

1977

## Five New Species of Orchesella (Collembola: Entomobryidae)

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### Recommended Citation

Christiansen, K. A. and Tucker, B. E. (1977) "Five New Species of Orchesella (Collembola: Entomobryidae)," *Proceedings of the Iowa Academy of Science*, 84(1), 1-13.

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Five New Species of *Orchesella* (Collembola: Entomobryidae)K. A. CHRISTIANSEN<sup>1</sup> and B. E. TUCKER<sup>2</sup>

CHRISTIANSEN, K. A. and BRUCE E. TUCKER (Dept. of Biology, Grinnell College, Grinnell IA 50112). Five New Species of *Orchesella* (Collembola: Entomobryidae). Proc. Iowa Acad. Sci. 84(1): 1-13, 1977.

This paper describes 5 species of the genus *Orchesella* (Collembola: Entomobryidae) new to science. The chaetotaxy of the abdomen as well as the antennal pin setae are used systematically for the first time in the taxonomy of the genus.

INDEX DESCRIPTORS: Collembola Taxonomy, North American Insect Taxonomy.

In the course of preparing a revision of the genus *Orchesella* for *The Collembola of North America*, Christiansen and Bellinger, nearctic specimens were examined which were sufficiently different from previously described species to warrant the separation of 5 new taxa.

The genus *Orchesella* as defined here consists of those scaleless Entomobryinae having a bidentate mucro with a basal spine reaching the subapical tooth (Fig. 7), clavate tenent hairs (Figs. 4 & 5), and the fourth abdominal segment less than 3 (2 for nearctic material) times as long as the third. For further details on classification systems of these organs consult *The Collembola of North America*.

There are, in addition to those structures mentioned above, a number of characteristics which are common to all nearctic members of the genus. These include: ANT IV with a pin seta and subapical organ of 2 blunt, slightly expanded rods (Fig. 1); ANT III with an apical sensory organ of 2 blunt rods in an integumentary fold and 2 small accessory pegs (Fig. 2); ANT I and II subsegmented; eyes 8+8, with eyes G & H smaller than others (Fig. 3); hind foot complex with an unguis with 1 outer, 2 larger lateral and 4 small inner teeth and an unguiculus composed of 4 lamellae, with an outer tooth (Figs. 4 & 5); tenaculum with 4+4 teeth and 1 seta; dens longer than manubrium, with large dorsal crenulations reduced apically to fine ribbing (Fig. 7); males with a dorsal manubrial organ of probable secretory function consisting of 4 coarsely ciliated setae recessed into an hemispherical protrusion from the center of the dorsal surface of the manubrium (Figs. 6 & 39); macrochaetae large and numerous on the thorax, decreasing in size and number posteriorly; ABD II - IV with very long, finely ciliated bothriotrichia (Figs. 14 & 30).

With the exception of pattern, there appear to be very few characteristics showing the consistent interspecific differences. The pin seta on the apex of the fourth antennal segment does show some variation, and there are 5 general types: Type 1) bidentate - 1 apical + 1 subapical pin; Type 2) bidentate - 2 strongly divided pins; Type 3) bidentate - 2 weakly divided pins; Type 4) tridentate - 1 apical and 2 subapical pins; Type 5) tridentate - 3 apical pins. The pin seta most commonly observed is of Type 4, although the angle of observation or lack of resolution may lead to confusion with Type 2 pin setae (Figs. 1, 45 & 46).

The numerous body setae and macrochaetae make traditionally used cephalic, ventral tube, manubrial or dental chaetotaxy very difficult if not impossible to use. The macrochaetae of the abdomen, however, are very regular, and the few macrochaetae of the third abdominal segment can be divided into 4 groups relative to the 2+2 lateral and 1+1 postero-medial bothriotrichia. The Lateral (L) setae are always 3 in number and lie lateral to the paired bothriotrichia, M setae lie on the level of and just inside (medial to) the paired bothriotrichia, A setae lie above the level of the paired bothriotrichia with the Inner A (IA) setae

extending from the midline to halfway between the single and paired bothriotrichia, and the Outer A (OA) setae anterior and slightly medial to the paired bothriotrichia which places them lateral to the Inner A and anterior to the M setae (Figs. 14, 24, 30, 31, 37 & 38). Table 1 presents the ABD III Chaetotaxy for all 14 nearctic species of the genus *Orchesella*.

Measurements of the type specimens and other representative material are presented in Table 2. All measurements are in millimeters and represent the mid-dorsal length with the exception of the cephalic diagonal (longest head measurement possible), foot structures (inner arc of unguis and unguiculus), and furcula (manubrium and dens measured ventrally, mucro dorsally).

Table 1. Chaetotaxy of the Third Abdominal Segment for Nearctic Species of the Genus *Orchesella*

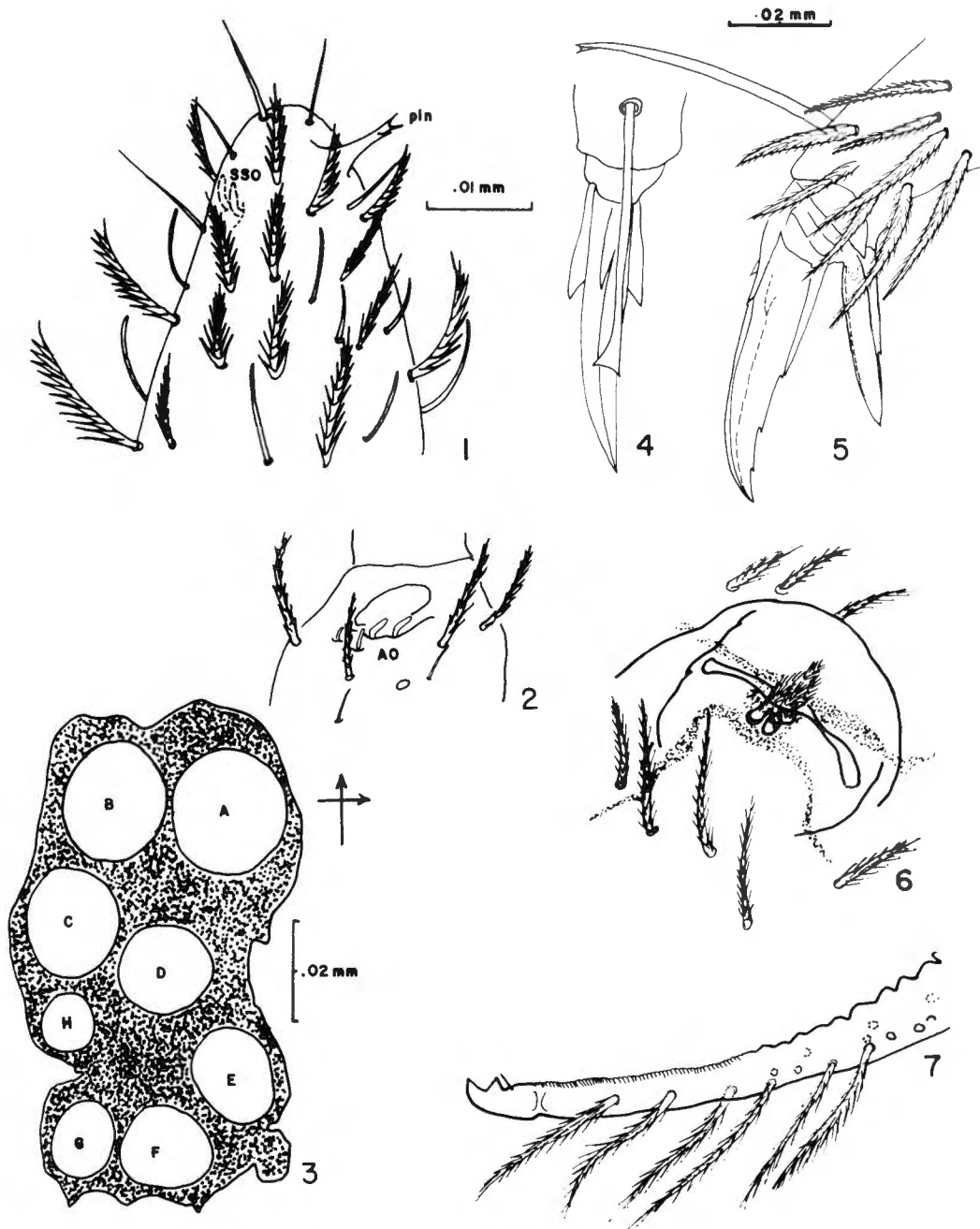
Species	MACROCHAETAETAE			
	Inner A	Outer A	M	Lateral
<i>ainsliei</i>	3-4	1	2	3
<i>albosa</i>	3-6	1	2	3
<i>alpa</i>	4-5	1	2-3	3
<i>annulicornis</i>	3	0	3	3
<i>bulba</i>	2-3	0	2	3
<i>carniceps</i>	?	0?	3?	3?
<i>celsa</i>	3	0	2	3
<i>cincta</i>	4	0	3	3
<i>fishmani</i>	4-5	1	2-3	3
<i>flora</i>	3	0	2(3)	3
<i>folsomi</i>	2?	0	3-4	3
<i>hexfasciata</i>	3	0	3	3
<i>villosa</i>	3-4	2-3	3-4	3
<i>zebra</i>	4-6	1(0)	3	3

*Orchesella bulba* n. sp.  
Plate I: Figs. 2, 6 & 7;  
Plate II: Figs. 8 14.

