



Revision of the Nearctic genus *Tritoxa* Loew (Diptera: Ulidiidae)

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Abstract

The species of the Nearctic genus *Tritoxa* Loew are revised. Seven species of *Tritoxa* are recognized, including two new species: *T. californica* **sp. nov.** (type locality: near Spring Garden, California), *T. cuneata* Loew, *T. decipiens* **sp. nov.** (type locality: near Smithers, British Columbia), *T. flexa* (Wiedemann), *T. incurva* Loew, *T. pollinosa* Cole and *T. ra* Harriot. One species from California and Nevada based on female specimens remains undescribed. A key to all species is provided, species are illustrated and their distributions mapped. Wing patterns may be used to differentiate among all species, although confident identification of certain sympatric species requires confirmation by examination of male genitalia.

Key words: Diptera, Ulidiidae, *Tritoxa*, Nearctic, new species, black onion fly

Introduction

The Ulidiidae are a cosmopolitan family of Diptera including more than 700 species, mostly breeding in decomposing plant material (Ferrari 1987; Kameneva & Korneyev 2010; Marshall 2012). Only a few are phytophagous and are considered pests. The phytophagous genus, *Tritoxa* Loew, 1873 (Figs 1, 2), is restricted to the Nearctic Region with five species known prior to this study. *Tritoxa flexa* (Wiedemann) is referred to as the black onion fly and breeds in commercial onions, causing economic damage (Chittenden 1927; Manis 1941; Cole 1969; Allen & Foote 1975; Downing 1977). Similarly, *Tritoxa incurva* Loew breeds in wild garlic, *Allium canadense* L., but can also develop in commercial onions (Allen & Foote 1975). The recognition of these pest species was first reported in 1865, noted by Osten Sacken in a footnote in Loew (1873, p. 104).

Examination of the male terminalia of a number of specimens of *T. cuneata* revealed two distinct forms, which led to the present revision and the need to re-evaluate species definitions in *Tritoxa*.

Material and methods

Specimens for examination were borrowed from the California Academy of Sciences, San Francisco, USA (CAS), Center for Biodiversity Genomics, Guelph, Canada (CBG), Canadian National Collection of Insects, Ottawa, Canada (CNC), California State Collection of Arthropods, Sacramento, USA (CSCA), University of Guelph Insect Collection, Guelph, Canada (DEBU), Lyman Entomological Museum, Ste-Anne-de-Bellevue, Canada (LEM), Museum of Comparative Zoology, Cambridge, USA (MCZ), and National Museum of Natural History, Smithsonian Institution, Washington, USA (USNM). Images of the holotype of *Tritoxa flexa* were provided by Museum für Naturkunde, Leibniz-Institut für Evolutions- und Biodiversitätsforschung, Berlin, Germany (ZMHB).

Morphological terminology follows Cumming & Wood (2017). Dissections were performed by heating the

post-abdomen in 85% lactic acid and subsequently examining and dissecting them in glycerin. Abdomens and genitalia were stored in a microvial with glycerin and pinned below the source specimen. Wings of certain species were permanently slide mounted in Euparal. The glass slides are stored separately and associated with the pinned specimen by a unique number. Photographs were taken with a Leica camera model DFC5400 using Leica Application Suite X. Photo montages were created using Zerene Stacker (version 1.04, Zerene Systems, LLC., Richland, WA). During photography, dissected specimens were submerged in hand sanitizer gel (which prevents movement of the specimen) on a depression slide (Fleming *et al.* 2014; Su 2016). Maps were constructed by using the location data on the specimen labels. If coordinates were not present on specimen labels, the collection locality data were used to estimate approximate coordinates, through the use of Google Maps and Google Earth. The internet software, SimpleMappr (Shorthouse 2010) was used to construct distribution maps for each species.

Taxonomy

Genus *Tritoxa* Loew

Tritoxa Loew, 1873: 102. Type species: *Trypeta flexa* Wiedemann, 1830 (by subsequent designation of Coquillett, 1910: 617).

Diagnosis. The genus as a whole is immediately recognizable by the brown or black wings with three hyaline crossbands. Other characters include broadly flattened palpi, a strong anepisternal and katepisternal seta, vein R_1 setulose above from just distal of humeral crossvein, vein R_{2+3} slightly sinuous, cell *cua* closed apically without extension; females with three elongate, cylindrical spermathecae and abdominal segment 6 significantly reduced; males with inner surstylus with prenisetae and phallus long and coiled, with ventral margin lined with spines.

Redescription. Head: dichoptic in both sexes, 1.3–2.6 times higher than wide; postocellar setae well developed, divergent; inner and outer vertical setae long, reclinate; ocellar setae short and latero-proclinate, slightly shorter and thinner than postocellar setae; 2 strong reclinate orbital setae, upper often stronger; frons wider than eye, essentially as tall as wide, with short interfrontal setulae except between upper pair of orbital setae; proboscis brown; palpus broadly flattened, yellowish to brownish with black setulae; lunule with setulae under anterior frontal margin sometimes visible; gena with subvibrissal setae and at least 1 long postgenal seta; antennal scape with dorsal rim of setae; pedicel densely setulose dorsally and dorsolaterally, with continuous rim of setae ventrally, also with notch prior to antennal seam; postpedicel pubescent, generally 3 to 5 times longer than wide; arista brown, short pubescent; supracervical setae yellow or black. **Thorax:** thoracic dorsum opaque with broad shiny lateral border; 1 postpronotal seta; 2 notopleural setae; 1 supra-alar seta; 1 postalar seta; 1 intrapostalar seta; 1 prescutellar dorsocentral seta; 1 prescutellar acrostichal seta; 2 pairs of scutellar setae; pleural segments shiny with white pruinescence; anepisternum usually with straight posterior row of setulae; anepisternum and katepisternum minutely setulose; 1 katepisternal seta; 1–2 anepisternal setae. **Wing:** brown or black with three oblique, hyaline crossbands (subbasal, discal, subapical) (Fig. 9); area below subbasal oblique crossband and alula opaque, only tinged with colour; distinct humeral break present; R_1 setulose above from just distal of humeral crossvein, R_{2+3} slightly sinuous, M vein distal to r-m crossvein gently and strongly arched; CuA arched to straight; apex of cell *cua* without point or extension. Halter white to yellowish-white. **Abdomen:** uniformly setulose; female with slender anteromedial apodemes present on sternites 3–6; tergite and sternite 6 short and transverse, subequal, significantly narrower than previous sclerites. **Male terminalia** (Fig. 16): hypandrium U-shaped, with pregonite narrow, bearing row of fine setae; postgonite small and oval. Epandrium wide with many long setae; inner surstylus broad, bearing prenisetae; outer surstylus digitiform; subepandrial sclerite V-shaped, with stiff setae; cercus with long setae; phallus long and coiled with many long ventral spines with longer and denser fine spines apically. **Female terminalia:** oviscape short, nearly as long as tergite 5, slightly shorter than aculeus. Eversible membrane slightly longer than aculeus, with 2 pairs of taeniae, not reaching posterior margin; membrane finely microtrichose on anterior 0.75, apical 0.25 with fine multidentate scales. Aculeus narrow, 4 times as long as wide; cercal unit with 3 pairs of long setae (subapical dorsal, subapical lateroventral and subbasal lateroventral) and shorter anterodorsal pair; 2 strong sensillae anterior to subapical lateroventral seta. Three elongate, cylindrical spermathecae.

Remarks. The major morphological characters used for species identification are wing patterns, body and supracervical setal colour, parafrenal pruinescence, and differences in surstylar chaetotaxy and shape.

In a molecular phylogeny of the Tephritoidea, *Delphinia* Robineau-Desvoidy, 1830 and *Tritoxa* were resolved as sister taxa in a dataset that included 15 species of Ulidiidae (Han & Ro 2016). These two genera both share an obliquely directed subbasal hyaline crossband, with accompanying pale anal lobe and alula. These two Nearctic genera were not included in the barcode study of Palaearctic Ulidiidae (Galinskaya *et al.* 2014). *Tritoxa* is assigned to the subfamily Otitinae, tribe Cephaliini, a group of nine genera supported by the single synapomorphy, extremely broad palpi (Kameneva & Korneyev 2006).

Key to the species of *Tritoxa*

(modified from Steyskal (1967))

- 1 Thorax and abdomen dark brown to black (Fig. 1), wings with dark brown to black background (Fig. 9); crossvein dm-m sinuate *T. flexa* (Wiedemann)
- Thorax and abdomen reddish-brown to brown (Fig. 2), wings with brown background (Figs 6–8, 10–13); crossvein dm-m straight to slightly sinuate or angulate 2
- 2 Crossvein dm-m straight or slightly sinuate (Figs 6–8, 10, 13); silvery parafrontal microtrichose stripe very narrow, only immediately adjacent to eye (Fig. 3) 3
- Crossvein dm-m angulate, or slightly angulate (Figs 11, 12); silvery parafrontal microtrichose stripe broad, surrounding bases of orbital setae (Figs 4, 5) 7
- 3 Discal and subapical hyaline crossbands arcuate and parallel (Fig. 10); subapical hyaline crossband attaining costa basad of crossvein r-m *T. incurva* Loew
- Discal and subapical hyaline crossbands arcuate or straight (Figs 6–8, 13); subapical hyaline crossband essentially straight, attaining costa apicad of crossvein r-m 4
- 4 Discal hyaline crossband reaching posterior wing margin, or at least extending beyond cell dm (Fig. 13); small hyaline spot in costal cell distal to humeral crossvein; silvery parafrontal microtrichia stripe distinct, extending nearly half distance from eye margin to orbital setae *Tritoxa* sp.
- Discal hyaline crossband not extending beyond cell dm (Figs 6–8); costal cell distal to humeral crossvein dark, without hyaline spot; silvery parafrontal microtrichia stripe narrow, extending less than one-third distance from eye margin to orbital setae. . . 5
- 5 Discal hyaline crossband ending in or very close to posterior distal corner of cell dm, generally tapered (Fig. 8); inner surstylus with row of 5–8 strong prenisetae; outer surstylus arched mesally (Fig. 17) *T. decipiens* sp. nov.
- Discal hyaline crossband ending distant to posterior distal corner of cell dm and usually wide posteriorly (Figs 6, 7); inner surstylus with prenisetae widely separated or in tight cluster; outer surstylus straight or arched (Figs 14, 16) 6
- 6 Inner surstylus with 3–4 strong, separated prenisetae; outer surstylus straight (Fig. 16); phallus very long, comprising some 4–5 loops; discal hyaline crossband long, extending to opposite crossvein r-m (Fig. 7) *T. cuneata* Loew
- Inner surstylus with straight row of 4–5 thick prenisetae in tight cluster, decreasing in size with largest adjacent to outer surstylus (Fig. 14); outer surstylus arched (Fig. 14); phallus much shorter than typical of genus, comprising 2 loops (Fig. 15); discal hyaline crossband shorter, not reaching opposite r-m crossvein (Fig. 6) *T. californica* sp. nov.
- 7 Crossvein dm-m with stump vein (Fig. 12); silvery parafrontal microtrichia stripe extending 1/4 to 1/3 distance from eye margin to midfrons (Fig. 5); discal hyaline crossband continuous from R₁ to posterior wing margin (Fig. 12); anepisternum shiny . . . *T. ra* Harriot
- Crossvein dm-m usually without stump vein (Fig. 11); silvery parafrontal microtrichia stripe extending halfway from eye margin to midfrons (Fig. 4); discal hyaline crossband disjunct along R₂₊₃ (Fig. 11); anepisternum densely clothed in yellow microtrichia. *T. pollinosa* Cole

