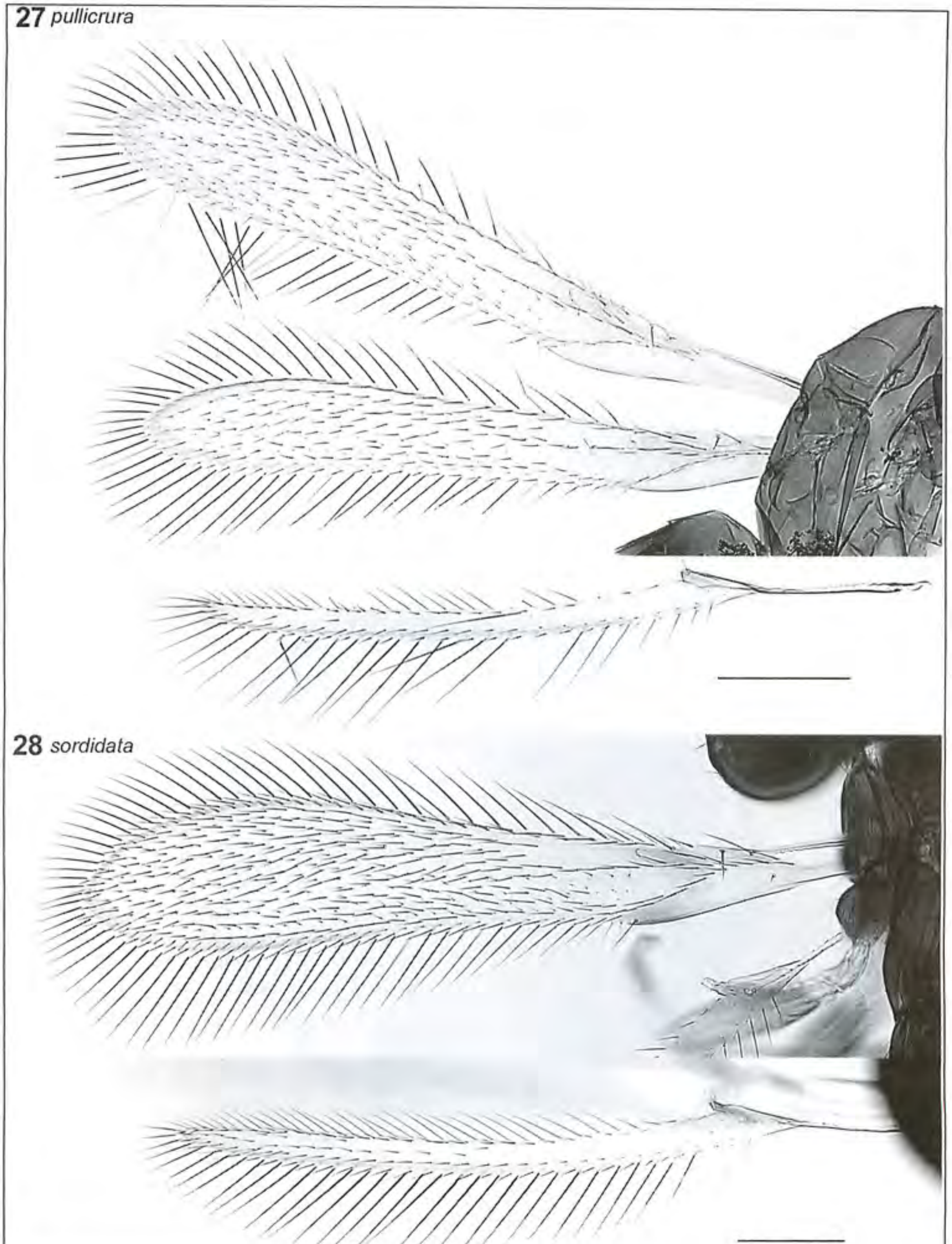
FIGURES 20-22. *Anaphes* spp., wings. 20, *cotei*, holotype; 21, *diana*, lectotype; 22, *gerrisophagus*, holotype. Scale bars = 0.1mm



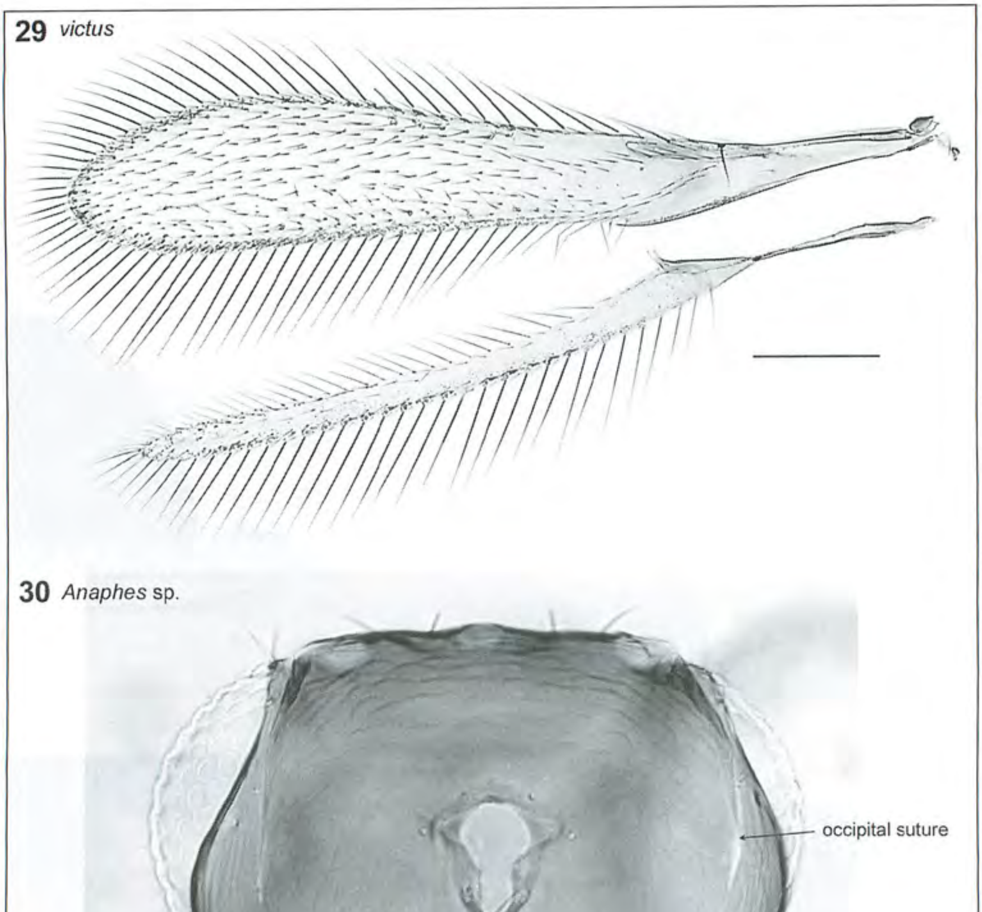
FIGURES 23, 24. *Anaphes* spp., wings. 23, *listronoti*, holotype; 24, *longiclava*, holotype. Scale bars = 0.1mm



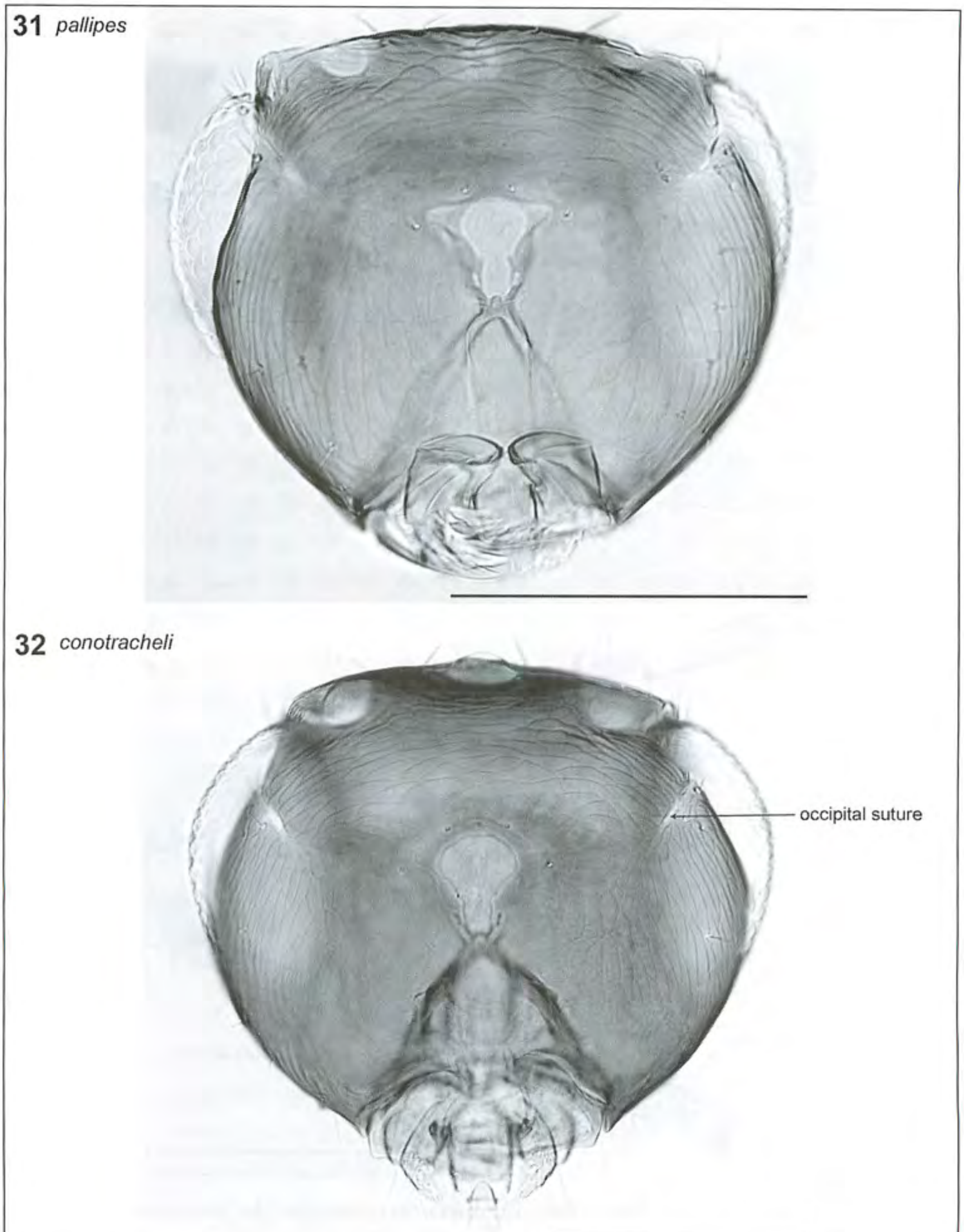