Color: Background white with blue pigment. Antennal segments with apical pigment rings. Head with inter-antennal spot with circum-antennal extensions, cheek patches posterior and lateral to and a mid-cephalic spot posterior to the eyes. Thoracic segments with pigmented lateral margins; dorsally with 2 stripes convergent in anterior half of TH II, TH III with 1 broad or 2 smaller anterior spots and 2 stripes in the posterior half. ABD I with a more or less broken transverse band; ABD II with a mid-dorsal patch or stripe, 2 dorsal and 2 lateral patches; ABD III with a central patch free of pigment along the mid-dorsal line and with 2 irregular patches dorsally; ABD IV with scattered irregular patches between the 2 dorsal stripes and a narrow transverse band at the posterior segmental margin; ABD V and ABD VI with 2 dorso-lateral

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**Plate I:** Typical Body Structures of *Orchesella*.

Fig. 1. Apex of ANT IV; *O. flora* — specimen #3 from Ind., Pin seta of type 4. (pin = Pin Seta; SSO = subapical sensory organ).

Fig. 2. Apex of ANT III; *O. bulba* — specimen 116-002 from La., (AO = Apical sensory Organ).

Fig. 3. Right eyepatch; *O. flora* — paratype #3 from Fla.

Fig. 4. Hind foot complex, frontal aspect; *O. celsa* — specimen from S.C.

Fig. 5. Hind foot complex, lateral aspect; *O. celsa* — specimen from N.C. holotype.

Fig. 6. Male dorsal manubrial organ; *O. bulba* — specimen from La., Ouachita Par..

Fig. 7. Mucro and distal dens; *O. bulba* — holotype from Fla.



patches. Precoxae lightly pigmented, ventral tube and furcula pale.

Light specimens from Louisiana with pigment limited to apical pigment rings on ANT IB and IIB, inter-antennal spot, faint cheek patches, lateral thoracic margins and pigment traces on dorsum of thorax and ABD III. Darker specimens show more complete transverse banding on ABD II III.

ANT IV with a bilobed apical bulb, Type 4 pin seta and subapical sensory organ of 2 blunt rods. ANT III apical organ of 2 blunt rods and 2 smaller accessory pegs. Eyes 8+8, eye B slightly larger than others, eyes G & H distinctly smaller than eye F. Hind foot complex with tenent hair longer than unguis, unguiculus .7 times as long as unguis and with an outer tooth inserted beyond the midpoint (.5-.56). Dens 1.3-2.0 times as long as manubrium. Small body setae narrowly fusiform and ciliate for apical 1/3 of length. Macrochaetae of ABD III: 3+3 (rarely 2+2) Inner A, 0+0 Outer A, 2+2 M, and 3+3 Lateral setae. Males with a dorsal manubrial organ. Length of holotype: 1.98 mm; maximum length: 2.24 mm.

#### Type Locality

Florida - Dade Co., Miami. Collected by J. E. Porter on April 1, 1951, Ill. Nat. Hist. Sur.: Acc. no. 49712. Holotype and 8 paratypes examined in detail, 20 alcoholic paratypes superficially examined under dissecting microscope.

#### Additional Localities

Florida - Monroe Co., Key West. Collected by Richards & Stannard on Dec. 27, 1951, from berlese sample of grass clumps.

Louisiana - Ouachita Parish. Collected from 4 localities by J. Cancelare:

027-001, Sept. 8, 1972,	S:13	T:7N	R:4
090-001, Sept. 12, 1972,	S:28	T:20N	R:5
116-002, Oct. 14, 1972,	S:9	T:17N	R:4
157-001, Aug. 4, 1973,	S:32	T:18N	R:3

#### REMARKS

*Orchesella bulba* and *O. celsa* resemble each other very strongly. The pattern show considerable overlapping and the third abdominal segment chaetotaxy is identical. The sole reliable characteristic for separating the two species is the presence of a retractile apical bulb on the fourth antennal segment. The extreme improbability that such an organ would be a polymorphic variant forces us to consider the two taxa as separate species.

*Orchesella celsa* n. sp.  
Plate III: Figs. 15 - 19;  
Plate IV: Figs. 20 - 24.

Color: Background white to yellow, with blue to blue-black pigment. Antennae with dark apical pigment rings on subsegments, distal half of ANT III and ANT IV increasingly pigmented. Head with inter-antennal

spot and eyepatches very dark, circum-antennal pigment paler and often with a mid-dorsal spot posterior to and cheek patches posterior and lateral to the eyepatches. Body pattern consisting of 5 longitudinal stripes and medial transverse banding. A thin mid-dorsal stripe is usually present of TH II to ABD II, sometimes completely absent or rarely extending from TH II to ABD III. A pair of dorsal stripes is usually present, extending from TH II to ABD V. The dorsal stripes on TH III may run parallel, converge in the anterior 1/3rd and diverge in the posterior 2/3rds, be absent from the anterior half or be completely absent. On ABD IV the dorsal stripes are connected by a transverse band along the posterior margin of the segment, and usually run anteriorly for 2/3rds of the segment, rarely reduced to medial spots. The lateral segmental margins of the thorax are always pigmented, ABD I - V with incomplete markings. The longitudinal stripes are usually incorporated into transverse bands. The mid-dorsal stripe is expanded laterally on TH III and rarely on ABD I. ABD II may have an expanded mid-dorsal stripe, a pair of spots between the mid-dorsal and dorsal stripes, or a complete transverse band. ABD III usually with a dark transverse band, rarely with fragmentary spots or patches. ABD V with lateral markings, rarely connected posteriorly or with a mid-dorsal patch. ABD VI without pigment or rarely with lateral patches. Legs with tibiotarsus and femur medially darkened, with only precoxae pigmented or completely pale. Furcula and ventral tube without pigment. Ventral ABD III usually with, and ventral ABD IV without pigment.

In addition to the normal pigmented forms, some specimens are pale except for traces on the lateral thoracic and posterior ABD IV segmental margins.

ANT IV with Type 4 pin seta, without apical bulb. Eyes 8+8, eyes A&B larger than C-F, eyes G&H distinctly smaller than eye F. Hind foot complex with tenent hair longer than unguis, unguiculus .66-.75 times as long as unguis, with an outer tooth inserted beyond the midpoint (.57-.6). Dens 1.25-1.65 times as long as manubrium. Small body setae basally cylindrical, apically tapering or narrowly fusiform, and unilaterally ciliate for 7/9 of length. Macrochaetae of ABD III: 3+3 Inner A, 0+0 Outer A, 2+2 M, and 3+3 Lateral setae. Males with dorsal manubrial organ. Length of holotype: 1.98 mm; maximum length: 2.68 mm.

#### Type Locality

North Carolina — New Hanover Co., Wilmington. Collected by W. M. Kulash on Feb. 23, 1949 under an Azalea bush. Holotype and 8 adult paratypes examined in detail, 33 alcoholic paratypes examined superficially with a dissecting microscope. Deposition of type material: Ill. Nat. Hist. Sur., Urbana, Ill.

#### Additional Localities

Arkansas — Hot Springs Co., Donalson. Collected by Ross and Stannard, May 1959, in forest debris.

Arkansas — Union Co., El Dorado. Collected by Ross and Stannard on April 22, 1959 in forest debris.

Illinois — Hancock Co., Nauvoo. Collected by Evers and Stannard on July 25, 1957 in forest litter.