Tritoxa californica sp. nov.

(Figs 6, 14, 15, 24)

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Type material. HOLOTYPE ♂, labelled: “CALIF: Plumas Co./ Little Long Valley/ Creek [39°52'06"N 120°42'08"W], 6000' 6 mi. E./ Spring Garden/ VIII-4-10-1977”; “Malaise Trap/ 8A-6P/ M. Wasbauer/ Collector”; “HOLOTYPE/ *Tritoxa californica* Sinclair, MacLeod & Wheeler” (CSCA). PARATYPES: USA. California: El Dorado Co., Pollack Pines [38°45'41"N 120°35'12"W], 2.ix.1986, Jackson trap, peach, D. Bolster (1♂, CSCA); Nipa Co., Angwin, 38.575°N 122.453°W, 17.ix.2008, McPhail trap, T. Samansky (1♂, 1♀, CSCA); Same data as holotype (1♂, 2♀, CSCA); Santa Cruz Co., Big Basin SP [37°10'21"N 122°13'21"W], 13.ix.1966, E.L. Sleeper (1♂, CAS); Trinity Co. [40.66°N 123.12°W], 13.vi.1934 (1♂, CAS); Tuolumne Co., 2.7 mi E Smoky Jack [37°49'3.72"N 119°42'45.61"W], Summer 1962, Frick trap on *Prunus emarginata*, D.P. Allen (1♂, CSCA).

Possible additional material. USA. California: El Dorado Co., Placerville [38°43'47"N 120°47'55"W],

26.vi.1953, P.H. Arnaud (1♂, USNM) [genitalia lost]; Sagehen Ck Field Stn., 15 km N Truckee, 39°25.89'N 120°14.61'W, 16.viii.1999, J. Savage (1♀, LEM); Nevada Co., Sagehen Ck [39°25'57"N 120°14'13"W], 2.vii.1968, R.W. Pinger (1♀, USNM).

Diagnosis. This species has the general appearance of *Tritoxa cuneata*, but is distinguished by the short, oblique discal hyaline crossband not extending beyond level of crossvein r-m in cell dm, inner surstylus with tight cluster of 4–5 thick prensisetae and phallus is shorter, with two loops.

Description. Entirely yellowish brown to brown, abdomen darker brown bands. **Head:** ocellar triangle dark brown to black, microtrichose; frons yellowish brown to brown; parafrontal silvery microtrichia stripe very narrow, limited to extreme margin of eye, continuous with very narrow microtrichose parafacial; gena slightly darker brown below narrowest part of lower eye margin; postocular microtrichia slightly wider than parafrontal microtrichose stripe in lateral view, extending from base to middle of eye; face concolourous with face laterally, slightly paler medially; supracervical setulae very pale. Antenna with postpedicel greyish brown, yellowish brown on inner and medially surfaces. Proboscis with yellowish brown palpus. **Thorax:** yellowish brown; scutum mostly thinly microtrichose without pair of vittae; lateral margin of scutum and postpronotal lobe broadly shiny; scutellum concolourous with scutum; mediotergite without distinct stripe; pleura shiny, anepisternum and katepisternum lightly clothed in whitish microtrichia when viewed obliquely; whitish microtrichia above fore coxa; 2 anepisternal setae. **Wing** (Fig. 6) entirely brown, slightly tapered apically, with 3 hyaline crossbands; some faded or paler regions between bands; costal cell without hyaline band at humeral break, with narrow hyaline band at extreme apex of cell in line with discal hyaline crossband; oblique subbasal hyaline crossband very short, extending to basal fifth of cell dm; discal hyaline crossband short, continuous from R₁, reaching posterior margin of cell dm, not extending beyond level of crossvein r-m in cell dm; subapical hyaline crossband nearly straight, anterior end not extending proximal to crossvein r-m; crossvein dm-m straight to slightly arched; anal lobe developed; calypter with white margin. **Abdomen:** yellowish brown. **Male terminalia** (Figs 14, 15): inner surstylus with tight cluster of 4–5 thick prensisetae, inner margin concave; outer surstylus slender, slightly tapered and arched, slightly longer than length of inner surstylus, with narrow apex (Fig. 10); subepandrial sclerite with strong dark setae. Cercus with short setae; apical margin slightly pointed. Phallus short, with 2 loops.

Distribution. This species is known exclusively from northern California (Fig. 24).

Remarks. See comments under *T. cuneata*.

Tritoxa cuneata Loew

(Figs 7, 16, 26)

Tritoxa cuneata Loew, 1873: 107. Type locality: Nebraska, USA.

Type material examined. **LECTOTYPE** ♂ [<https://mczbase.mcz.harvard.edu/guid/MCZ:Ent:13246>], labelled: “Neb[raska]. [41°29'33"N 99°54'06"W]”; “cuneata/ m.”; “Loew/ Coll.”; “Type/ 13246 [red label]”; “Lectotype/ Tritoxa cuneata/ Loew/ Steyskal 1971”; “MCZ-ENT/ 00013246/ data matrix code”; “LECTOTYPE/ *Tritoxa cuneata* Loew/ des. B.J. Sinclair 2020 [red label]” (MCZ). **PARALECTOTYPE:** same data as lectotype (1 ♂, dissected, MCZ).

Taxonomic notes. Loew based this species on an unspecified number of male and female specimens. Steyskal attached his lectotype label to a male syntype, but this designation was never published. Our lectotype label is now attached to this specimen in order to fix the identity of the species.

Additional material examined. **CANADA. Alberta:** Elkwater Park [49°39'39"N 110°16'54"W], 16.vi.1952, A.R. Brooks (1♂, CNC); Empress [50°57'0"N 110°00'22"W], 7.vi.1957, Brooks & MacNay (1♂, 1♀, CNC); Irvine [49.9553°N 110.2767°W], 11.vi.52, L.A. Konotopetz (1♂, CNC); Medicine Hat [50°02'30"N 110°40'39"W], 28.vii.1927, F.S. Carr (1♂, CNC); Onefour Heritage Range Land, nr Rte 41, Sage Ck, 49.15666° -110.2036°, 4.vii.2012, S. Rochefort (1♂, 1♀, CNC); Pinhorn Grazing Reserve, 33 km SSW Manyberries, 49°7'51"N 110°53'23"W, 7.vii.2009, J.H. Kits (1♂, DEBU). **Saskatchewan:** Grasslands NP, Butte trail, grass/sage brush plains, 49.198° -107.634°, 15.vii.2008, 814 m, J. Straka, N. Jeffery, 08BBDIP-0174, 08BBDIP-0173 (2♂, barcoded, CBG); Saskatoon [52°08'N 106°41'W], 26.vi.1951, L.A. Konotopetz (1♂, 1♀, CNC); Val Marie [49°13'59"N 107°44'05"W], 10.vi.1955, A.R. Brooks (1♂, CNC); same data except, 8.viii.1955 (4♂, CNC); 15 km E Val Marie,