FIGURES 25, 26. *Anaphes* spp., wings. 25, *luna*, lectotype; 26, *pallipes*, USA, TX, Travis Co., Austin, Zilker Park, 8.x.1983, J.B. Woolley. Scale bars = 0.1mm



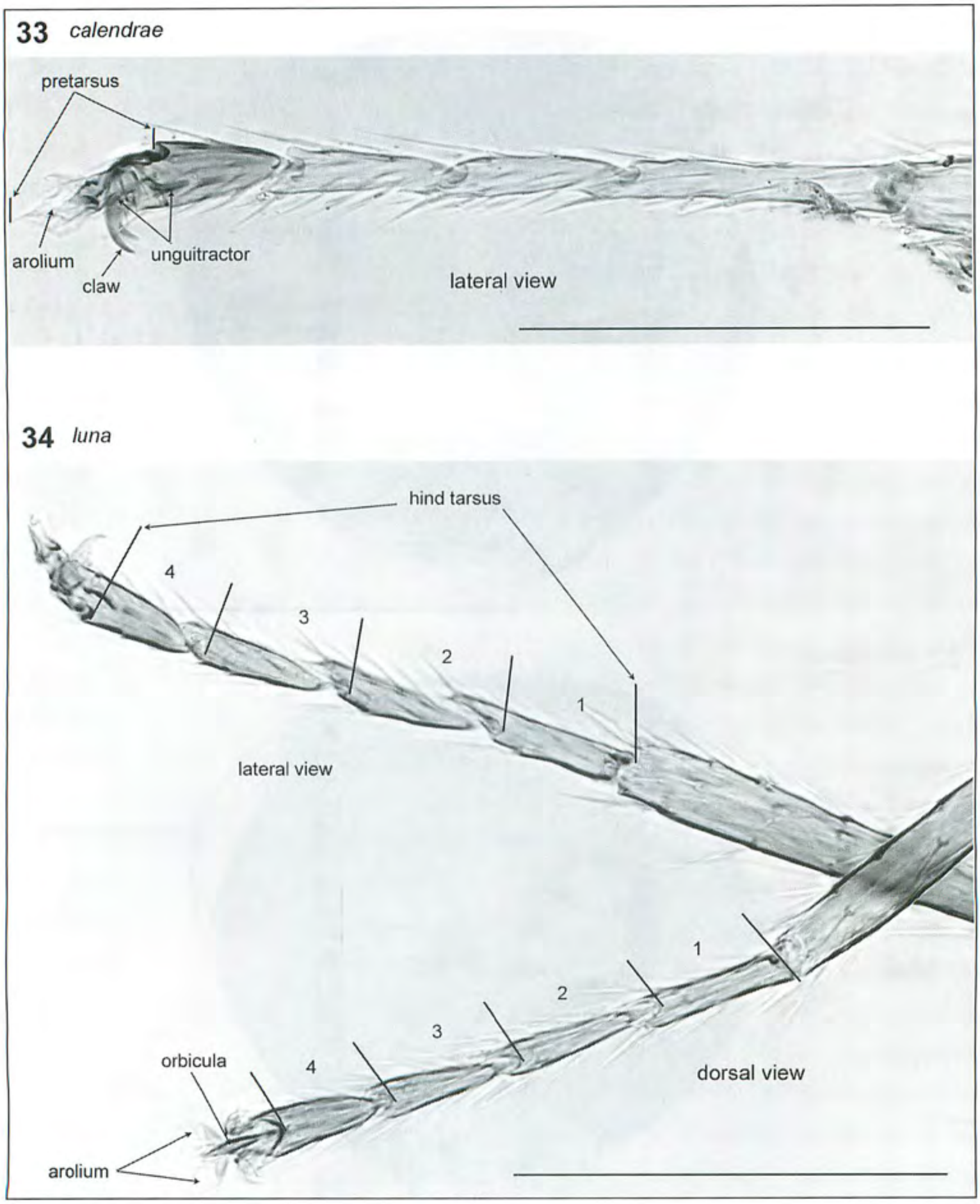
FIGURES 27, 28. *Anaphes* spp., wings. 27, *pullicrurus*, holotype; 28, *sordidatus*, lectotype. Scale bars = 0.1mm



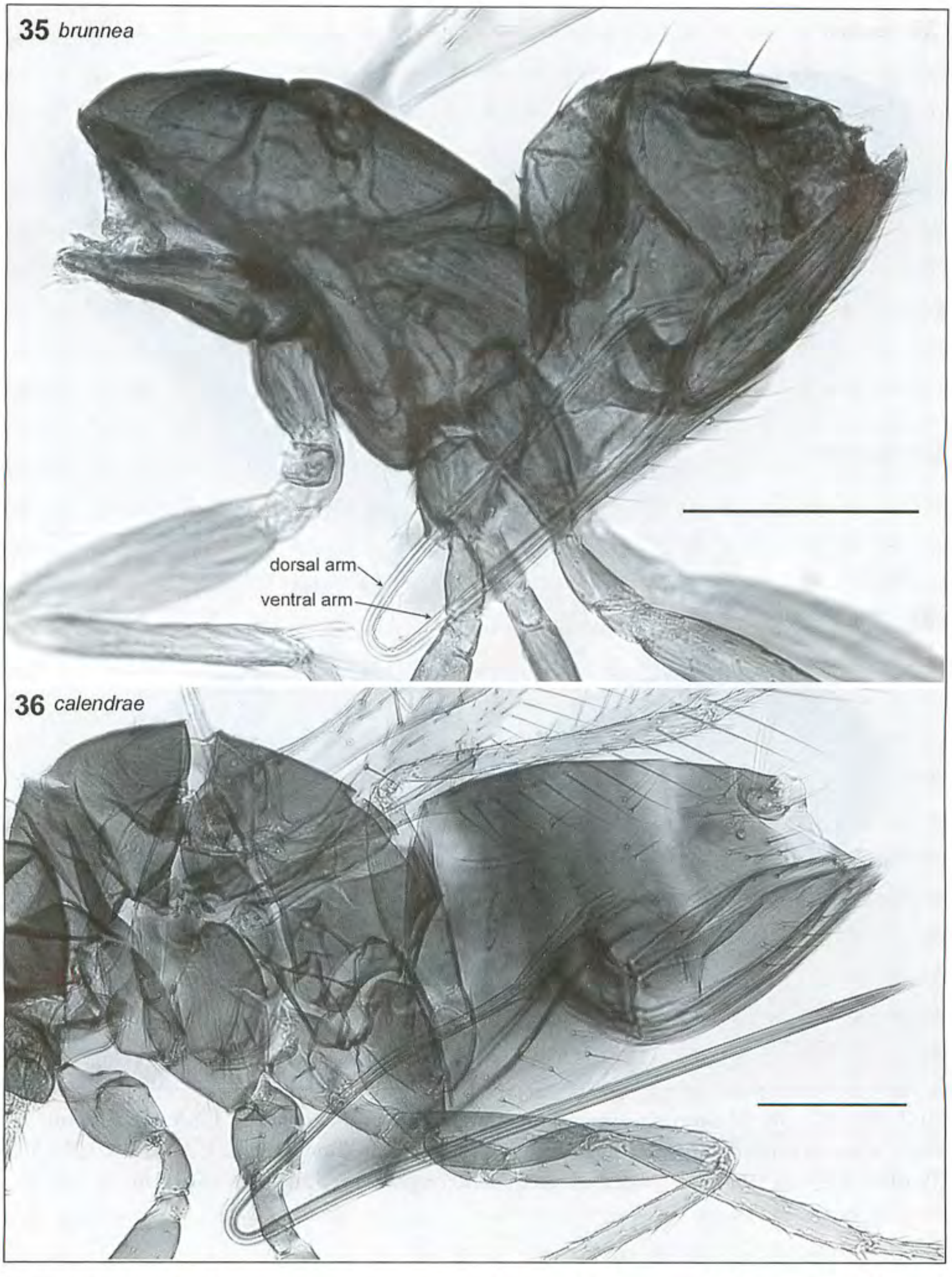