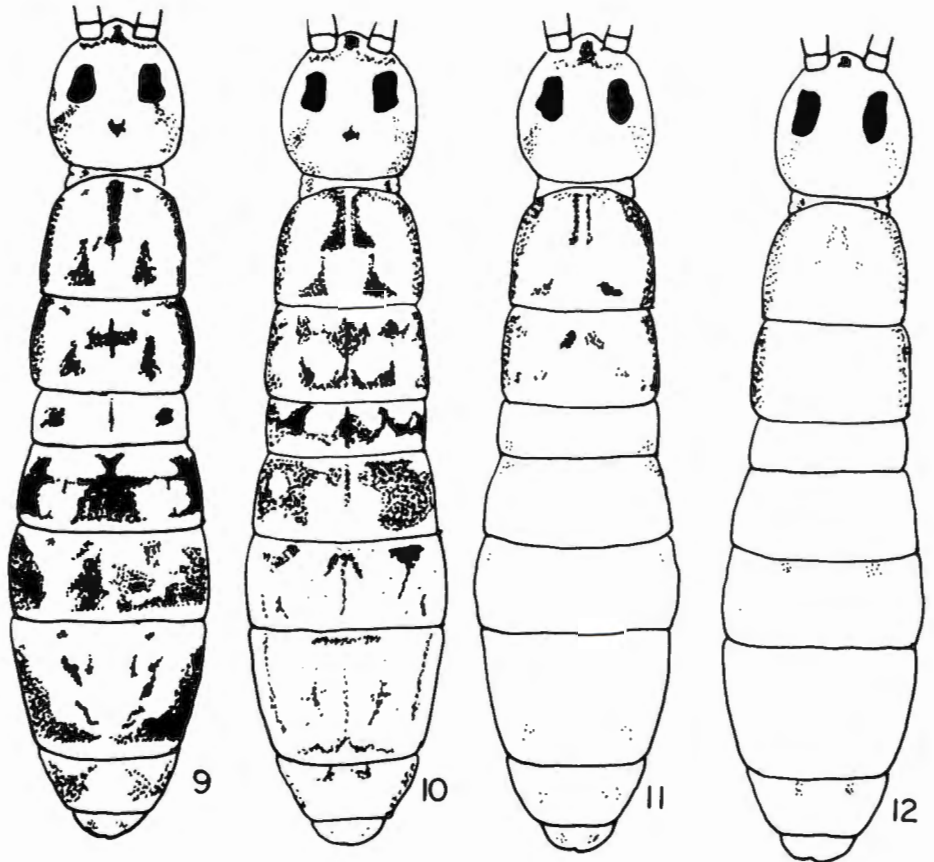
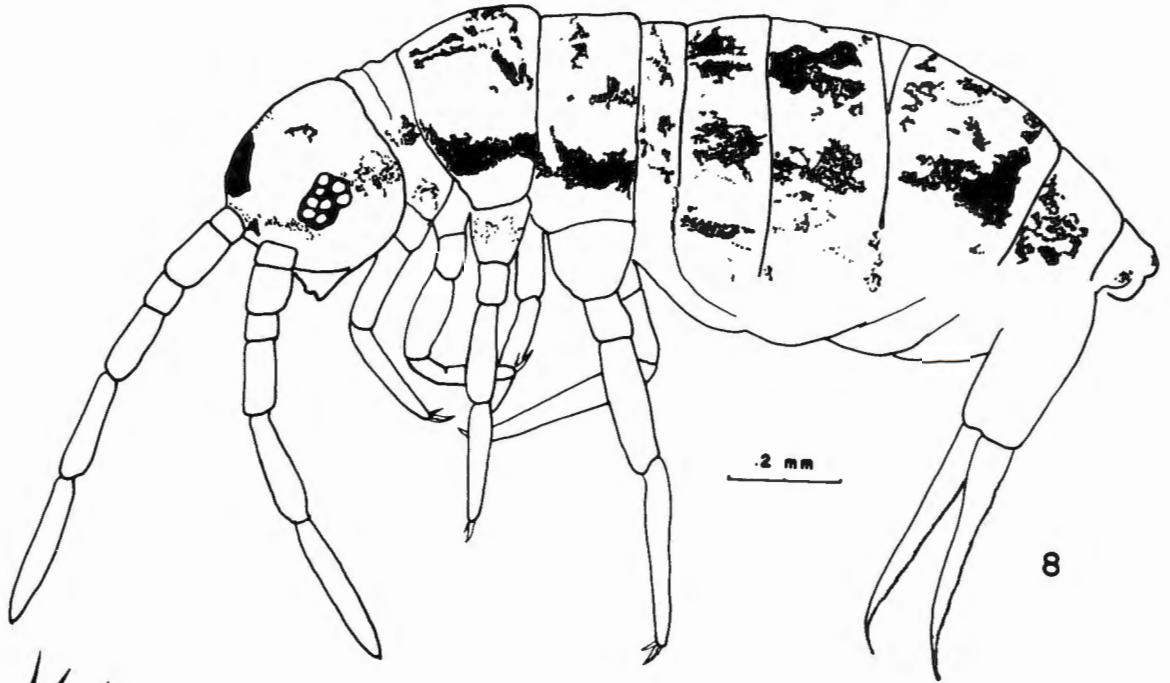
#### Plate II: *Orchesella bulba*.

Fig. 8. Habitus of holotype from Fla.

Fig. 9-12. Pattern variation, dorsal aspect: Fig. 9. paratype #5; Fig. 10. specimen 157-001 c from Ouachita Par. La.; Fig. 11. specimen 157-001 a from Ouachita Par. La.; Fig. 12. specimen 116-002 from Ouachita Par. La.

Fig. 13. Apex of ANT IV, (AB = Apical Antennal Bulb; pin = Pin Seta; SSO = subapical Sensory Organ); specimen 157-001. Pin seta of type 4.

Fig. 14. ABD III chaetotaxy; holotype from Fla., (IA = Inner A, M = M, L = lateral macrochaetae, B = Bothriotrichia).





Louisiana — Ouachita Parish. Collected by J. Cancellare from 6 localities:

074-001, Aug. 23, 1972;  
 079-001, Aug. 28, 1972;  
 113-001, Sept. 22, 1972;  
 148-002, Oct., 1972  
 172-001, Oct. 27, 1973  
 150-172 (?)

Louisiana — Winn Par., Winnfield. Collected by Ross and Stannard on April 22, 1959 in forest litter.

Missouri — Boone Co. Collected by Hennesey on July 21, 1975 in Soybean field pit trap.

Pennsylvania — Bedford Co., Tussy Mts. Collected by K. A. Christiansen on Sept. 28, 1953 under pine bark; # 518.

Pennsylvania — Centre Co., Bear Meadow. Collected by KAC on July 7, 1952 from a dead stump; # 517.

South Carolina — Oconee Co., Long Creek. Collected by J. G. Watts on Nov. 23, 1934 in dead pine wood.

Tennessee — Putnam Co., Bee Rock near Monterey. Collected by T. C. Barr on Dec. 4, 1955 from berlese extraction of *Cladonia* (lichen) mat on Rock Castle conglomeratic sandstone.

#### REMARKS

Introspecific pattern variation is great in *Orchesella celsa*: specimens from Pennsylvania differ in possessing a mid-dorsal stripe continuous from TH II to ABD III and pigment on ABD VI; south-central specimens (Louisiana, Arkansas and Illinois) all show convergence of the dorsal stripes on TH II while north and south-eastern forms have parallel markings; and within populations were frequently found both pale and pigmented forms.

The general pattern of *O. celsa* — longitudinal lines with transverse banding in the first abdominal segments is generally distinctive but could be confused with *O. bulba*, *O. ainsliei*, *O. hexfasciata*, *O. alpa* and *O. fishmani*. *O. celsa* can be distinguished from *O. ainsliei* by the presence of a mid-dorsal stripe on at least ABD I, the dorsal stripes of ABD IV which are incomplete or not extending to the anterior segmental margin and which are connected by a transverse band along the posterior margin. *O. celsa* differs from *O. hexfasciata* in lacking a broad band along the anterior margin of TH II. *O. alpa* lacks continuous stripes on TH III and ABD I, and has a mostly pigmented ABD IV, while *O. fishmani* differs in having ABD II with less pigment than ABD II and lacking clearly separate dorsal and mid-dorsal stripes.

In addition to these differences in pattern form, the chaetotaxy of ABD III can be used to separate these forms. As can be seen from Table 1, of the 8 (9) nearctic species lacking Outer A setae, only 3 have only 2 M setae: *O. celsa*, *O. bulba* and *O. flora*. The unique apical antennal bulb of *O. bulba* and the completely dark thorax of *O. flora* easily separate these forms from *O. celsa*.

*Orchesella flora* n. sp.  
 Plate I: Figs. 1 & 3  
 Plate V: Figs. 25 - 31

Color: Background yellow to orange with dark blue to black pigment. Antennal segments with apical pigment rings, absent from subsegment apices. Head with an inter-antennal spot and dark eyepatches. Solid pigmentation on all thoracic segments, coxae, trochanters and

often ABD I. Abdomen with ABD I completely or mostly pigmented; ABD II-V pigmentless (Fig. 26), with dorsal markings and ventrolaterally pigmented from ABD II - V (Figs. 25 & 27), with narrow transverse bands along the segmental margins of ABD II-V and a broken mid-dorsal stripe in the anterior half of ABD I & II (Fig. 28), or with a mid-dorsal stripe complete on ABD III - IV and with dorsal stripes and ventro-lateral pigmentation extending from ABD I - V (Fig. 29). Legs with dark pigmentation on precoxae, coxae, and trochanters, lighter pigmentation usually on femurs and tibiotarsae. Ventral tube with light pigment basally, furcula pigmentless.

ANT IV without apical bulb, with Type 4 pin seta, Eyes 8+8, eye A larger than B & C, eyes G & H distinctly larger than E & F. Hind foot complex with tenent hair longer than the unguis; unguiculus .6 to .72 times as long as unguis, with an outer tooth inserted beyond the mid-point (.53 - .65). Dens 1.5 to 1.9 times as long as manubrium. Small body setae cylindrical for basal  $\frac{3}{4}$ , apically tapered and unilaterally ciliate for apical  $\frac{1}{4}$  of length. Macrochaetae of ABD III: 3+3 Inner A, 0+0 Outer A, 2+2 M, and 3+3 Lateral setae. Males with a dorsal manubrial organ. Length of holotype: 1.43 mm; maximum length: 2.43 mm.

#### Type Locality

Florida - Liberty Co., Camp Torreaga. Collected by T.H. Hubbell on April 30, 1927. Holotype and 13 paratypes examined in detail, 13 alcoholic paratypes examined with dissecting microscope only.

#### Additional Localities

Indiana - Crawford Co. Collected on Jan 27, 1975 by J. W. Hart.  
 North Carolina - Graham Co.  
 Virginia - Fairfax Co., Falls Church. Collected on April 16.