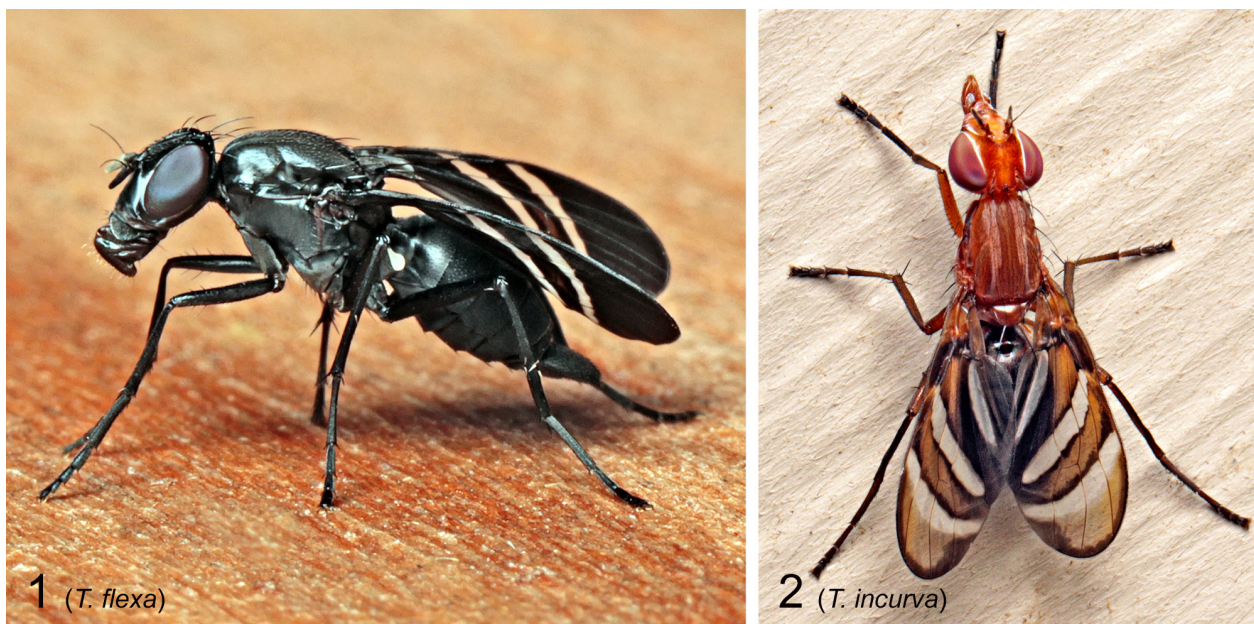
hilltop, 13.vi.1989, M. Polak & M. Wood (1♂, CNC); Wood Mountain [49°13'18"N 106°13'32"W], 17.vi.1955, A.R. Brooks (2♂, CNC). **USA. Arizona:** Apache Co., Big Lake, 33°53'N, 109°26'W, 14.vii.1992, G.F. Hevel (1♂, USNM). **California:** Callahan [41°18'35"N 122°48'05"W], 12.vi.1934, T.G.H. Aitken (1♀, CAS); Glen Co., Plaskett Meadows [39°43'40"N 122°50'42"W], 11.x.1964, J.D. Birchim (1♂, CAS); Inyo Co., Sage Flat [37.130241° -118.413617°], 15.viii.1966, E.L. Sleeper (1♂, CAS); Inyo Co., White Mts, 2 mi S Schulman Grove [37.385° -118.178°], 28.viii.1984–11.vi.1985, 9200 ft, D. Giuliani (1♂, CSCA); same data except, 6.5 mi N, 7.5 mi E Big Pine, 7000 ft, 27.ii.–28.viii.1984 (2♂, 1♀, CSCA); Lake Tahoe [39°05.5'N 120°02.5'W], 2.vii.1915, E.C. Van Dyke (1♂, CAS); Mendocino Co., Anthony Peak [39.84624°N 122.96457°W], 6.ix.1961, M. Poyner (1♂, CAS); Mt. Shasta [41°24'33"N 122°11'42"W], 1.viii.1909, 7000 ft, L. Eighme (1♂, CSCA); Obispo Co., San Luis, Cerro Alto [35°25'27.37"N 120°44'20.35"W], 4.iv.1966, E.L. Sleeper (2♂, 2♀, CAS). **Colorado:** Buckhorn Ck [40.4208169° -105.1752614°], 11.vii.1937, C.L. Johnston (2♂, USNM); Clark [40°42'26"N 106°55'08"W], 3.viii.1947, O. Bryant (1♂, CAS); Estes Park [40°22'N 105°31'W], 7500 ft, 2.vii.1961, W.R.M. Mason (1♂, CNC); 4.5 mi N Boulder [40°00'N 105°16'W], 5500 ft, 13.vi.1961, W.R.M. Mason (1♂, CNC); Jefferson [39°22'N 105°48'W], 9400 ft, 14.vii.1961, W.R.M. Mason (1♂, CNC). **Idaho:** Blaine Co., Galena Summit [43°52'N 114°42'W], 8600 ft, dry hillside, 15.vii.1961, J.G. Chillcott (1♂, CNC); Waha [46°12'N 116°49'W], 12.viii.1923, A.L. Melander (1♂, USNM). **Montana:** Petroleum Co., 1.5 mi S, 5 mi W Winnett [47°0'N 108°21'W], 30.vii.1969, G.B. Hewitt (1♀, USNM); Petroleum Co., 3 mi NW Winnett, 16.vi.1969, G.B. Hewitt (1♂, USNM). **Nevada:** Elko Co., Wells [41°6'34"N 114°58'8"W], 13.viii.1981, P.H. Arnaud (1♂, CAS); White Pine Co. [39°26'N 114°54'W], Lehman Ck, 10.vii.1966, R.P. Allen (1♂, 2♀, CSCA). **New Mexico:** Otero Co., Lincoln NF, Sacramento Mtns, Bailey Ck nr Cloudcroft, 1642 m, 32°58'56.1"N 105°45'13.4"W, 13.vi.2007, S.D. Gaimari (1♂, CSCA). **Oregon:** McMinnville [45°12'42"N 123°11'50"W], 28.vii.1930 (2♂, USNM). **Texas:** NW Blanco Co. [30°16'N 98°24'W], Davis Ranch, 12.iv.1959, J.F. McAlpine (2♂, CNC); Dallas Co. [32°46'N 96°47'W], vii.1931, J.K.G. Silvey (1♀, USNM); Garza Co., 2 mi N Justiceburg [33°2'31"N 101°12'11"W], collected on *Xanthocephalum sarothrae*, 4.viii.1976, D.E. Foster (1♂, USNM); Hondo [29°20'49"N 99°8'44"W], 25.iv.1942, A.L. Melander (1♀, USNM); Kerrville [30°2'51"N 99°8'26.1"W], swept meadow, 18–20.iv.1959, J.F. McAlpine (3♂, 2♀, CNC); same data except, 16.iv.1959, W.R.M. Mason (1♂, CNC); Maverick Co., Texas A&M Ranch, 15 mi WSW Uvalde [29°12'N 99°47'W], sweeping *Xanthocephalum sarothrae*, 13.x.1976, Robbins & Seedle (1♀, USNM); Maverick Co., 35 mi SE Del Rio [29°21'N 100°54'W], 4.ix.1982, Huber, Gonzalez (1♀, CSCA); San Antonio [29°25'N 98°29'W], 3.iv.1942, A.L. Melander (1♂, USNM); same data except, 16.iv.1942 (1♀, USNM); San Antonio, ii.1928, F.C. Pratt (1♀, USNM); Texas 281 RV Park Meadow, Bulverde, 29.7875°N 98.4191°W, 340 m, 12.iv.2010, Biobus 2010, 10BBDIP-0308, 10BBDIP-0309, 10BBDIP-1818 (1♂, 2♀, barcoded, CBG); same data, 29.7898° -98.4202°, 11.iv.2010, 378 m, Treed Nature Trail, 10BBDIP-1821 (1♂, barcoded, CBG); Travis Co., Austin [30°16'N 97°44'W], *Gutierrezia glutinosa*, 20.ix.1978, P.D. Hurd (1♂, USNM); Uvalde Co., 3 mi NW Uvalde [29°12'52"N 99°47'23"W], MT, 4–6.v.1977, T. Eichlin, M. Washbauer (2♀, CSCA); Val Verde Co., Langtry [29°48'N 101°33'W], 4.ix.1982, Huber & Gonzalez (1♀, CSCA). **Utah:** 9 mi E Oak City [39°22'N 112°20'W], Oak Ck Camp, MT, 1.ix.1963, D.C. Rentz (5♂, 2♀, CAS). **Washington:** Blue Mtns, Godman's Springs RS [46.1007217° -117.7868657°], 6000 ft, 28.vii.1940, M.C. Lane (1♂, USNM); Pullman [46°44'N 117°10'W], 25.viii.1897, R.W. Doane (1♂, 1♀, USNM). **Wyoming:** Cheyenne Co. [38°49'N 102°35'W], 19.vi.1972, E.L. Sleeper (1♂, CAS); Sheridan [44°47'N 106°57'W], no date, Metz (1♂, USNM).

Diagnosis. This species can be recognized by the long discal hyaline crossband, extending to opposite crossvein r-m, inner surstylus with 3–4 strong, separated prenisetae and outer surstylus straight.

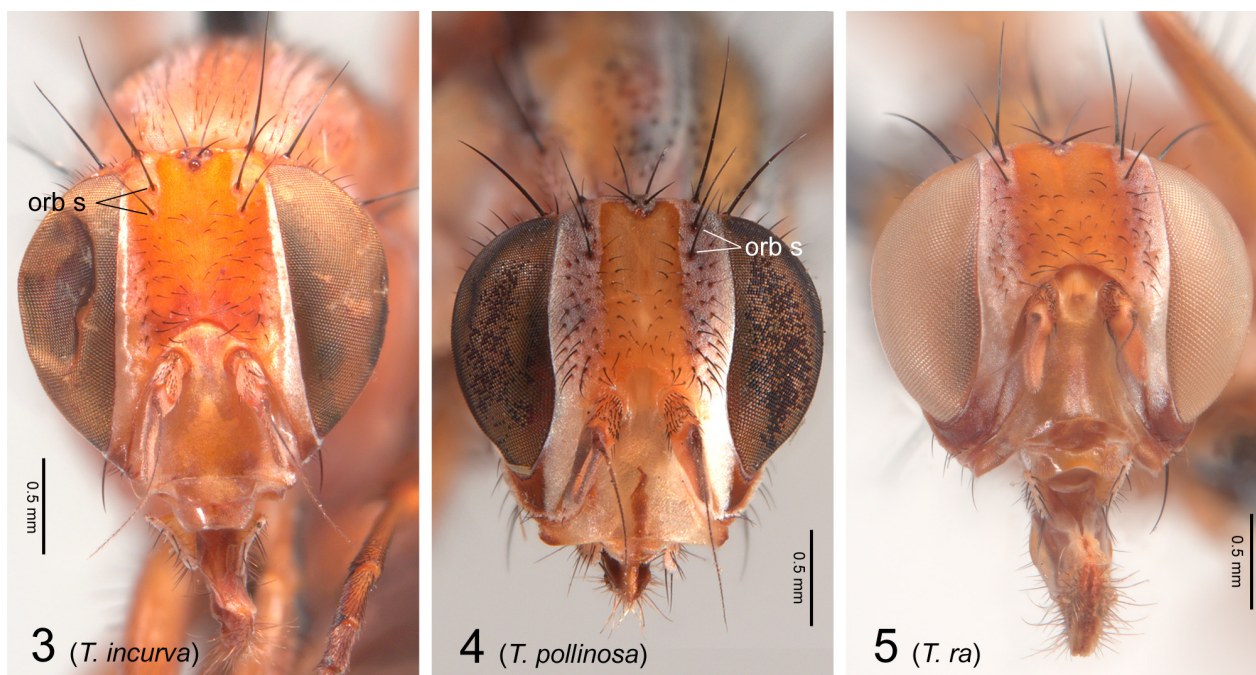
Redescription. Entirely reddish brown to black, abdomen darker. **Head:** ocellar triangle shiny black; frons reddish-brown to brown; silvery parafrontal microtrichose stripe very narrow, continuous with very narrow microtrichose parafacial; gena dark brown below narrowest part of lower eye margin; postocular microtrichia wider than parafrontal microtrichia in lateral view, extending from oral margin to middle of eye; face yellowish-brown to brown; supracervical setulae usually yellow. Antenna with postpedicel greyish brown, yellowish brown on ventral and basal surfaces. Proboscis with palpus concolourous with face. **Thorax:** yellowish-brown to brown; scutum mostly thinly pruinulent with pair of whitish pruinulent vittae; lateral margin of scutum and postpronotal lobe broadly shiny; scutellum concolourous with scutum; mediotergite without distinct stripe; pleura shiny, posterior portion of anepisternum and katepisternum lightly clothed in whitish microtrichia when viewed obliquely; whitish microtrichia above fore coxa; 1 rarely 2 anepisternal setae. **Wing** (Fig. 7) rounded apically, brown, especially along margins of hyaline crossbands, with some faded or paler regions; costal cell without narrow hyaline band at humeral break, with or without hyaline band at apical fourth in line with discal hyaline crossband; often hyaline