FIGURES 29, 30. *Anaphes victus*, holotype, wings; 30, *A.* sp. not *luna*, WI, Madison, spring, 1985, lab. culture ex. *Hypera postica*, W. Gould, Posterior of head. Scale bars = 0.1mm



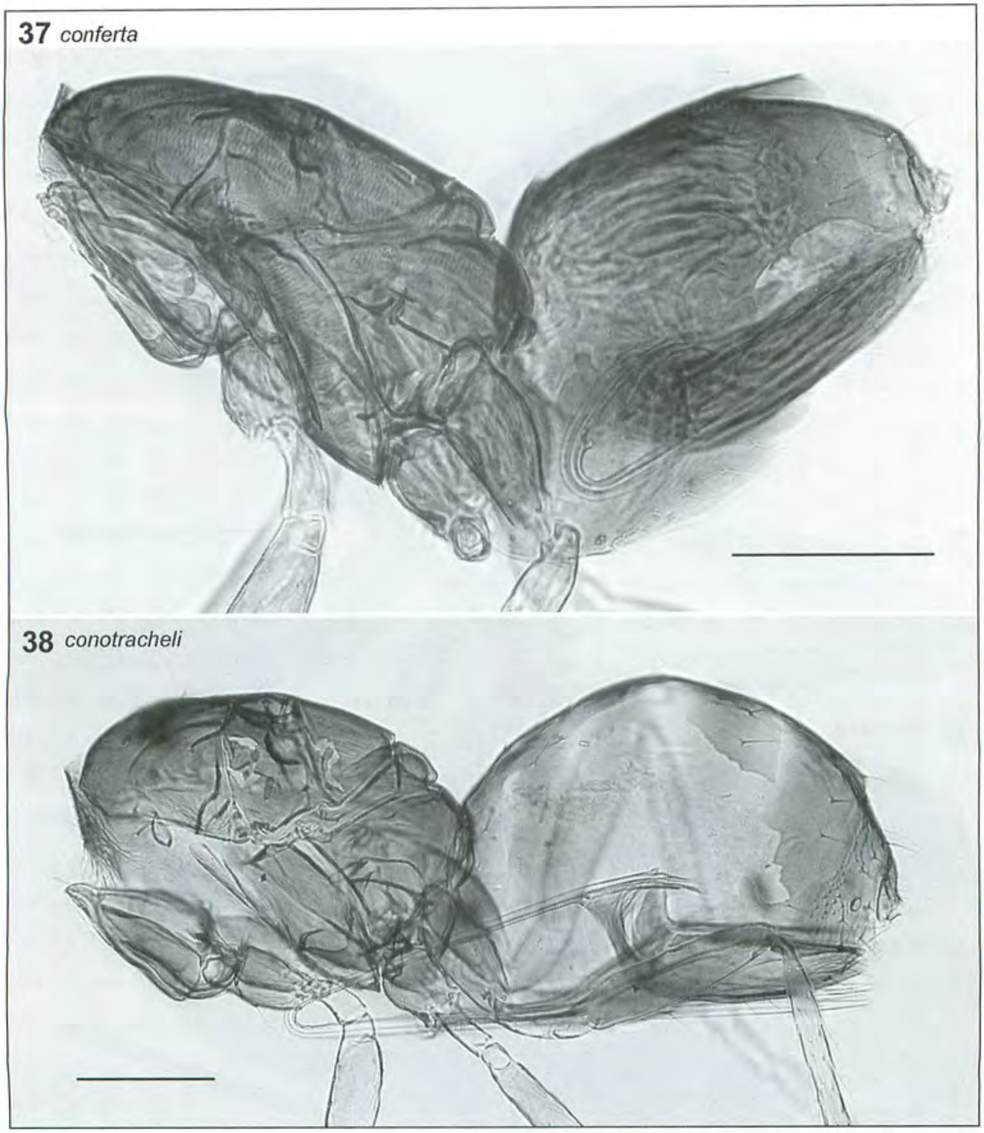
FIGURES 31, 32. *Anaphes pallipes*, Posterior of head. 31, ex. *Cylindrocopturus adspersus*, ND, Cass. Co.; 32, ex. lab. culture on *Listronotus oregonensis* but originally collected from *Conotrachelus geminatus*. Scale bars = 0.1mm