#### REMARKS

*Orchesella flora*, *O. cincta*, *O. folsomi* and *O. carniceps* are the only nearctic species in the genus with one or more completely pigmented segments. The completely black thorax and paler abdomen of *O. flora* is easily distinguished from the unpigmented TH II of *O. cincta* and *O. folsomi* and the dark ABD IV of *O. carniceps*. One population from Indiana differs slightly in pattern and chaetotaxy from the other localities. Several specimens possess mid-dorsal and dorsal stripes extending from the thorax to ABD III, and with 3 instead of 2 M ABD III macrochaetae (see Table 1).

*Orchesella fishmani* n. sp.  
 Plate VI: Figs. 32-38

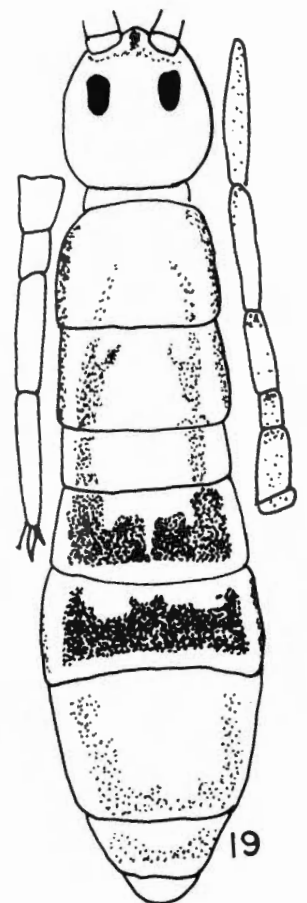
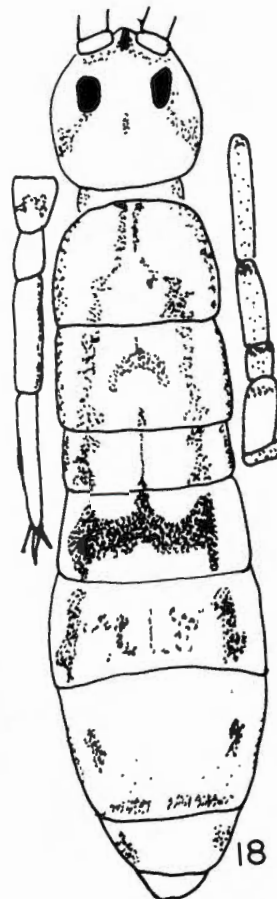
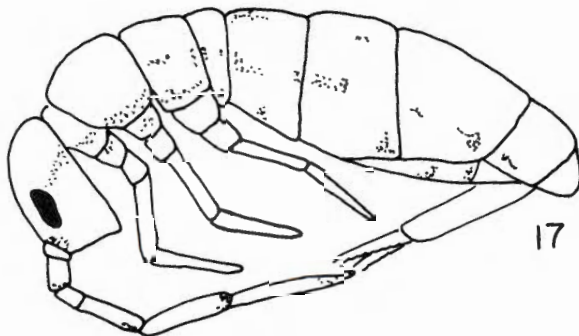
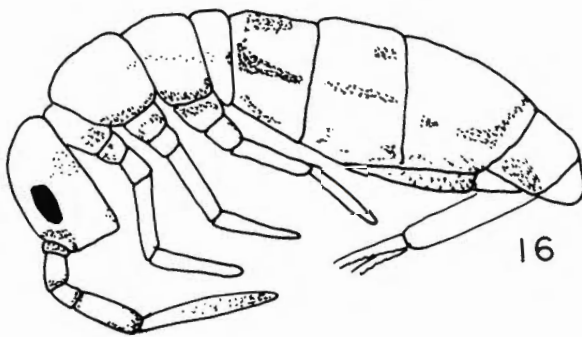
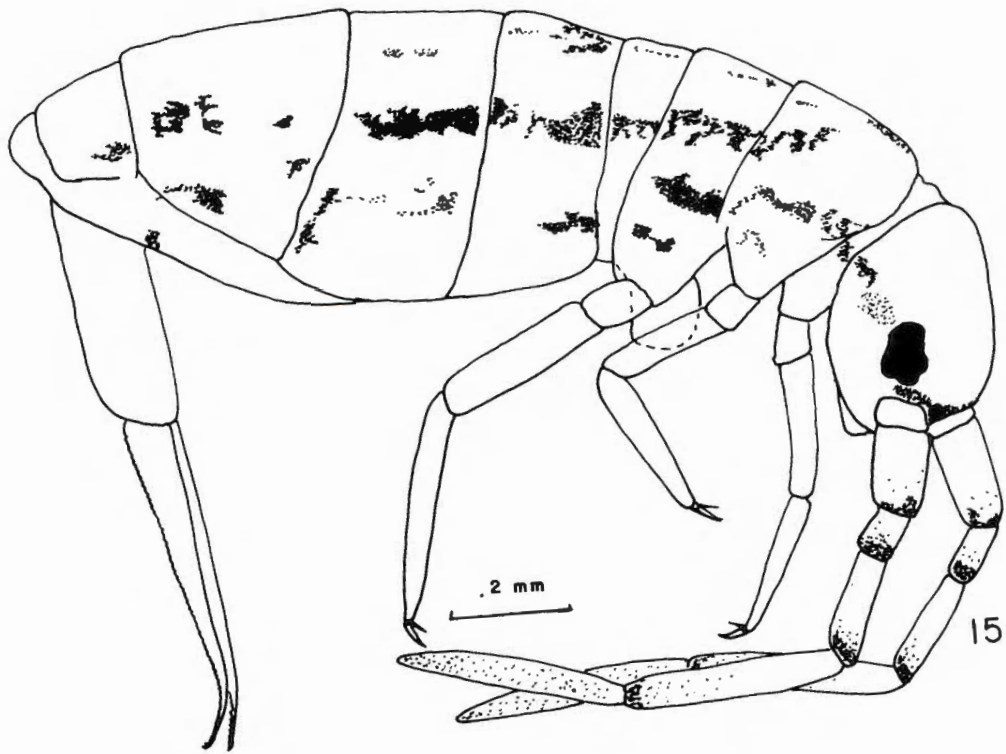
Color: Background yellow (in old alcoholic specimens) with blue-black pigment. Antennae with uniform pigmentation on ANT IA, IB, and usually on the distal 1/2 to 1/3 of ANT IIB. Head with an inter-antennal pigment spot with circum-antennal extensions paler, with a double V shaped (rarely absent) mark posterior to the eyepatches, with cheekpatches and posteriorly with a more or less complete (rarely absent) transverse band. Body with lateral longitudinal stripes extending from the anterior margin of TH II to ABD I and/or II; with a mid-dorsal longitudinal stripe with triangular or wing-shaped expansions extending from the thorax to ABD II or III, and/or fragmented to ABD III or IV; ABD II with a wide transverse band extending nearly to

#### Plate III: *Orchesella celsa*.

Fig. 15. Habitus of holotype from N:C..

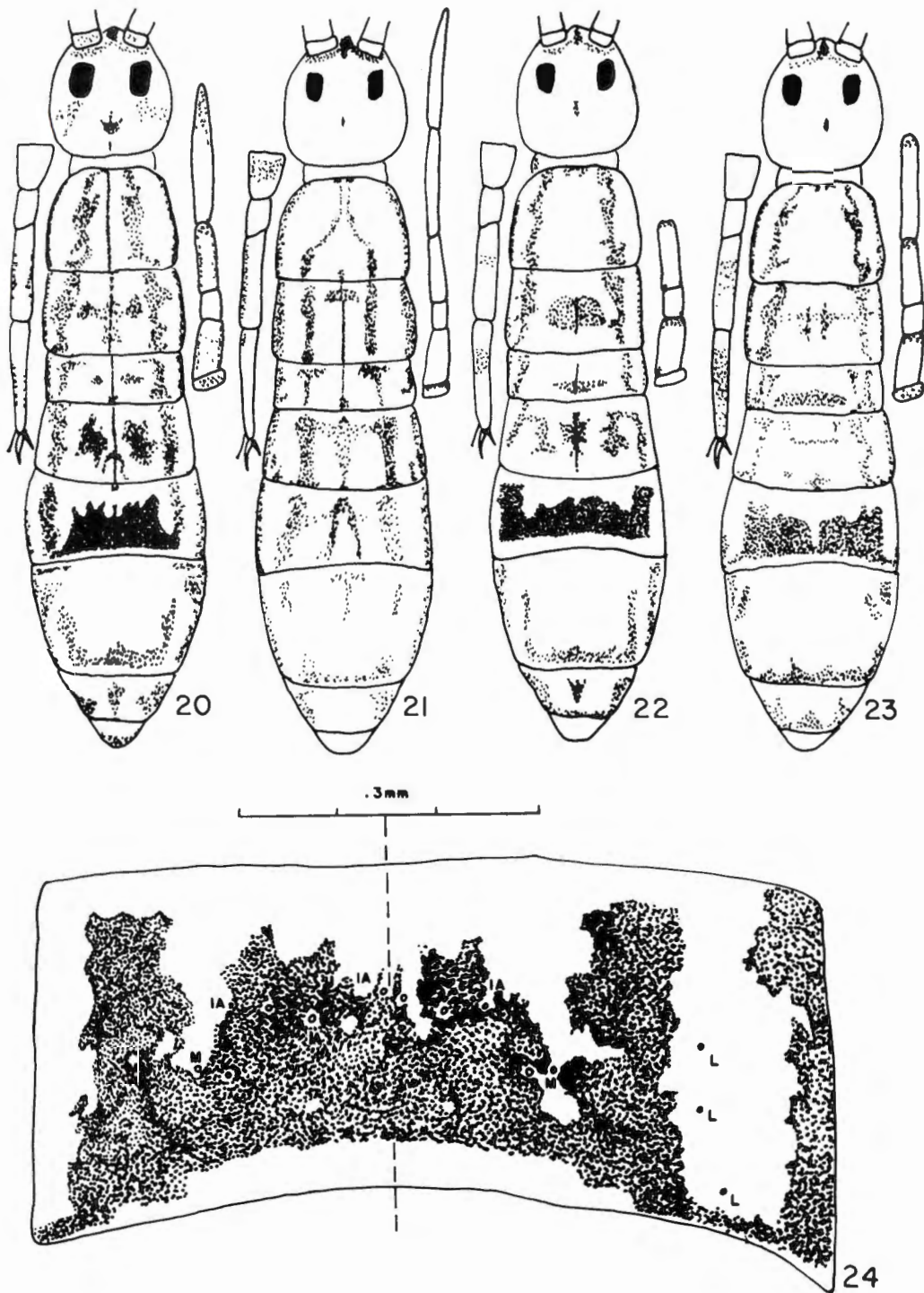
Figs. 16-17. Pattern variation, lateral aspect: Fig. 16, Paratype #1; Fig. 17, Paratype #7.