area from apical region of Sc to R₁; oblique subbasal hyaline crossband reaching basal third of cell dm; discal hyaline crossband oblique, short, continuous from R₁, broader posteriorly, long, obliquely arched, extending to level of crossvein r-m in cell dm, often somewhat displaced at R₄₊₅; subapical hyaline crossband broad, nearly straight to arched, anterior end not extending proximal to crossvein r-m; crossvein dm-m straight; anal lobe well-developed; calypter usually with broad white margin. **Abdomen:** brown bands on anterior portion of some tergites in paler forms; sternites dark to yellow; pleural membrane infuscate. **Male terminalia** (Fig. 16): inner surstylus with 3–4 separated, thick prenisetae, inner margin straight; outer surstylus slender, longer than inner surstylus, slight tapered and straight with rounded apex; subepandrial sclerite with scattered dark setae. Cercus with long, strong apicolateral setae; apical margin straight. Phallus long, with some 4–5 loops.

Distribution. *Tritoxa cuneata* is widespread in western North America, from southeastern Alberta and southern Saskatchewan to Texas and west to California (Fig. 26).



FIGURES 1–2. Photographs of living *Tritoxa* species. **1.** *T. flexa* (Madison County, Tennessee); **2.** *T. incurva* (Madison County, Tennessee). Photographs @ Ken Childs.



FIGURES 3–5. Heads of *Tritoxa* species, anterior view. **3.** *T. incurva*; **4.** *T. pollinosa*; **5.** *T. ra*. Abbreviation: orb s—orbital setae.

Remarks. *Tritoxa cuneata* is very similar to *T. decipiens* and where the distribution of the two species overlap (e.g., Rocky Mtns), care should be taken for identification and examination of the male terminalia is recommended to confirm. In California, *T. cuneata* is also sympatric with *T. californica* and again, dissection and examination of the male terminalia is required to confirm identification.

A single male from Cochise County, Arizona (AZ: Cochise Co., Dragoon Mtns, Cochise Stronghold, 1219 m, 30.viii.1982, E.S. Ross (CAS)) is possibly conspecific based on the wing pattern, but the male terminalia suggests *T. decipiens*. Specimens from this locality should be further investigated.



FIGURES 6–13. Wings of *Tritoxa* species. **6.** *T. californica* sp. nov.; **7.** *T. cuneata*; **8.** *T. decipiens* sp. nov.; **9.** *T. flexa*; **10.** *T. incurva*; **11.** *T. pollinosa*; **12.** *T. ra*; **13.** *Tritoxa* sp. Abbreviations: d bd—discal band; dm—discal medial cell; dm-m—discal medial crossvein; r-m—radial medial crossvein; sbap bd—subapical band; sbb bd—subbasal band.

***Tritoxa decipiens* sp. nov.**

(Figs 8, 17, 25)

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Type material. **HOLOTYPE** ♂, labelled: “BC 30 km E/ Smithers [54°46'N 127°10'W]/ 15.VI.1989/ M.Pollak”; “HOLOTYPE/ *Tritoxa/ decipiens* Sinclair,/ MacLeod & Wheeler” (CNC). **PARATYPES: CANADA. Alberta:** Banff [51°10'N 115°34'W], 30.vii.1924, E. Hearle (1♂, 3♀, CNC), same data except, no date, N.B. Sanson (1♂, CNC); same data except, Buffalo Pk, 4500 ft, 2,17.vii., 5.viii.1925, O. Bryant (1♂, 1♀, USNM); Elkwater Park [49°39'39"N 110°16'54"W], 26.vii.1952, L.A. Konotopetz (1♂, CNC); Dunvegan, N shore Peace River, south facing grassy slopes, 12–14.vii.1997, T.A. Wheeler, S. Boucher (9♂, 5♀, LEM); same data except, 55°55.59'N 118°35.74'W, 19.vii.2003, S. Boucher (1♂, LEM); same data except, 55°55'25"N 118°35'40", 21.vii.2003, V. Dion (1♀, LEM); Lethbridge [49°41'39"N 112°49'58"W], 15.vi.1925, H.L. Seamans (1♂, CNC); Peace River [56°14'02"N 117°17'23"W], 10.vii.1961, A.R. Brooks (1♂, CNC); Waterton Lakes [49°02'N 113°54'W], 19.vi.1923, J. McDunnough (3♂, CNC); same data except, 2.vii.1923 (1♀, DEBU); Waterton, 11.vi.1962, K.C. Herrmann (2♂, 1♀, CNC); same data except, 13.viii.1922, H.E. Gray (1♂, CNC). **British Columbia:** Adams Lake [51°15'N 119°30'W], 16.vi.1923, W.B. Anderson (1♂, 2♀, CNC); Elko [49°18'N 115°06'W], Chilcotin [51°52'N 123°15'W], 30.vi.1920, E.R. Buckell (1♂, CNC); Elko [49°18'00"N 115°06'42"W], E. Kootenay, 9.vii.1949, H.B. Leech (1♀, CAS); Lac la Hache [51°48'N 121°28'W], 12.vii.1964, L.H. McMullen (1♀, CNC); Pouce Coupe [55°42'N 120°08'W], 1.vii.1927, P.N. Vroom (1♀, CNC); Pavilion Lake [50.86677°N 121.74191°W], 5.vi.1938, G.S. Walley (1♂, 1♀, CNC); Robson [49°20'08"N 117°41'19"W], 30.v.1948, 7.vii.1950, H.R. Foxlee (2♂, 2♀, CNC); Rolla [55°54'N 120°08'W], 21.vii.1927, P.N. Vroom (1♂, CNC); 30 km E Smithers [54°46'N 127°10'W], 15.vi.1989, M. Pollak (11♂, 7♀, CNC); Williams Lake [52°07'N 122°08'W], 11.vii.1938, J.K. Jacob (1♀, CNC). **USA. Arizona:** Greer [34°00'N 109°27'W], 3.vii.1953, A.&H. Dietrich (1♂, USNM); White River [34°00'N 109°27'W], 21.vi.1957, G. Butler & F. Werner (2♂, USNM); White Mtns [33°54'N 109°33'W], 8.vii.1933, Parker (1♂, 1♀, USNM). **Colorado:** Boulder [40°00'N 105°16'W], 5500 ft, 16.vi.1961, B.H. Poole (2♂, CNC); same data except, 19.vi.1961, W.R.M. Mason (1♂, CNC); 5 mi S Boulder, 21–17.vi.1961, W.R.M. Mason (1♂, 2♀, CNC); same data except, 4 mi N, 20.vi.1961, C.H. Mann (1♂, CNC); Buckhorn Ck [40.4208169° -105.1752614°], 11.vii.1937, C.L. Johnston (1♂, USNM); 5 mi. W Denver, 17.vi.1965, J.R. Bider (1♂, LEM); Estes Park [40°22'N 105°31'W], 7500 ft, 2–16.viii.1961, B.H. Poole (5♂, 8♀, CNC); same data except, 20.vii.1961, C.H. Mann (1♂, CNC); same data except, J.R. Stainer (1♀, CNC); Florissant [38°56'N 105°17'W], 8200 ft, vi.24.14, Champlain (1♂, USNM); Gilpin Co., Kelly-Dahl [39°55'57"N 105°29'52"W], south of Nederland, 2615 m, 4.viii.1973, P.H. Arnaud (1♂, CAS); Larimer Co., 15 mi. W Livermore [40°47'N 105°13'W], 1500 ft, 3.vii.1982, W.J. Pulawski (1♂, CAS); Manitou [38°51'N 104°54'W], 25.vii.1903, Van Duzee (1♂, CAS); near Meeker [40°2'N 107°54'W], 11.vi.1984, Ponderosa pine/prairie, H. Goulet (18♂, 24♀, CNC); Nederland [39°57'N 105°30'W], Science Lodge, 9000 ft, 29.vii.1961, J.R. Stainer (1♂, 1♀, CNC); same data except, 9500 ft, 29.vi.1961, B.H. Poole (1♀, CNC); same data except, 8200 ft, W.R.M. Mason (1♀, CNC); South Park, nr Jefferson [39°22'N 105°48'W], 21.vi.1961, C.H. Mann (2♂, 2♀, CNC); Westlake [40.788701° -105.568232°], 7.vii.1900, no collector (1♂, USNM). **Idaho:** Lehmi Co., Lehmi Pass [44°58'27"N 113°26'42"W], 7340–7500 ft, 16.vii.1978, J.F.G. & T.M. Clarke (1♂, USNM). **Montana:** Lolo [46°45'N 114°5'W], 1.vii.1904, no collector (1♀, USNM); Silver Box Co., 14 mi. S Butte [45°59'N 112°31'W], 23.viii.1973, A.J. & M.E. Gilbert (1♂, CSCA). **New Mexico:** Cloudcroft [32°57'N 105°44'W], 8.vi.1968, R. Eads (2♂, 1♀, USNM); Lincoln Co., Lincoln NF, 33°23'32.5"N 105°44'01.1"W, 2374 m, 7.vi.2010, T.N. & S.D. Gaimari (3♂, 1♀, CSCA); same data except, White Mtns, Mills Cyn, 33°27'08.2"N 105°44'46.6"W, 1837 m, 14.vi.2007, S.D. Gaimari (1♂, 2♀, CSCA); Raton [36°53'N 104°26'W], 19.vi.1937, E.D. Ball (1♂, 1♀, USNM). **Utah:** Henry Mtns, Bull Creek Pass [38°05'N 110°48'W], 10200 ft, 18.vii.1968, H.F. Howden (1♂, CNC); Snowville [41°58'N 112°42'W], 2.vii.1950, F.C. Harmston (1♂, USNM). **Wyoming:** Red Gulch Rd. off Hwy. 14 nr. Shell [44°32'N 107°46'W], pans in barren area nr. cottonwoods, cow dung, 5–19.viii.1990, J.E. Swann (2♂, DEBU).