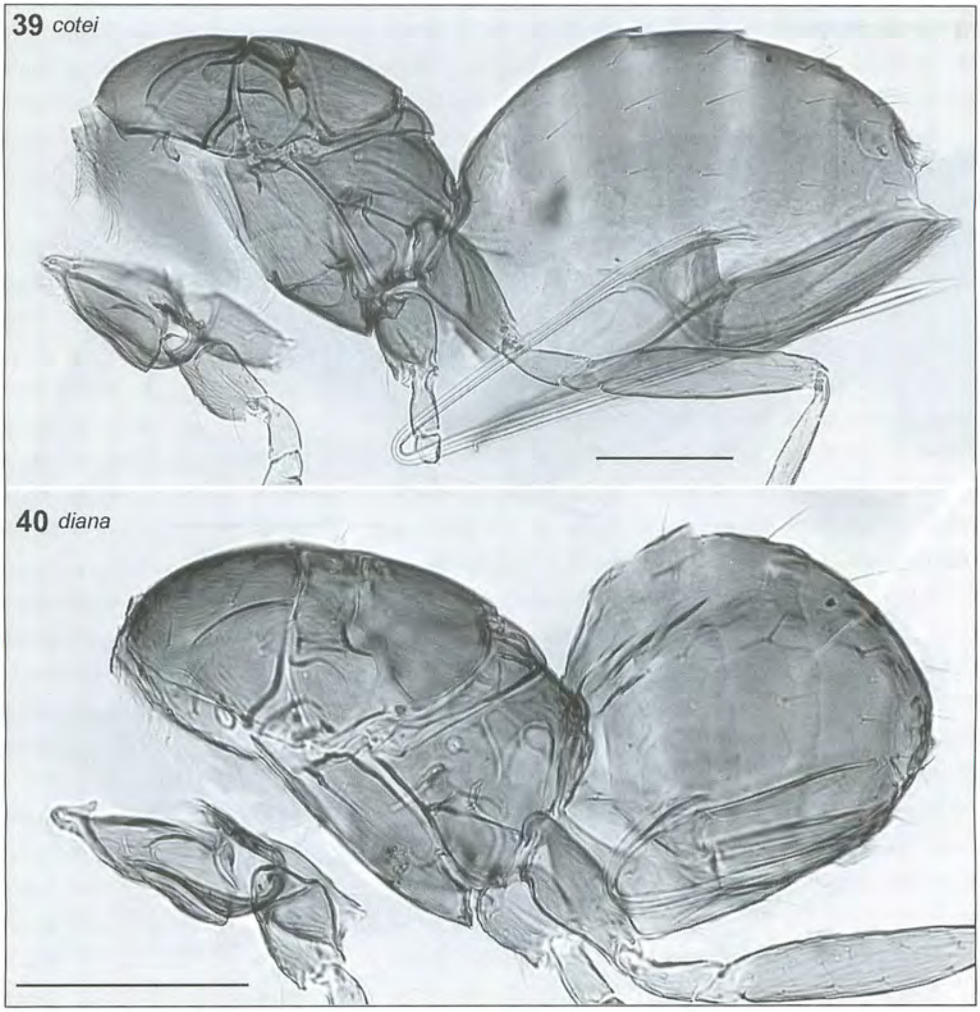
FIGURES 33, 34. *Anaphes*, hind tarsi. 33, *calendrae*, paratype; 34, *luna*, holotype. Scale bars = 0.1mm



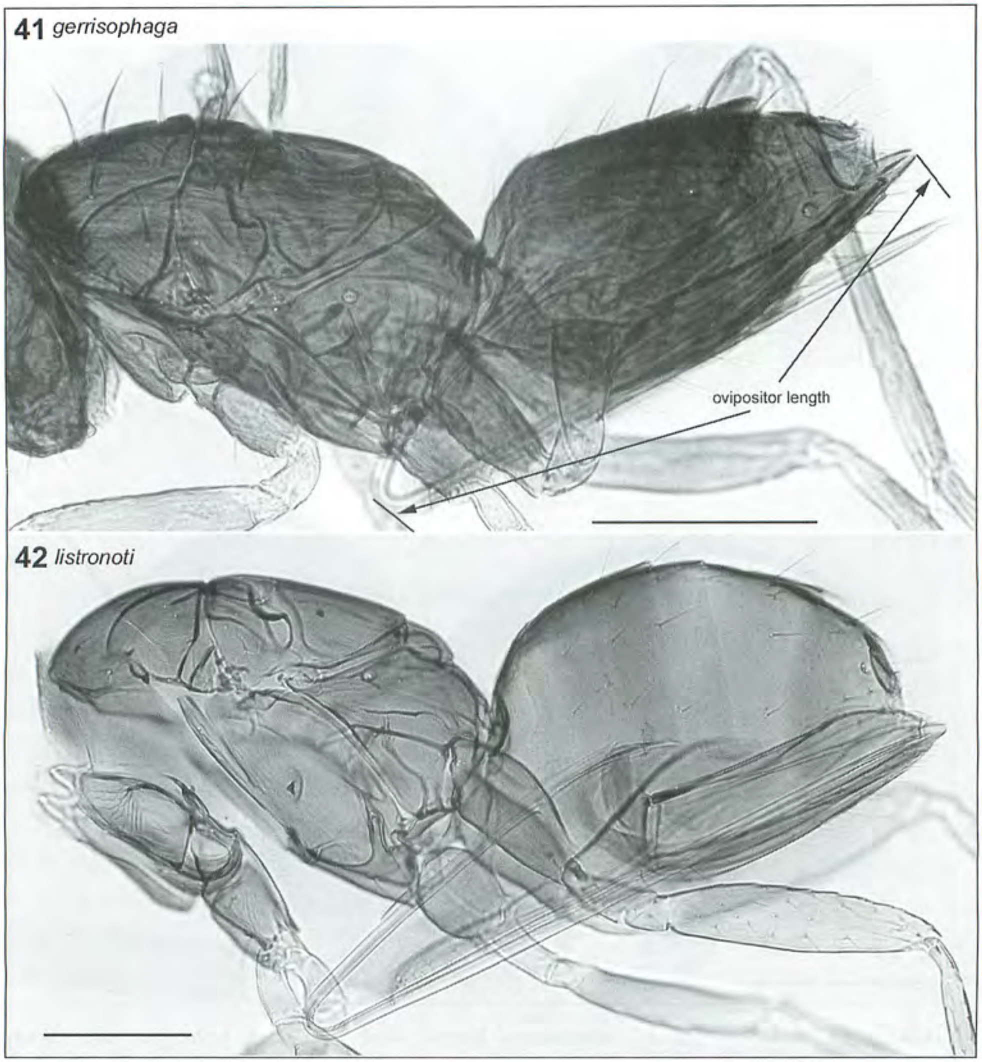
FIGURES 35, 36. Mesosoma + metasoma, lateral view. 35. *brunneus*, holotype; 36, *calendrae*, ex. *Sphenopterus venatus vestitum*, USA: FL, Ft. Lauderdale, vii.1968, H. Nakao & R. Suyukawa. Scale bars = 0.1mm