Figs. 18-19. Pattern variation, dorsal aspect: Fig. 18, Specimen from Ouachita Par., La.; Fig. 19, specimen from Hancock Co., Il..





FIVE NEW SPECIES OF ORCHESELLA



**Plate IV:** *Orchesella celsa*.

Figs. 20-23. Pattern variation, dorsal aspect: Fig. 20. specimen from Bedford Co., Pa.; Fig. 21. specimen from Hot Springs Co., Ark.; Fig. 22. specimen from Putnam Co., Tenn.; Fig. 23. specimen from Oconee Co., S.C.

Fig. 24. ABD III chaetotaxy of specimen from Bedford Co., Pa., (IA=Inner A, M=M, L=Lateral macrochaetae).



the lateral margins; ABD III always less pigmented than ABD II, often with a fragmented mid-dorsal stripe, paler dorsal longitudinal stripes or anterior spots; ABD IV & V with or without pale dorsal-lateral markings. Legs ventral tube and furcula unpigmented.

ANT IV sometimes shorter than ANT III and with more pronounced annulation, with a Type 4 pin seta and no apical bulb. Eyes 8+8, variable in size but usually with eye A larger than B, C & D, eyes G & H smaller than others. Hind foot complex with tenet hair shorter than unguis; unguiculus .6 - .67 times as long as unguis, and with an outer tooth inserted beyond the mid-point (.5 - .7). Dens 1.3 to 2.1 times as long as manubrium. Small body setae narrowly fusiform and ciliate for apical 7/8 of length. Macrochaetae of ABD III: 5+5 (4+4) Inner A, 1+1 Outer A, 3+3 (2+2) M, and 3+3 Lateral setae. Males with a dorsal manubrial organ. Length of holotype: 2.07 mm; maximum length: 2.7 mm.

#### Type Locality

Texas-Calhoun Co., Port Lavaca. Collected in April, 1935 in cotton and butterweed. Holotype and 21 paratypes examined in detail, 20 alcoholic paratypes examined superficially under a dissecting microscope. Deposition of type material: Ill. Nat. Hist. Sur., Urbana, Ill..

#### REMARKS

*Orchesella fishmani* has been collected from only one locality, and is the only lowland *Orchesella* known from the southwest. The single large collection shows some variation in pattern, but the presence of lateral marginal stripes extending from the anterior edge of TH II, a thin mid-dorsal strip variously expanded with wing-shaped and triangular expansions present from TH II to ABD II, the transverse band on ABD II and the paler posterior abdominal segments clearly distinguish this species from all other nearctic species. Large specimens usually have 5 Inner A, 1 Outer A and 3 M setae, smaller specimens may have 4-1-2 setae.

*Orchesella alpa* n. sp.  
Plate VII: Figs. 39-47.

Color: Background yellow with pigment blue to purple brown. Antennae usually with all segments completely pigmented and apically darkened. Head with an inter-antennal spot, circum-antennal extensions and mid-dorsal spot posterior to eyepatches dark, and on darker specimens with lighter pigment extending from the eyepatches ventrolaterally to the posterior edge and ventrally from the mouth to posterior margin. Thorax darkly pigmented on lateral margins, with lighter pigment on TH II in 2 variable dorsal patches. ABD I with a mid-dorsal stripe and 2 variously shaped dorsal patches, lateral margins with a dark spot. ABD II - IV with broad mid-dorsal rectangular patches extending across the dorsal surface, lighter pigment on the lateral surface. ABD V with a dark band on the dorsal and lateral surface. ABD VI usually lacking pigment except in the darkest specimens. Legs completely pigmented or commonly with only the precoxae and coxae dark. Furcula usually lacking pigment, but manubrium rarely with dorsal pigment.

Some populations include pale forms with lighter coloration. Antennae either completely pigmentless, with only apical rings on segments, or with segmental apical pigment rings plus uniform pigmentation on ANT III & IV. Head with inter-antennal spot, eyepatch and mid-dorsal spot dark. Thorax with light pigmentation on lateral margins or completely absent. Abdomen lacking pigment except for some with pale pigmentation on posterior margin of ABD IV. Legs and furcula pale.

ANT IV without apical bulb, with a Type 2 pin seta. Eyes 8+8, with eyes A,B,E, & F slightly larger than C & D, and G & H only slightly smaller than eye F. Hind foot complex with tenet hair subequal or slightly shorter than unguis; unguiculus with an outer tooth inserted beyond the midpoint (.54-.6). Dens 1.3-1.6 times as long as manubrium. Small body setae narrowly fusiform, ciliate for apical 7/8 of length on all but one surface. Macrochaetae of ABD III: 4+4 (5+5) Inner A, 1+1 Outer A, 3+3 (2+2) M, and 3+3 Lateral setae. Males with dorsal manubrial organ. Length of holotype: 1.8 mm; maximum length: 2.7 mm.

#### Type Locality

New Mexico - Taos Co., vicinity of Wheeler Peaks. Collected by KAC (# 295 D) in June, 1955, in dry short grass alpine meadow in timberline region. Holotype and 3 paratypes examined in detail, with 2 alcoholic paratypes examined under dissecting microscope only. Deposition of type material: holotype and paratypes at Museum of Comparative Zoology, Cambridge, Mass.; additional paratypes to Ill. Nat. Hist. Sur., Urbana, Ill.

#### Additional Localities

New Mexico - Taos Co., same as type locality. Collected by KAC (# 295 E) on slanting wet alpine meadow near upper part of timberline area.  
New Mexico - Sierra Co., Emory Pass. Collected by KAC (# 299) in damp streambed in pine woods.  
Colorado - Chaffee Co., Monarch Pass summit. Collected by KAC (# 303 C) in June, 1955 on north side of hill on edge of highest large spruces, in open alpine area — under rocks on moist soil.  
Colorado — Huerfano Co., Cucharas Pass. Collected by KAC (#289) on June 25, 1955 at pass, open grazed mountain meadow, open mixed spruces and aspen woods. KAC 289 A under fallen dead wood on ground; KAC 289 C in spruce cones.  
Colorado — San Juan Co., Red Mountain Pass elev. 11,018 ft. Collected by KAC (#301 B) in June, 1955, well above timberline in short herb meadow, under stones on damp earth.  
Utah — Summit Co., Bear River in the Uinta Mts., elev. 8,000 ft. Collected by F. Werner on June 2, 1949.  
Wyoming — Albany Co., Medicine Bow National Forest, Meadow Lakes elevation 10,000 ft. Collected by KAC (#2909) on Aug. 20, 1971 in open Spruce Fir Forest, on surface of boulder; KAC (#3282) on Aug. 3, 1972 below Meadow Lakes, under stones.

#### REMARKS

*Orchesella alpa* can be separated from *O. cincta* and *O. hexfasciata* by the absence of an Outer A macrochaeta on ABD III in these last two species. The well pigmented ABD IV readily distinguishes *O. alpa* from *O. fishmani* and *O. celsus*. Unpigmented forms of *O. alpa* may be confused with *O. albosa*, but they usually differ in ABD III M setae number (usually 3 in *O. alpa*, always 2 in *O. albosa*) as well as the habitat. *O. albosa* is known only from lowlands, whereas *O. alpa* is the commonest surface collembolan in alpine regions of the west. It is often seen walking over rock surfaces in a variety of alpine habitats, but generally in the vicinity of coniferous woods near the timberline.

#### ACKNOWLEDGEMENTS

This work is an outgrowth of our joint work with P. F. Bellinger. His name is not appended to this paper for reasons of bibliographic economy. This work was made possible by N.S.F. grant 73-06852 as well as earlier grants.