Diagnosis. This species can be recognized by the discal hyaline crossband ending in or very near the posterior corner of cell dm and inner surstylus with 5–8 thick prensisetae.

Description. Entirely reddish brown, abdomen darker. **Head:** ocellar triangle shiny black; frons reddish-brown to brown; silvery parafrontal microtrichose stripe very narrow, continuous with very narrow microtrichose parafacial; gena dark brown below narrowest part of lower eye margin; postocular microtrichia wider than parafrontal microtrichia in lateral view, extending from oral margin to middle of eye; face yellowish-brown to brown; supracervi-

cal setulae usually yellow. Antenna with postpedicel greyish brown, yellowish brown on ventral and basal surfaces. Proboscis with palpus concolourous with face. **Thorax:** reddish-brown to brown; scutum mostly thinly pruinulent with pair of whitish pruinulent vittae; lateral margin of scutum and postpronotal lobe broadly shiny; scutellum concolourous with scutum; mediotergite without distinct stripe; pleura shiny, posterior portion of anepisternum and katepisternum lightly clothed in whitish microtrichia when viewed obliquely; whitish microtrichia above fore coxa; 1 anepisternal seta. **Wing** (Fig. 8) rounded apically, brown, with some faded regions; costal cell without narrow hyaline band at humeral break, with hyaline band at apical fourth in line with discal hyaline crossband; hyaline area from apical region of Sc to R₁; oblique subbasal hyaline crossband reaching near mid-length of cell dm; discal hyaline crossband oblique, long, extending to or very close to posterior distal corner of cell dm, not displaced at R₄₊₅; subapical hyaline crossband nearly straight to slightly arched, anterior end not extending proximal to crossvein r-m; crossvein dm-m straight; anal lobe more weakly developed; calypter usually with broad white margin. **Abdomen:** brown to black tergites and sternites; pleural membrane infusate. **Male terminalia** (Fig. 16): inner surstylus with 5–8 thick prenisetae distributed along curved inner margin; outer surstylus slender, longer than inner surstylus, arched mesally with rounded apex; subepandrial sclerite with scattered dark setae. Cercus with long apicolateral setae; apical margin pointed. Phallus long, with some 5 loops.

Distribution. *Tritoxa decipiens* is widespread along the Rocky Mountains and neighbouring ranges and areas from British Columbia and Alberta to New Mexico (Fig. 25).

Etymology. The species name is from the Latin *decipiens* (deceive), referring to the species' similar appearance to *T. cuneata*.

Remarks. Steyskal had recognized and labelled several unpublished subspecies of *T. cuneata* from the USNM collection, including some identified here as *T. decipiens* **sp. nov.** These species appeared to be based on wing pattern differences, which are not supported on the basis of male terminalia.

See the Remarks section under *T. cuneata* for further comments.

***Tritoxa flexa* (Wiedemann)**

(Figs 1, 9, 18, 20, 21, 26)

Trypeta flexa Wiedemann, 1830: 483. Type locality: "Neugeorgien" [= USA, Georgia].

Trypeta arcuata Walker, 1853: 383. Type locality: USA (Loew, 1873: 102, synonym).

Tritoxa flexa (Wiedemann, 1830): Loew, 1873: 102 (new combination).

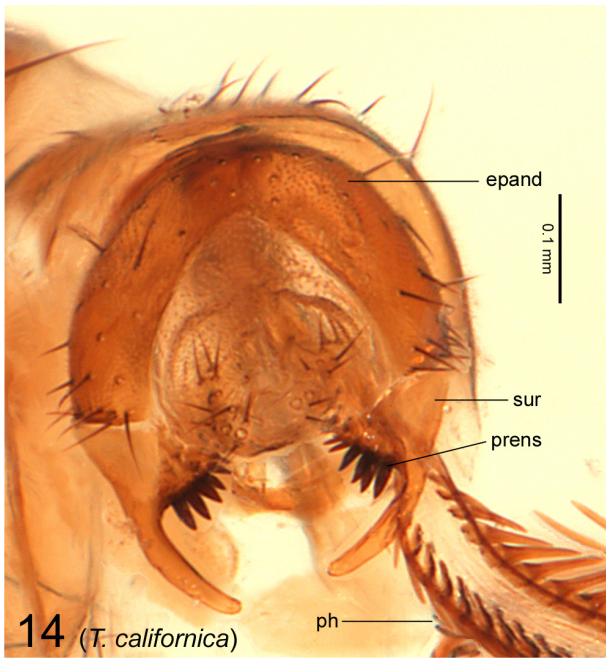
Type material. **HOLOTYPE** ♀ (Fig. 20): Georgia [32°09'56"N 82°54'00"W] (See Fig. 21 for label details) (ZMHB).

Additional material examined. **CANADA. Manitoba:** Aweme [49°43'N 99°36'W], 23.vii.1913, 20,23.vii.1915, 16.viii.1916, 24.viii.1917, 4,8.vii.1924, M. Criddle (3♂, 3♀, CNC; 1 ♀, DEBU); same data except, 27.vi.1921, 4.vii.1924, R.M. White (1♂, 1♀, CNC); Bald Head Hills [49°40'52"N 99°18'20.9"W], 13 mi. N Glenboro, 18.viii.1958, J.G. Chillcott (1♀, CNC); Bald Head Hills, 12 km N Glenboro, 4.viii.1983, K.N. Barber (1♂, 1♀, DEBU); Deloraine [49°11'N 100°29'W], 2.vii.1927, E. & S. Criddle (1♂, CNC); Douglas [49°53'N 99°42'W], 10.vi.1921, P. Vroom (1♂, CNC); 15 mi N Glenboro, 11.vii.1958, J.G. Chillcott (1♀, CNC); Oak Lake [49°45'N 100°37'W], 11.vii.1953, Brooks & Kelton (1♀, CNC); 5 mi. SW Shilo [49°48'N 99°38'W], 13.viii.1958, J.G. Chillcott (2♀, CNC); St. Charles Rifle Range, Winnipeg, 49°54.2'N 97°20.3'W, 8.vii.1998, tallgrass prairie, P. Bouchard (1♂, LEM); St. Lazare [50°26'N 101°18'W], 15.viii.1954, Brooks & Kelton (1♂, CNC). **Ontario:** Manitoulin Is., Christina Bay [45°49'N 82°55'W], 25.vi.1994, G. Vogg (1♀, DEBU); One Sided Lake [not plotted, locality unconfirmed], 30.vii.1960, S.M. Clark (1♂, 1♀, CNC); Pelee Is. [41°45'N 82°37'W], 12.ix.1961, Kelton & Brumpton (1♀, CNC); Pelee Island, sweep at Stone Rd. Alvar, 10.vi.1993, B. Larson (2♂, 4♀, DEBU); same data except, Alvar FON Res., 41°45'20"N 82°37'54"W, 8.vi.2002, S.A. Marshall (4♂, 2♀, DEBU); same data except, 8–9.vi.2002, S.M. Paiero (1♂, 1♀, DEBU); same data except, prairie, yellow pans, 8–9.vi.2002, Paiero & Buck (1♀, DEBU); same data except, 41°47'N 82°40'W, 1.x.2000, S.A. Marshall (1♀, DEBU); same data except, 1.x.2000, S.A. Marshall (3♂, DEBU); same data except, Blue Ash Savanna, 16.vii.1995, J. Skevington (4♂, 4♀, DEBU); same data except, 41°45.3'N 82°37.9'W, 8.vi.2002, K.N. Barber (1♀, DEBU); same data except, 30.vii.1998, B. Larson (1♀, DEBU); Pelee Island, 14.vi.2018, K.H. Stead (2♂, DEBU). **Saskatchewan:** Arcadia, 4.vii.1938, W.B. Fox (1♂, CNC); Estevan [49°08'N 102°59'W], 15.viii.1955, A.R. Brooks (1♀, CNC). **USA. Connecticut:**