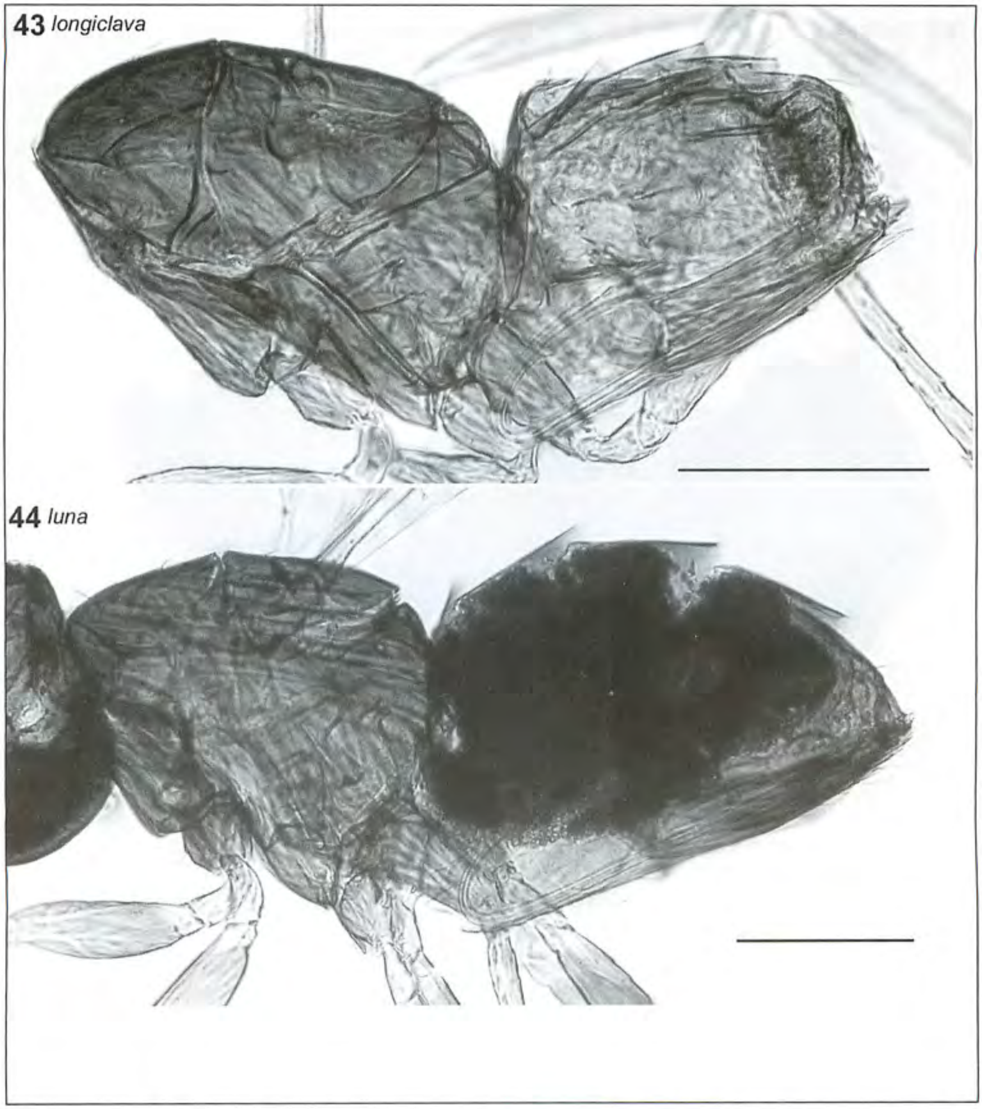
FIGURES 37, 38. Mesosoma + metasoma, lateral view. 37, *confertus*, USA: AZ, 12 mi. N. Sierra Vista, Ramsey Canyon. 10.vi.1987, B.V. Brown; 38, *conotracheli*, CANADA: QC, Ste. Clotilde, 1-23.vii.1990, lab. reared ex. *Listronotus oregonensis*. Scale bars = 0.1mm



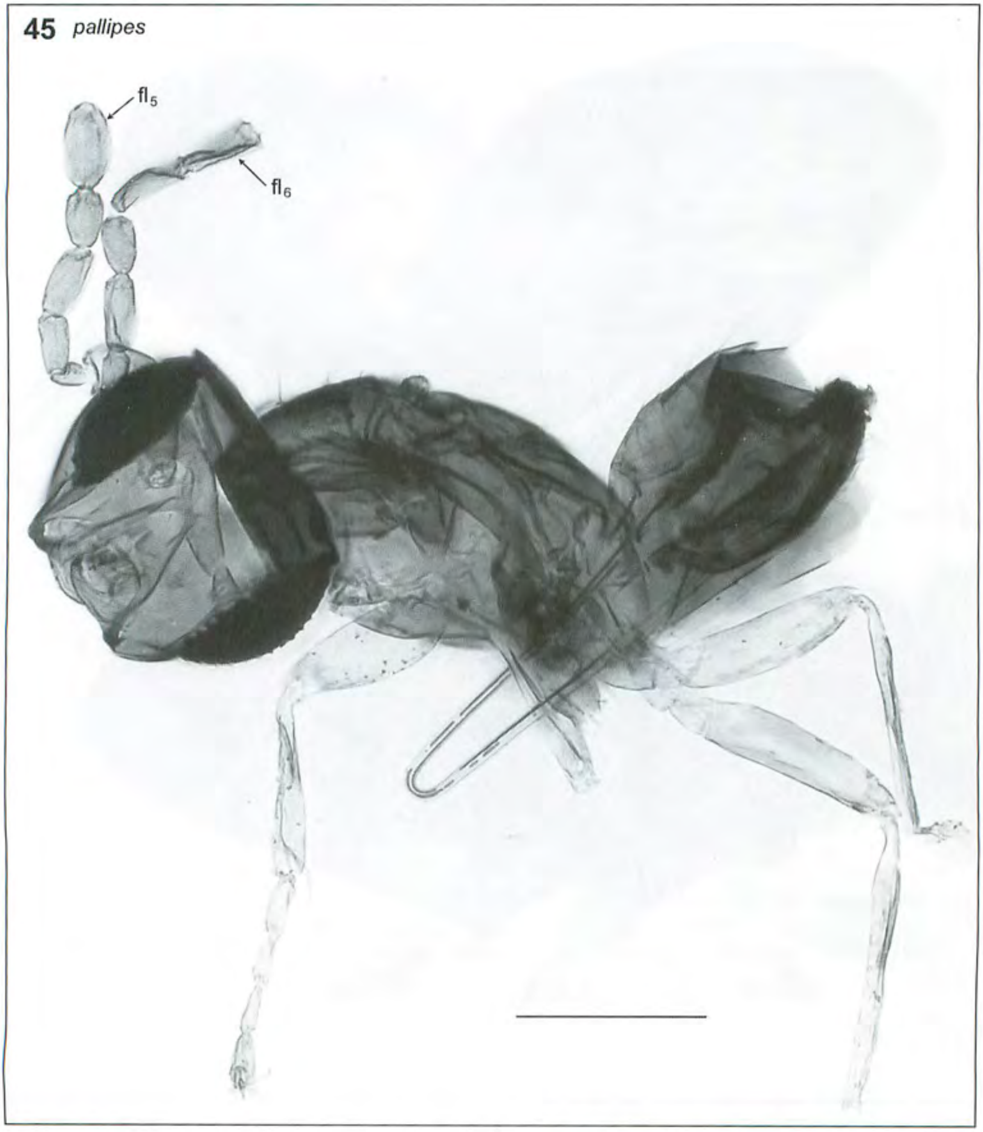