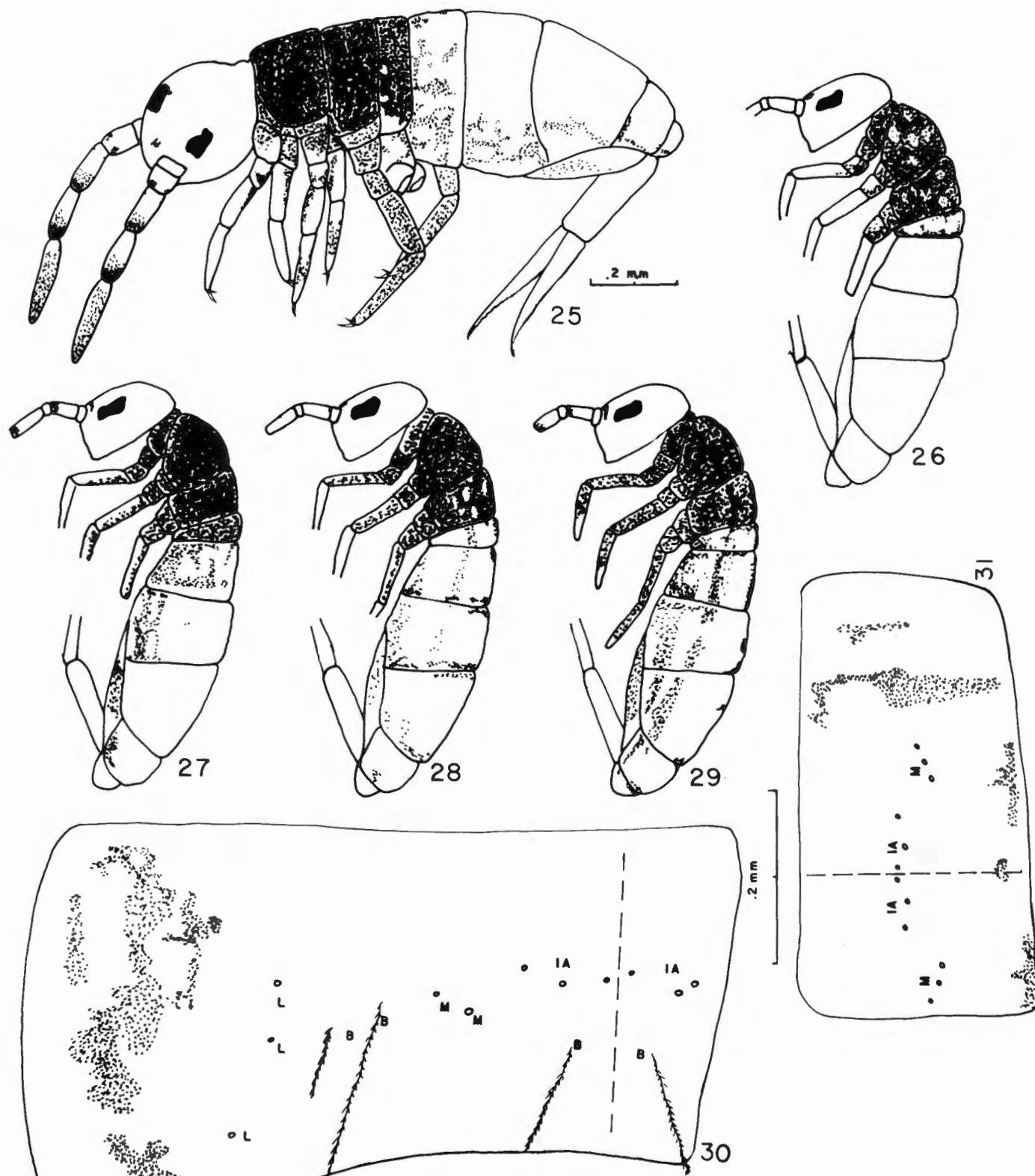
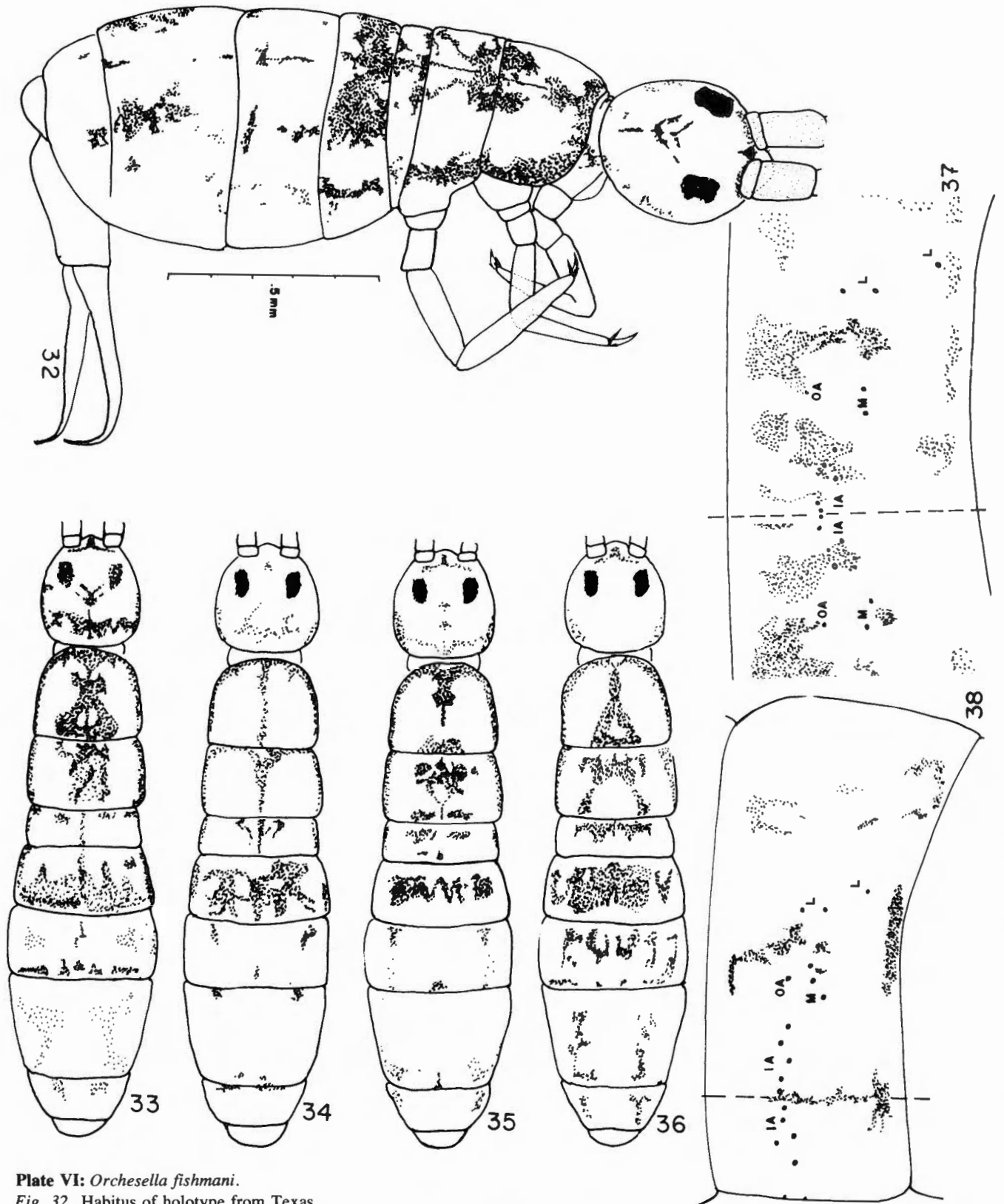
**Plate V: *Orchesella flora*.**

Fig. 25. Habitus of holotype from Fla.

Figs. 26-29. Pattern variation, lateral aspect: Fig. 26. paratype #2; Fig. 27. paratype #3. Fig. 28. specimen from Va.; Fig. 29. specimen from Ind..

Figs. 30-31. ABD III chaetotaxy, (IA = Inner A, M=M, L=Lateral macrochaetae; B=bothriotrichia): Fig. 30. holotype from Fla.; Fig. 31. specimen #3 from Ind..





**Plate VI: *Orchesella fishmani*.**

Fig. 32. Habitus of holotype from Texas.

Figs. 33-36. Pattern variation, dorsal aspect: Fig. 33. paratype #5; Fig. 34. paratype #7; Fig. 35. paratype #21; Fig. 36. paratype #13.

Figs. 37-38. ABD III chaetotaxy, (IA = Inner A, OA = Outer A, M= M, L = Lateral macrochaetae): Fig. 37. paratype #13; Fig. 38. holotype.