Milford [41°13'N 73°03'W], ix.1943, soy beans (2♂, USNM); New Haven [41°18'N 72°55'W], 10.i.1939, S.C. Ball (1♀, USNM). **Illinois:** Chicago [41°52'N 87°37'W], 27.v.1911 (1♂, USNM). **Indiana:** Lafayette [40°25'N 86°52'W], 1923, G.M. Stirrett (1♀, CNC). **Iowa:** Ames [42°02'N 93°37'W], 19.vi.1947, A.R. Brooks (1♂, 1♀, CNC); same data except, 16,23.vii.1930, H.M. Harris (3 ♂, 4 ♀, DEBU); Moravia [40°53'26"N 92°48'57"W], 20.vii.1969, C.A. Toff (1♂, USNM); Pleasant Valley [41°41'N 86°04'W], 23.vi., 5.vii.1928, G.S. Walley, ex onions (5♂, 2♀, CNC). **Maryland:** Anne Arundel Co., 6 km S Edgewater, 38°53'N 76°33'W, 25.v.1976, J.H. Falk (2♂, USNM); Anne Arundel Co. [39°00'N 76°36'W], CBCES, 12.x.1976, J.H. Falk (1♀, USNM); Baltimore Co. [39°24'N 76°36'W], 22.x.1967, C.F. Reed (2♂, 5♀, USNM); Bradshaw [39°25'N 76°22'W], Rte 40, 3.vii.1965, W. Boyle (1♀, LEM); Cabin John [38°58'N 77°9'W], 21.v.1944, G.E. Bohart (1♂, CAS); Calvert Co. [38°32'N 76°32'W], Rte 416, 24.ix.1961, R.A. Boett (1♂, USNM); Calvert Co., Lusby [38°21'N 76°26'W], 3.viii.1969, G. Steyskal (1♀, USNM); Colesville [39°4'N 77°0'W], 5,20,28.viii.1975, 1.viii.1976, 4.vi.1977, W.W. Wirth (4♂, 2♀, USNM); Howard Co., Clarksville [39°12'N 76°56'W], 12.ix.1981, N.E. Woodley (1♀, USNM); Montgomery Co., Rockville [39°5'N 77°8'W], 20.v.1979, S.W. Gross (1♀, USNM); Plummers Is. [38°58'10"N 77°10'35"W], 27.ix.1949, G.E. Shewell (1♀, CNC); Prince George's Co., College Park [38°59'N 76°55'W], 8.viii.2001, P.H. & M.M. Arnaud (1♀, CAS); Prince George's Co., Beltsville [39°2'N 76°55'W], 16–26.x.1964, P.H. Arnaud (1♂, 1♀, 1?, CAS); Prince George's Co., Oxon Hill [38°48'N 76°59'W], 28.vi.1971, G.F. Hevel (1♂, USNM); Prince George's Co., Patuxent Research Station [39.06°N 76.78°W], 24.viii.1986, N.E. Woodley (1♂, USNM); Prince George's Co., Cedarville SP, 38°38'N 76°48'W, 24–29.vii.2008, S.M. Paiero (1 ♂, DEBU); Thurmont [39°37'N 77°24'W], 8.vi.1962, J.R. Vockeroth (1♂, 3♀, CNC). **Michigan:** Ann Arbor [42°16'N 83°44'W], 11.iv.1942, A. Peterson (1♀, 1?, UNSM); Detroit [42°19'N 83°02'W], 6.vi.1940, 28.vi.1942, G. Steyskal (2♂, USNM). **Minnesota:** Wilkin Co. [46°22'N 96°28'W], vi.1921, C.W. Howard (1♀, USNM). **Mississippi:** Lafayette Co. [34°22'N 89°29'W], no date, F.M. Hull (1♂, CNC). **Missouri:** 25 mi. S St. Louis [38°37'N 90°11'W], 3.viii.1965, H. Hoek & J. Lovely (1♀, LEM). **Nebraska:** Lincoln [40°48'N 96°40'W], 13.vi.1924, no collector (1♂, USNM). **New Jersey:** Marlboro [40.342°N 74.257°W], 4.vii.1962, J. Tomlinson, L. Davenport (1♂, 4f, CAS); Moorestown [39.977°N 74.944°W], 8.viii.1927, J.E. Holloway (1♂, USNM); Princeton [40.357°N 74.670°W], x.1901, A.H. Sturtevant (1♀, USNM); Riverton [40.011°N 75.014°W], 6.ix.1927, C.H. Ballou (1♂, USNM). **New York:** New York City [40°39'N 73°56'W], 11.iv.1939 (1♂, CAS). **Ohio:** Columbus [39°57'N 83°00'W], 25.viii.1916, A.J. Bosinger (1♂, CAS). **Pennsylvania:** Bryn Mawr [40°01'N 75°19'W], vi.1913, A.H. Sturtevant (1♂, USNM); Centre Co., Scotia Barrens [40°47'N 77°51'W], 13.ix.1972, 21.vii.1973, D.D. Wilder (2♀, CAS); same data except, 19.vii.1973, D.J. Shetlar (3 ♂, CAS); Franklin Co., Chambersburg [39°56'N 77°39'W], 9.viii.1972, S.S. Maxwell (3♂, 1♀, CAS); Lebanon Co., Indiantown Gap [40°26'N 76°34'W], 26.vi.1973, D.D. Wilder (1♀, CAS); Perry Co., Buffalo Bridge [40°29.38'N 77°09.48'W], 5.x.1968, J.W. Adams (1♂, USNM); Perry Co., nr Millerstown [40°33'N 77°09'W], 17.viii.1968, J.W. Adams (1♀, USNM); York Co., 5 mi. NW Davidsburg [39°59'N 76°53'W], 1.vii.1961, P. Spangler (1♂, USNM); Wyoming, Philadelphia [40°00'36"N 75°06'58"W], 4.vii.1904, G.M. Greene (1♂, USNM). **Tennessee:** Davidson Co., Nashville [36°10'N 86°47'W], 4.vii.1982, P.H. Arnaud (1♀, CAS); Roane Co., nr Rockwood [39°54'N 79°09'W], 8.v.1979, K.A. Spencer & G.C. Steyskal (1♂, USNM). **Virginia:** Botetourt Co., Jefferson Mtn Pk, 37°32'14"N 79°58'31"W, 588 m, 22.v.1999, S. Paiero (1♂, DEBU); Emporia [36°41'N 77°32'W], 7.v.1973, G.C. Steyskal (1♂, 1♀, USNM); Fairfax Co., Fairfax [38°51'N 77°18'W], 12.x.1974, R.W. Baumann (1♂, USNM); Fairfax Co., Great Falls [38°59'N 77°17'W], 11.vi.1944, G.E. Bohart (2♂, 1♀, CAS); same data except, 23.ix.1956, P.H. Arnaud (1♀, CSCA); Hawksbill [38°33'N 78°23'W], Shenandoah NP, 3600–4050 ft, 7.vi.1962, J.R. Vockeroth (5♂, 3♀, CNC); Shenandoah NP; Natural Bridge [37°37'N 79°32'W], 7.vi.1962, J.R. Vockeroth (1♂, CNC). **Washington DC:** [38°54'N 77°00'W] 19.vi.1938, J.F.G. Clarke (1♀, USNM); same data except, 25.vi.1944, G.E. Bohart (1♀, CAS); Rock Creek Park, Military Field Meadow [38°57'N 77°2'W], 16.viii.1978, R.A. Boettche (1♀, USNM). **West Virginia:** Morgantown [39°38'N 79°57'W], 10.vi.1964, O. Peck (1♀, CNC); Morgan Co., Cherry Run, 6 mi. NW Hedgesville [39°33'N 77°59'W], 1.ix.2001, P.H. & M.M. Arnaud (1♀, CAS). **Wisconsin:** Milwaukee [43.05°N 87.95°W], iv.1910, no collector (1♀, USNM).

Diagnosis. *Tritoxa flexa* is characterized by its dark brown to black body and broad, dark-brown wings, with a narrow and arched subapical hyaline crossband and inner surstylus with evenly space large prenisetae.

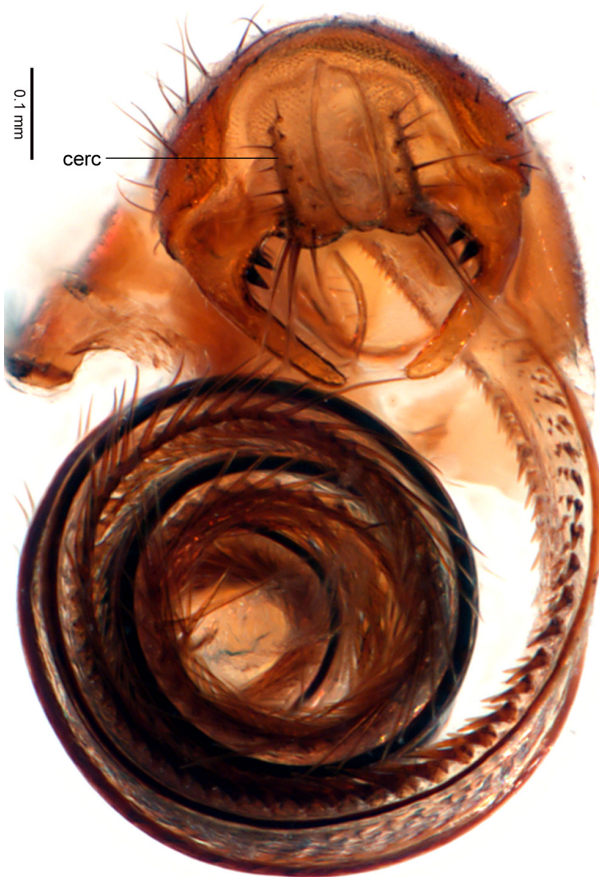
Redescription. Entirely dark brown to black (Fig. 1). **Head:** ocellar triangle shiny black; frons reddish-brown to brown; silvery parafrenal microtrichose stripe very narrow, continuous with very narrow microtrichose parafacial; gena slightly darker below narrowest part of lower eye margin; postocular microtrichia wider than parafrenal microtrichia in lateral view, extending from base to middle of eye; face dark brown; supracervical setulae pale.