FIGURES 39, 40. Mesosoma + metasoma, lateral view. 39, *cotei*, holotype; 40, *diana*, bisexual form, FRANCE: Hérault, St.-Gély-du-Fesc, iii.1984, J.P. Aeschlimann, ex *Sitona* sp. Scale bars = 0.1mm



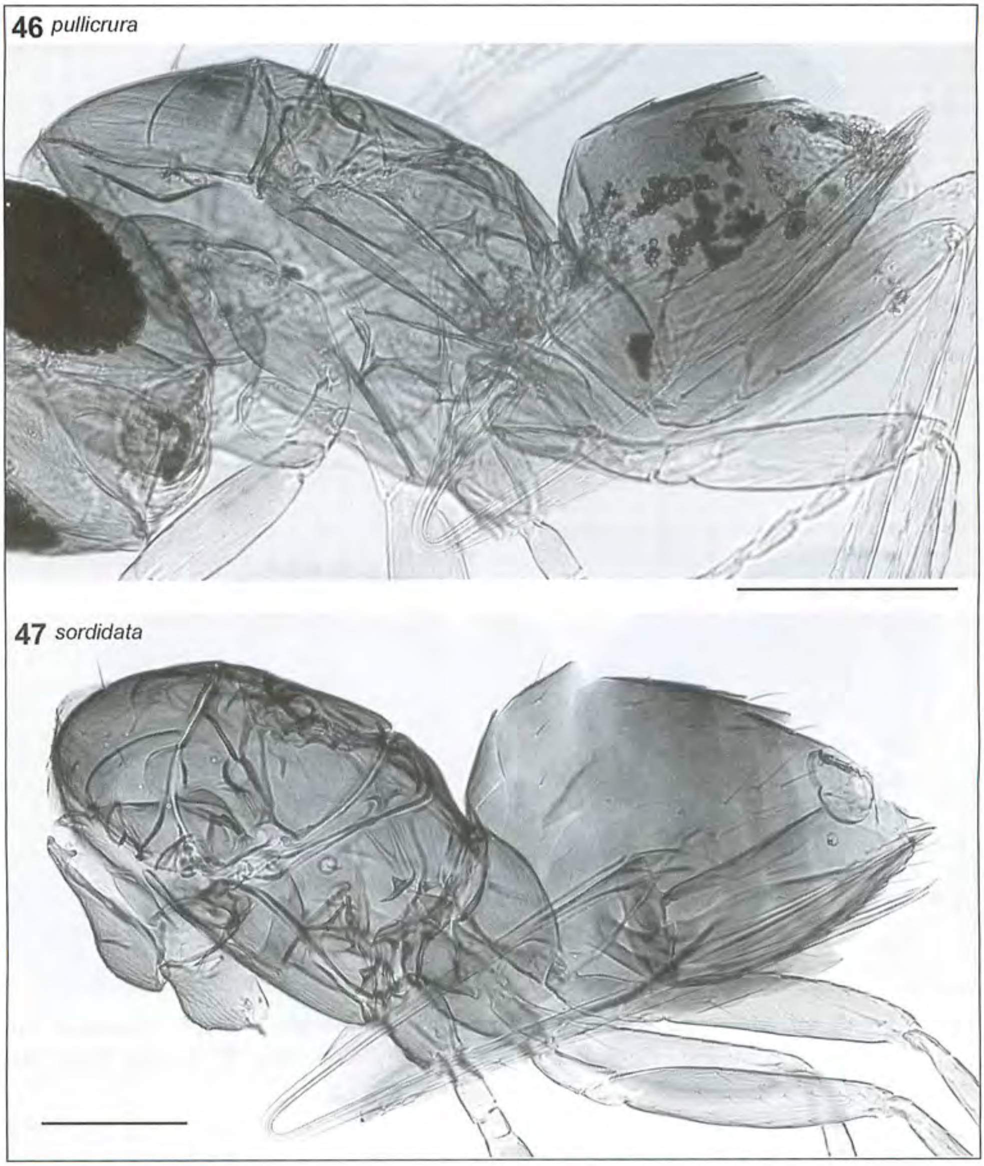
FIGURES 41, 42. Mesosoma + metasoma, lateral view. 41, *gerrisophagus*, CANADA: ON, Oxford Mills, 13-20.vii.1973, L. Masner; 42, *listronoti*, holotype. Scale bars = 0.1mm