## FIVE NEW SPECIES OF ORCHESELLA

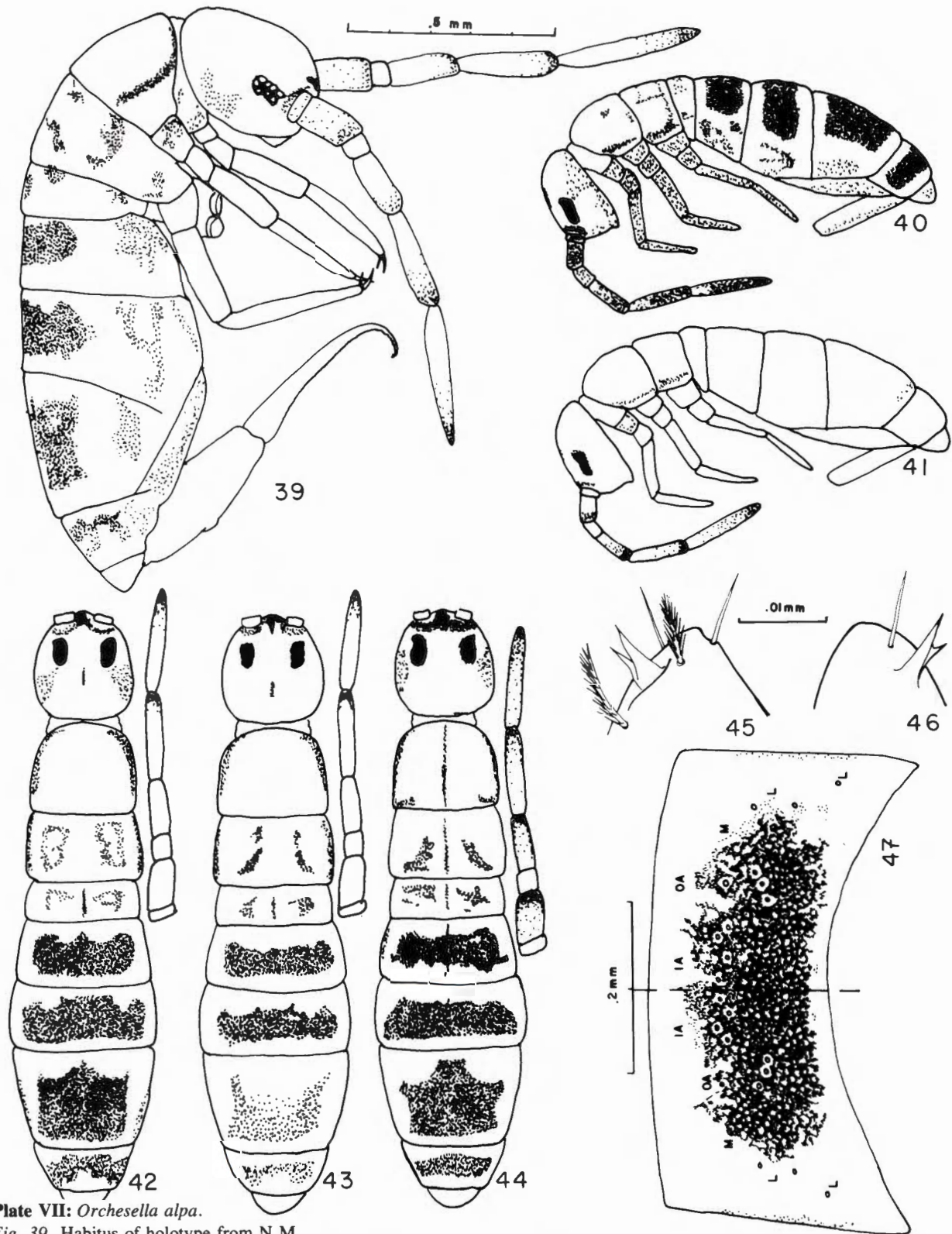
**Plate VII: *Orchesella alpa*.**

Fig. 39. Habitus of holotype from N.M.

Figs. 40-41. Pattern variation, lateral aspect: Fig. 40. specimen 2909 #3 from Wyo.; Fig. 41. specimen 2909 #5 from Wyo..

Figs. 42-44. Pattern variation, dorsal aspect: Fig. 42. Paratype #3 from N.M.; Fig. 43. specimen 292 J from N.M.; Fig. 44. specimen 292 H from N.M.

Fig. 45. Apex of left ANT IV showing pin seta: specimen from Utah. Pin seta of type 1.

Fig. 46. Same: Holotype from Taos. Co. N.M. Pin seta of type 1.

Fig. 47. ABD III chaetotaxy (IA = Inner A, OA = Outer A, M = M, L = Lateral macrochaeta): paratype #3 from N.M.

TABLE 2

MEASUREMENTS OF BODY STRUCTURES OF 5 NEW SPECIES OF THE GENUS ORCHESSELLA.  
 ALL MEASUREMENTS WERE MADE WITH AN OCULAR MICROMETER, AND ARE IN MILLIMETERS.  
 FUSED ANT III & IV MEASUREMENTS IN PARENTHESIS.  
 BLANKS REPRESENT MISSING OR DISTORTED SEGMENTS.

SPECIMEN	BODY ANT		ANTENNAL SEGMENTS				CEPHAL		THORAX			ABDOMINAL SEGMENTS						FURCULA		TENENT	UN	UNGUI	
	LNTH	LNTH	IV	III	IIB	IIA	IB	IA	DIAG	II	III	I	II	III	IV	V	VI	MAN	DENS	MUCRO	HAIR	GUIS	CULUS
BULBA																							
FLA:HOLD	1.98	.839	.289	.217	.139	.056	.111	.036	.403	.256	.192	.092	.156	.250	.331	.158	.106	.268	.480	.0112	.0459	.0432	.0319
PARA 1	2.01	1.01	.322	.258	.168	.077	.141	.048	.370	.238	.187	.110	.143	.253	.320	.146	.139	.348	.480	.0144	-----	-----	-----
PARA 2	2.29	----	(.403)	.190	.110	.172	.055	.476	.289	.271	.198	.247	.256	.366	.183	.073	.410	.531	.0144	.0518	.0545	.0288	
PARA 3	1.14	----	-----	.146	.070	.110	.037	.318	.176	.146	.092	.117	.146	.256	.146	.055	.238	.355	.0108	.0331	.0295	.0209	
PARA 5	1.90	.885	.318	.251	.170	.092	.143	.040	.403	.293	.223	.146	.183	.293	.366	.183	.092	.256	.501	.0137	.0490	.0439	.0302
PARA 6	1.20	.537	.227	.143	.092	.040	.073	.026	.274	.198	.134	.101	.146	.179	.256	.114	.062	.238	.329	.0108	.0360	.0331	.0245
PARA 7	1.58	.758	.284	.201	.156	.070	.121	.037	.348	.201	.183	.147	.201	.220	-----	-----	.055	.329	.428	.0130	.0432	.0389	.0288
PARA 8	1.63	.777	.315	.218	.157	.070	.121	.033	.355	.227	.201	.128	.183	.238	.311	.128	.055	.275	.421	.0130	.0432	.0403	.0288
LA #116-2	1.46	.751	.250	.195	.122	.056	.117	.133	.278	.209	.159	.111	.184	.197	.278	.120	.072	.231	.350	-----	.0392	.0319	.0235
LA #157-A	2.24	1.40	.428	.392	.256	.133	.186	.059	.445	.289	.228	.158	.217	.225	.339	.267	.067	.345	.517	.0073	.0414	.0437	.0291
LA #157-B	1.81	1.23	.361	.323	.195	.100	.161	.045	.403	.270	.270	.195	.206	.250	.317	.139	.072	.406	.500	.0101	.0448	.0392	.0280
LA #157-C	2.21	1.08	(.459)	.250	.128	.189	.056	.411	.278	.247	.178	.239	.275	.339	.181	.072	.403	.556	.0112	.0448	.0403	.0224	
LA #027-1	1.50	-----	-----	.156	.083	.122	.028	.334	.197	.172	.111	.153	.184	.272	.117	.050	.300	.390	.0090	-----	.0336	.0168	
LA #090-1	2.21	.184	.339	.253	.150	.779	.139	.039	.473	.258	.206	.133	.200	.222	.334	.184	.089	.320	.448	.0146	.0448	.0426	.0297
CELSA																							
NC HOLD	1.98	1.25	.403	.378	.189	.095	.153	.028	.361	.264	.228	.153	.236	.278	.411	.175	.073	.370	.556	.0124	.0476	.0448	.0297
PARA 1	2.44	-----	(.436)	.158	.136	.164	.042	.395	.334	.234	.153	.295	.314	.442	.203	.092	.434	.556	.0129	.0521	.456	.0303	
PARA 2	1.78	-----	-----	.334	.178	.089	.156	.036	.389	.228	.167	.125	.181	.211	.375	.156	.052	.342	.481	.0118	.0448	.0392	.0258
PARA 3	2.06	-----	-----	.156	.089	.139	.033	.375	.278	.255	.139	.167	.195	.361	.172	.070	.334	.489	.0123	.0476	.0392	.0258	
PARA 4	1.93	.929	.328	.264	.153	.072	.111	.036	.348	.261	.211	.144	.206	.222	.334	.167	.103	.277	.445	.0123	.0408	.0353	.0258
PARA 5	1.83	-----	-----	-----	-----	-----	.177	.031	.356	.236	.209	.142	.195	.200	.342	.145	.050	.264	.439	.0117	.0398	.0347	.0252
PARA 6	1.83	-----	-----	-----	-----	-----	.172	.031	.370	.239	.136	.133	.189	.222	.331	.209	.089	.370	.495	.0129	-----	-----	-----
PARA 7	1.48	.578	.222	.164	.086	.042	.070	.022	.278	.195	.167	.103	.145	.158	.259	.222	.052	.253	.314	.0093	-----	-----	-----
PARA 8	1.70	.937	.328	.250	.139	.074	.117	.028	.375	.231	.167	.117	.167	.189	.328	.150	.070	.345	.423	.0112	.0420	.0375	.0269
ARK:HT SP	2.15	1.56	.473	.459	.239	.139	.203	.044	.370	.278	.231	.158	.236	.300	.392	.172	.083	.409	.586	.0129	.0499	-----	.0274
ARK:UNION	1.96	.888	.289	.245	.128	.072	.120	.028	.328	.233	.195	.115	.217	.250	.334	.172	.097	.353	.448	.0106	.0381	.0362	.0277
IL:HANCK	1.32	.900	.300	.272	.145	.081	.158	.031	.272	.167	.161	.095	.117	.167	.278	.112	.050	.311	.270	.0112	.0420	.0314	.0280
LA:QUA74	1.79	-----	-----	.303	.172	.100	.147	.033	.367	.245	.183	.208	.169	.214	.319	.139	.097	.345	.445	.0112	-----	.0358	.0258
LA:WINN	2.68	1.73	.514	.484	.264	.139	.289	.042	.389	.367	.292	.295	.317	.356	.439	.225	.117	.534	.583	.0146	.0545	.0445	.0333
PA:BEDFRD	2.32	1.15	(.55)	.267	.078	.200	.058	.473	.322	.264	.189	.278	.317	.523	.234	.083	-----	-----	-----	-----	-----	-----	-----
SC	2.22	-----	-----	.278	.183	.064	.142	.036	.417	.261	.236	.172	.222	.234	.395	.133	.089	.450	.542	.0146	.0476	.0420	.0269
TENN	1.82	-----	-----	.122	.047	.095	.031	.434	.250	.194	.133	.189	.211	.373	.145	.095	.403	.461	.0131	.0409	.0293	.0235	
FLORA																							
FLA:HOLD	1.43	.578	.222	.139	.100	.034	.086	.025	.328	.178	.150	.089	.167	.189	.284	.117	.034	.195	.361	.0090	-----	.0347	.017
PARA 1	2.18	1.41	.699	.278	.175	.070	.150	.036	.514	.289	.153	.095	.195	.284	.456	.231	.089	.395	.612	.0180	-----	.062	.0392
PARA 2	1.62	.967	.345	.272	.186	.058	.117	.028	.361	.239	.139	.083	.184	.234	.334	.139	.050	.411	.550	.0123	.0420	.0538	.0381
PARA 3	1.82	-----	-----	.278	.178	.061	.147	.033	.500	.267	.170	.089	.161	.261	.417	.167	.061	.389	.611	.0416	-----	.0532	.0308
PARA 4	1.68	.762	.267	.195	.239	.039	.206	.025	.361	.236	.161	.097	.167	.234	.306	.117	.042	.278	.500	-----	-----	.0437	.0314
PARA 5	1.65	-----	-----	.250	.181	.070	.133	.033	.389	.195	.153	.111	.167	.200	.320	.184	.056	.278	.542	.0157	.0414	.0515	.0347
PARA 7	1.23	.776	.222	.145	.095	.022	.072	.020	.306	.167	.122	.067	.136	.178	.278	.100	.033	.222	.348	.0112	-----	.0325	.0224
PARA 8	1.60	.917	.311	.263	.117	.050	.139	.022	.390	.234	.161	.111	.189	.278	.361	.446	.034	.323	.473	.0123	.0392	.0465	.0325