14 (*T. californica*)



15 (*T. californica*)



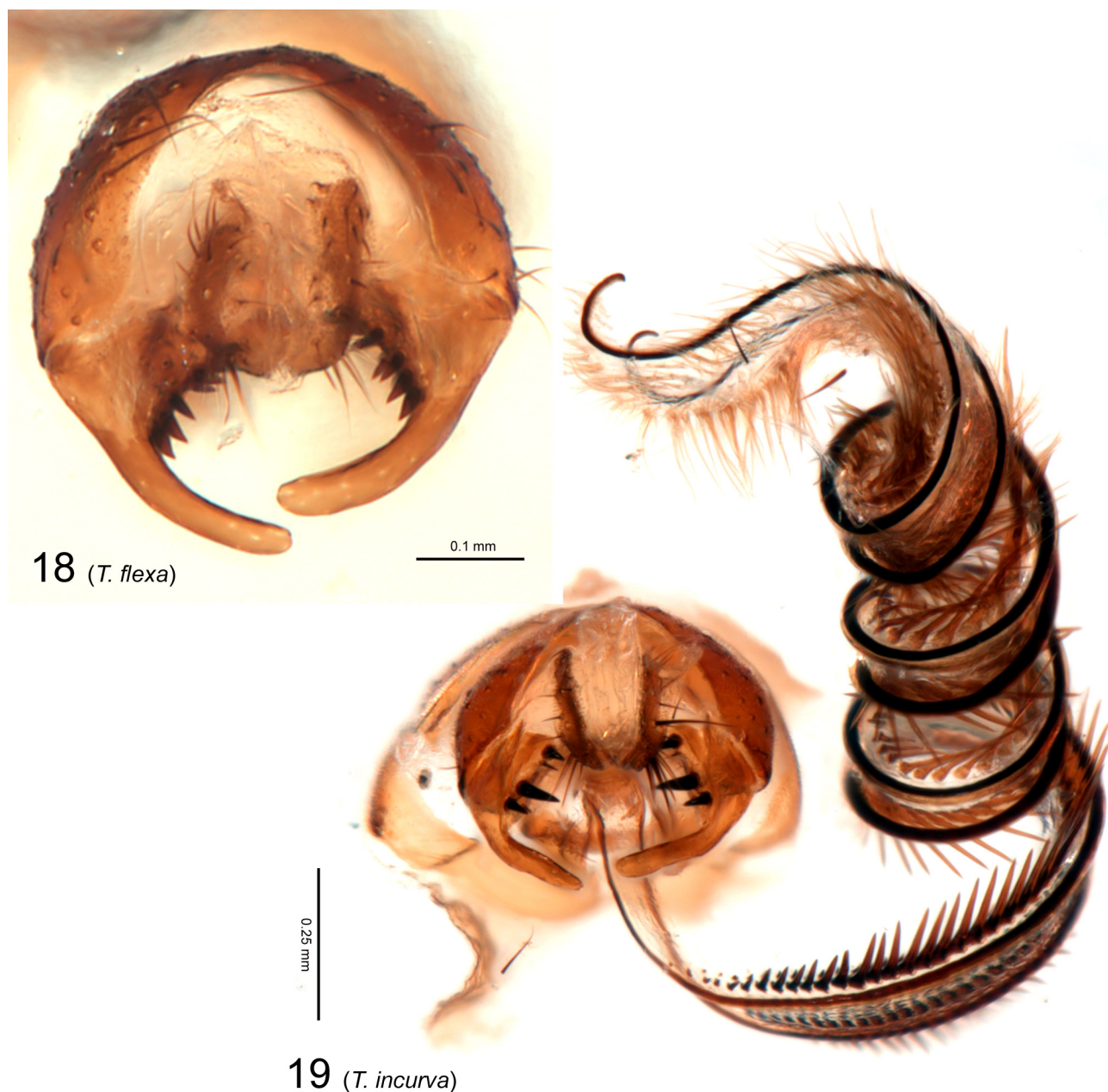
16 (*T. cuneata*)



17 (*T. decipiens*)

FIGURES 14–17. Male terminalia of *Tritoxa* species. **14.** *T. californica* **sp. nov.**, posterior view; **15.** *T. californica*, oblique lateral view; **16.** *T. cuneata*, posterior view; **17.** *T. decipiens* **sp. nov.**, posterior view. Abbreviations: cerc—cercus; epand—epandrium; ph—phallus; prens—prensiseta; sur—surstylus.

Antenna with postpedicel dark brown to black, sometimes yellowish brown on ventral and basal surfaces. Proboscis with dark brown palpus. **Thorax:** dark brown to black; scutum mostly thinly microtrichose with pair of faint microtrichose vittae; lateral margin of scutum and postpronotal lobe broadly shiny; scutellum concolourous with scutum; mediotergite without distinct stripe; pleura shiny, anepisternum and katepisternum lightly clothed in whitish microtrichia when viewed obliquely; whitish microtrichia above fore coxa; 1 anepisternal seta. **Wing** (Fig. 9) broadly rounded and slightly enlarged apically; entirely dark brown to black without faded regions; costal cell without narrow hyaline band at humeral break, with hyaline band at apical fourth in line with discal hyaline crossband; hyaline area from apical region of Sc to R₁; oblique subbasal hyaline crossband reaching two-thirds length of cell dm to nearly wing margin; discal hyaline crossband oblique, long, arched, extending to posterior distal corner of cell dm, sometimes slightly beyond cell; subapical hyaline crossband narrow, nearly straight to arched, anterior end extending proximal to crossvein r-m; crossvein dm-m sinuous; anal lobe somewhat developed; calypter with brown margin. **Abdomen:** black. **Male terminalia** (Fig. 18): inner surstylus with 6–8 thick prenisetae distributed along straight inner margin; outer surstylus slender, longer than inner surstylus, arched mesally with rounded apex; subepandrial sclerite with scattered dark, stiff setae. Cercus with long apicolateral setae; apical margin straight. Phallus long, with 4–5 loops.



FIGURES 18–19. Male terminalia of *Tritoxa* species, posterior view. **18.** *T. flexa*; **19.** *T. incurva*.

Distribution. *Tritoxa flexa* is widespread in eastern North America, from southeastern Saskatchewan and southern Manitoba to Mississippi. In eastern Canada, this species is only known from Manitoulin and Pelee Islands in Ontario (Fig. 26). Additional records include sites from Alabama, North and South Carolina and Massachusetts based on images from BugGuide and iNaturalist.

Remarks. *Tritoxa flexa* has received more attention than congeners due to its higher economic importance. Its main host plant is the commercial onion, *Allium cepa* L., though larvae may also feed on wild garlic. The larva was first described and illustrated by Banks (1912). Chittenden (1927) provided a brief description of the adult and larval stage and summarized reports of its injurious nature. One parasitoid is known for this pest, *Tachinaephagus zealandicus* Ashmead (Downing 1973). *Tritoxa flexa* breeds from late spring to early summer and completes two and a partial third generations per year, with larvae and pupae overwintering (Downing 1977). Manis (1941) also described the biology of this species and the mature larva was described and illustrated by Peterson (1960). In areas where the ranges of *T. flexa* and *T. incurva* overlap, and where the latter species completes two generations per year, competition on wild garlic may occur in the month of September (Downing 1977).

***Tritoxa incurva* Loew**

(Figs 2, 3, 10, 19, 27)

Tritoxa incurva Loew, 1873: 104. Type locality: Illinois, USA.

Type material examined. LECTOTYPE ♂ [<https://mczbase.mcz.harvard.edu/guid/MCZ:Ent:13247>], labelled: "Ill. [Illinois, 40.0417°N 89.1965°W]"; "illegible/ Shimer"; "Loew/ Coll."; "incurva/ m."; "Type/ 13247 [red label]"; "MCZ-ENT/ 00013247/ data matrix code"; "LECTOTYPE/ *Tritoxa/ incurva* Loew/ des. B.J. Sinclair 2020 [red label]" (MCZ).

Taxonomic notes. Loew based this species on an unspecified number of male and female specimens. A lectotype is here designated in order to fix the identity of the species.

Additional material examined. CANADA. Ontario: Beamsville [43°09'N 79°28'W], 23.viii.1977, R.G. Bennett (1♂, 1♀, DEBU); Elgin Co., Newport Forest, ~3 km SW of Wardsville, 42°37'52"N 81°46'43"W, 30.vii.2009, S.A. Marshall (1♀, DEBU); Essex Co., Windsor, Ojibway Prairie [42°15'N 83°05'W], 22.ix.2001, S. Paiero (1♂, DEBU); same data except, 21.vii.2000, S.A. Marshall (1♂, DEBU); same data except, 26–27.viii.2002, S. Paiero (1♂, DEBU); Essex Co., Windsor [42°15'N 83°02'W], Spring Garden Road ANSI, 28.vii. 2005, M.D. Bergeron (1♂, DEBU); Essex Co., Pelee Island [41°45'N 82°45'W], Stone Rd. Alvar, 1.x.2000, S.A. Marshall (1♀, DEBU); Essex Co., Windsor, Broadway Pk [42°16'17"N 83°5'7"W], 13.ix.2005, S.M. Paiero (1♀, DEBU); Harrow [42°02'N 82°55'W], 24.viii.1975, G.J. Umphrey (1♀, DEBU); Jarvis [42°53'N 80°06'W], viii.1961, Taylor & Wood (2♂, CNC); same data except, 15.x.1960 (1♂, CNC); River Canard [42°06'N 83°05'W], 10.vii.1977, W.A. Attwater (4♂, 1♀, DEBU); same data except, E.A. Innes (1♂, DEBU). Saskatchewan: Grasslands NP, West Black nr Frenchman River, grassland prairie, 49.149° -107.53°, 804 m, 27.viii.2012, A. Pawlowski, BIOUG03413-D02 (1♂, barcoded, CBG). USA. Alabama: Clay Co., Millerville [33°11'N 85°55'W], 18.vi.1963, H.G. Barwood (5♂, 1♀, USNM); Cleburne Co., Mt Cheaha [33°29'N 85°48'W], 2400 ft, 23.v.1965, J.G. Chillcott (2♂, CNC). Arkansas: Lincoln Co., Gould [33°59'N 91°33'W], vii.1954, P.H. Thompson (1♂, USNM); Knoxville, rest stop I-40 East, 35.3666°N 93.344°W, 17.v.2010, Biobus 2010, 10BBDIP-0310, 10BBDIP-0793 (1♂, 1♀, barcoded, CBG). Colorado: Boulder, Flagstaff Canyon [40°00'N 105°18'W], 5800 ft, 8.viii.1961, J.R. Stainer (1♀, CNC); Estes Park [40°22'N 105°31'W], 14.viii.1949, R.R. Dreisbach & R.K. Schwab (1♂, CNC); no locality or date, J.M. Aldrich (1♂, USNM); Florissant [38°56'N 105°17'W], 8.viii.1973, C.W. Sabrosky (1♀, USNM); Hugo [39°8'N 103°28'W], 7.vii.1907, C.H. Marsh (1♂, USNM). Connecticut: Branford [41°16'N 72°47'W], 5.vii.1921, P. Gorman (2♂, 1♀, 1?, USNM); Meriden [41°32'N 72°47'W], 31.viii.1933, B.H. Walden (2♀, USNM); Milford [41°13'N 73°03'W], Wheelers Farms, 23.vii.1936, M.B. Bishop (1♂, USNM); Stratford [41°12'N 73°07'W], 6.ix.1933, B.H. Walden (2♂, 2♀, USNM). Georgia: Athens [33°57'N 83°23'W], ex *Pinus taeda*, 17.v.1965, H.O. Yates (1♂, 1♀, USNM); Marietta [33°57'N 84°32'W], 20.v.1965, R.C. Froeschner (1♀, USNM); Rockyford [32°39'N 81°49'W], 25.viii.1957, W.R. Richards (1♂, CNC). Illinois: Beverley Hill[s] [41°42.6'N 87°40.8'W], 15.vii.1903 (1♀, USNM); Zeigler [37°53'59"N 89°3'12"W], 27.viii.1929, J. Karlovic (1♂, 2♀, USNM). Iowa: Ames [42°02'N 93°37'W], vii.1890, J.M. Aldrich (1♂, USNM); Delaware Co., Robinson [42°20'N 91°34'W], 24.vii.1924, N.M. Bigelow (1♀, CNC); Pleasant Valley [41°34'N 90°28'W], 5.vii.1928, G.S. Walley (1♂, CNC); Lucas Co., Red Haw SP, 41°00'N,