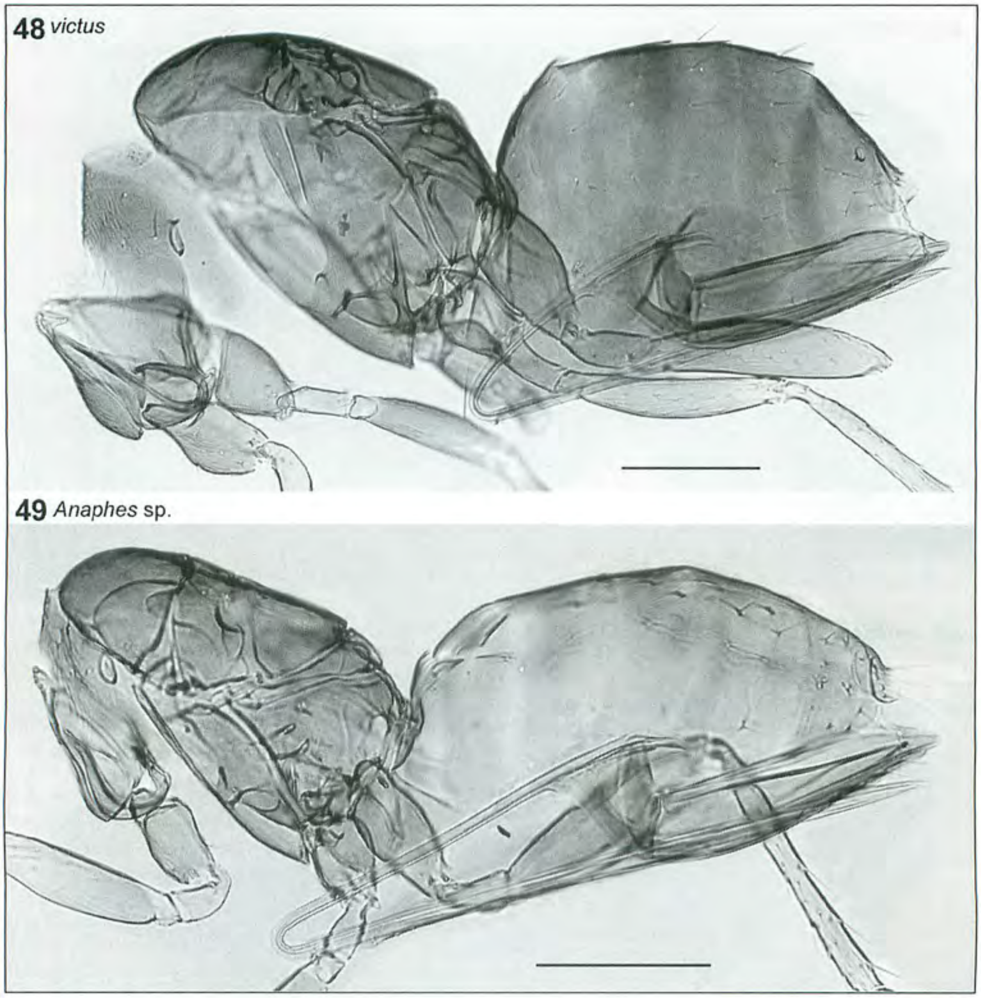
FIGURES 43, 44. Mesosoma + metasoma, lateral view. 43, *longiclava*, holotype. 44, *luna*, USA: UT, Salt Lake City, 12.vi.1911, T.H. Parks, ex. *Hypera* "reared through Utah eggs." Scale bars = 0.1mm



FIGURES 45. Entire body (before remounting) of *pallipes*, holotype. Scale bars = 0.1mm



FIGURES 46, 47. Mesosoma + metasoma, lateral view. 46, *pullicrurus*, holotype; 47, *sordidatus*, USA: IL, Marion Co., Centralia, emerg. 29.vi.1992, ex. *Tyloderma foveolatum* on *Oenothera biennis*, S. Côté. Scale bars = 0.1mm



FIGURES 48, 49. Mesosoma + metasoma, lateral view. 48, *victus*, holotype; *Anaphes* sp. not *luna*, WI, Madison, spring, 1985, lab. culture ex. *Hypera postica*, W. Gould. Scale bars = 0.1mm