## FIVE NEW SPECIES OF ORCHESELLA

VA	1.60	.819	.264	.206	.150	.039	.111	.039	.389	.228	.195	.120	.167	.224	.342	.147	.061	.280	.523	.0123	.0392	.0426	.0213
NC	1.67	.542	.209	.139	.131	.022	.078	.028	.306	.222	.172	.111	.178	.206	.309	.111	.050	.306	.378	.0127	.0314	.0325	.0213
IND #3	2.18	.814	.286	.212	.139	.036	.106	.036	.445	.278	.222	.139	.208	.264	.361	.189	.073	.417	.514	.0112	.0420	.0437	.0280
IND #5	2.43	.867	.300	.209	.140	.056	.125	.039	.459	.278	.250	.167	.189	.300	.389	.181	.067	.411	.542	.0142	.0437	.0450	.0351

## FISHMANI

TX: HOLO	2.07	1.15	.417	.317	.167	.128	.167	.039	.375	.264	.181	.128	.195	.278	.384	.167	----	.339	.536	.0168	.0414	.0448	.0297
PARA 3	2.66	-----	-----	-----	.261	.128	.334	.0612	.562	.361	.278	.181	.278	.400	.472	.292	.111	.500	.681	.0190	-----	.0605	.0402
PARA 5	2.76	1.85	.481	.556	.289	.178	.278	.067	.531	.328	.250	.116	.250	.361	.389	.195	.062	----	.617	.0112	.0538	.0605	.0364
PARA 6	1.75	-----	-----	.459	.245	.139	.211	.045	.473	-----	-----	-----	-----	-----	-----	-----	-----	-----	.673	.0179	-----	-----	-----
PARA 7	-----	-----	-----	-----	-----	-----	.222	.058	.500	.361	.319	.203	.305	.334	.417	.167	-----	-----	-----	-----	.0336	.0560	.0347
PARA 9	2.01	1.21	.348	.428	.222	.133	.195	.056	.439	.272	.181	.097	-----	-----	-----	-----	-----	.289	.600	.0168	-----	.0549	.0358
PARA 11	2.04	-----	-----	.289	.167	.068	.156	.039	.417	.267	.222	.167	.206	.245	.331	.175	.070	.334	.445	.0123	.0470	.0420	.0280
PARA 13	2.46	-----	-----	-----	.272	.125	.181	.042	.500	.339	.284	.167	.272	.361	.431	.245	.117	.459	.648	.0162	-----	.0582	.0392
PARA 17	1.62	-----	-----	-----	.167	.097	.167	.033	.348	.222	.178	.075	.145	.222	.361	.145	.072	.348	.500	.0100	-----	.0420	.0280
PARA 19	2.60	-----	-----	-----	.192	.100	.164	.050	.500	.300	.250	.150	.220	.250	.395	.181	.083	.356	.503	.014	-----	-----	-----
PARA 20	2.32	1.56	.431	.445	.250	.139	.256	-----	.567	.348	.278	.150	.222	.292	.484	.195	.080	.360	.667	-----	-----	.0590	.0330
PARA 21	1.64	-----	-----	-----	-----	-----	.150	.045	.356	.217	.189	.095	.145	.178	.328	.172	.050	.300	-----	-----	-----	-----	-----

## ALPA

NM HOLO	1.79	1.40	.340	.259	.167	.070	.128	.042	.389	.284	.236	.156	.206	.236	.373	.063	.167	.278	.459	.0112	.0448	.0448	.1280
PARA 1	1.90	-----	-----	.548	.236	.106	.189	.055	.367	.278	.222	.139	.203	.264	.384	.167	.069	.406	.556	.0106	.0448	.0465	.0370
PARA 2	2.24	1.20	.389	.306	.206	.100	.158	.045	.445	.270	.245	.128	.245	.278	.440	.200	.070	.348	.556	-----	.0436	-----	.0229
PARA 3	1.84	1.07	.348	.278	.167	.081	.156	.042	.384	.300	.167	.156	.195	.225	.356	.153	.083	.320	.473	.0101	.0448	.0420	.0302
COLO 292H	1.98	1.17	.367	.328	.203	.108	.175	.042	.417	.305	.228	.150	.245	.222	.384	.170	.083	.459	.528	.0112	.0442	.0459	.0291
COLO 292J	1.01	.926	.292	.234	.156	.073	.139	.028	.334	.278	.195	.145	.211	.228	.306	.156	.078	.428	.403	.0101	.0392	.0408	.0242
UTAH	2.15	.987	.306	.250	.181	.080	.161	.036	.417	.250	.195	.125	.222	.231	.389	.167	.139	.361	.478	.0118	.0425	.0470	.0285
WY 2909-3	2.63	1.12	.328	.278	.195	.089	.178	.056	.473	.345	.306	.209	.300	.328	.417	.278	.139	.395	.539	.0123	.0437	-----	.0302

## ALPA: PALE FORM

WY 2909-5	1.76	1.06	.245	.278	.170	.078	.139	.050	.403	.234	.203	.136	.181	.203	.320	.111	.105	.345	.528	.0123	-----	-----	-----
COL 301-B	2.35	1.01	.348	.261	.175	.080	.141	.031	.473	.318	.278	.183	.228	.278	.373	.183	.067	.375	.509	.0123	.0437	.0437	.0291
COL 292-D	1.83	.980	.325	.237	.153	.081	.142	.042	.411	.264	.209	.153	.200	.234	.356	.156	.111	.356	.512	.0134	-----	.0448	.0314
NM 295-E	1.79	.719	.250	.172	.117	.059	.100	.031	.348	.236	.206	.128	.181	.226	.373	.167	.098	.318	.428	.0112	.0381	.0381	.0263