93°16'W, 24.viii.1998, N.D. Penny (1♂, CAS); Monroe Co., Tyrone Wildlife Area, 40°59'N, 92°56'W, 23.viii.1998, N.D. Penny (1♂, 1♀, CAS). **Kansas:** Labette Co., Oswego [37°10'N 95°6'W], 14.vi.1965, G.F. Hevel (1♂, 1♀, USNM); same data except, 9.x.1963 (1♂, USNM). **Kentucky:** Fort Knox [37.92°N 85.96°W], 7.vii.1963, P.E. Adams (1♀, CSCA). **Maryland:** Prince Georges Co., Beltsville [39°2'N 76°55'W], 18.ix.1969, R.E. Holmes (1♂, 1♀, USNM); same data except, 18.ix.1964, P.H. Arnaud (1♀, CAS); Prince Georges Co., Patuxent Research Station [39.06°N 76.78°W], 24.viii.1986, N.E. Woodley (1♂, USNM). **Mississippi:** v.1920, F.M. Hull (1♂, CNC); Lafayette Co., v.–vi.1945, F.M. Hull (1♂, 1♀, CNC); same data except, 1–15.v.1949 (1♀, CNC); same data except, v.–vi.1960 (1♀, CNC); same data except, vi.1934 (2♂, 2♀, CNC); Oxford [34°21'N 89°31'W], 15.viii.1954, F.M. Hull (1♂, CNC); State College, 5.x.1932, D. Shaw (1♂, USNM). **Missouri:** Columbia [38.951°N 92.328°W], Malaise, 23.x.1968, F.D. Parker (1♂, USNM); 25 mi. S St. Louis [38°37'N 90°11'W], 3.viii.1965, W. Hoele & J. Lovily (1♀, LEM). **Montana:** Petroleum Co., 1.5 mi S, 5 mi W Winnett [47°0'N 108°21'W], 30.vii.1969, C.B. Hewitt (1♀, USNM); Roundup [46°26'54"N 108°32'34"W], 3.ix.1924, H.L. Seamans (2♂, 1♀, CNC). **New Jersey:** Hunterdon Co., Bulls Island SP [40°24'N 75°2'W], 27.vii.1974, A.S. Menke (1♀, CSCA); Millington [40°40'38"N 74°31'04"W], 7.viii.1958, E.J. Hansens (1♂, 1♀, USNM); Hopewell [40.389°N 74.763°W], Stoney Brook Millstone Watershed, Adventure Trail, 28.vi.2001, J. Lento (1♀, DEBU); Ramsey [41.059°N 74.145°W], 30.vii.1912, J.R. Malloch (1♂, 1♀, USNM). **New York:** no date or collector (1♀, USNM); 8.9.1890, illegible (1♂, USNM); (1♂, USNM); Staten Is. [40°34'N 74°8'W], 1923, A.H. Sturtevant (1♂, 1♀, USNM). **North Carolina:** Highlands [35°3'N 83°11'W], 3800 ft, 10.v.1957, J.R. Vockeroth (1♂, CNC); Johnston Co. [35°31'N 78°22'W], 8.x.1961, D.L. Davies (2♀, DEBU). **North Dakota:** Beach [46°54'N 104°00'W], no date, C.N. Ainslie (1♀, CNC); same data except, 28.viii.1923 (1♀, CNC). **Ohio:** Athens [39°19'N 82°5'W], 28.ix.1933, W.C. Stehr (1♀, USNM). **Pennsylvania:** Reading [40°20'N 75°55'W], 23.vii.1895, no collector (1♀, USNM). **South Carolina:** Aiken [33°32'N 81°43'W], 31.v.1957, H.F. Howden (1♂, CNC); same data except, W.J. Brown (1♂, CNC); Aiken, 24.viii.1957, W.R. Richards (1♀, CNC); Seneca [34°41'N 82°57'W], 20.viii.1957, L.A. Kelton (1♀, CNC); Spartanburg Co. [34°56'N 81°59'W], 12.ii.1961 (1♂, USNM); York Co., Rock Hill Blackjacks Preserve [34°54'N 81°01'W], 25–27.v.2001, A. Zayed (1♀, CNC). **South Dakota:** Brookings [44°18'N 96°47'W], 29.vii.1891, J.M. Aldrich (1♀, USNM); same data except, 29.vii.1891 (1♂, 1♀, USNM); Murdo [43°53'N 100°42'W], 19.viii.1963, C.V. Reichart (1♂, USNM). **Tennessee:** Memphis [35°07'N 89°58'W], 4/7 1927, F.M. Hull (1♀, CNC); Morristown [36°12'N 83°17'W], 18.viii.1981, F. Liard (1♂, LEM). **Texas:** Paris [33°39'N 95°32'W], 6/10 1904 (1♀, USNM); Travis Co., Austin [30°16'N 97°44'W], 2–7.v.1980, P.D. Hurd, *Thelesperma filifolium* (1♀, USNM). **Utah:** Salt Lake City [40°45'N 111°53'W], 4.vii.1951, F.C. Harmston (1♀, USNM). **Wyoming:** Larimie Co., Rte 80, Hillsdale [41°12'N 104°28'W], on sunflower, 29.vii.1974, PSB (1♀, CAS).

Diagnosis. *Trioxa incurva* can be recognized by its rather broad, rounded wings, strongly arched subapical hyaline crossband and inner surstylus with 3–4 large prenisetae.

Redescription. Entirely reddish yellow to brownish, abdomen darker (Fig. 2). **Head:** ocellar triangle reddish-brown; frons reddish-yellow; silvery parafacial microtrichose stripe narrow (Fig. 3), continuous with slightly broader microtrichose parafacial; gena reddish brown below narrowest part of lower eye margin; postocular microtrichia wider than parafacial microtrichia in lateral view, extending from oral margin to middle of eye; face yellow to reddish yellow; supracervical setulae usually yellow. Antenna with postpedicel greyish dorsally, yellowish ventrally. Proboscis with palpus yellowish with apical half greyish. **Thorax:** reddish-yellow; scutum mostly thinly pruinose with pair of whitish microtrichose vittae; lateral margin of scutum and postpronotal lobe broadly shiny; scutellum concolourous with scutum; mediotergite sometimes with faint stripe; pleura shiny, extreme posterior portion of anepisternum and kataposternum lightly clothed in whitish microtrichia when viewed obliquely; whitish microtrichia above fore coxa; 1 anepisternal seta. **Wing** (Fig. 10) broad, rounded apically, brown, especially along margins of crossbands, with some faded or paler regions; costal cell without narrow hyaline band at humeral break, with small white band at apex in line with discal hyaline crossband; often hyaline area from apical region of Sc to R₁; oblique subbasal hyaline crossband reaching mid-length to two-thirds length of cell dm; discal hyaline crossband oblique, arched, continuous from R₁, broader posteriorly, extending to near posterior distal corner of cell dm; subapical hyaline crossband broad, strongly arched, anterior end extending proximal to crossvein r-m; crossvein dm-m straight; anal lobe well-developed; calypter without white margin. **Abdomen:** black or brownish black, sometimes chestnut brown on sides of, or in centre of, tergites 1–2. **Male terminalia** (Fig. 19): inner surstylus with 3–4 thick prenisetae, distinctly separated, with middle preniseta larger than others, inner margin straight; outer surstylus narrow, straight, longer than base with rounded apex; subepandrial sclerite with a few scattered setae. Cercus with long apicolateral setae; apical margin rounded and pointed. Phallus long, with some 4–5 loops.

Distribution. *Tritoxa incurva* is the most widespread species of this genus, known from Connecticut to Utah and Saskatchewan and southern Ontario to Texas (Fig. 27). Paiero *et al.* (2010) published the first Canadian record of this species (although earlier collection records are present in CNC and DEBU). The identification of the single female specimen from Wyoming listed above remains uncertain. Additional material is required to confirm the presence of this species in this state.

Remarks. Allen & Foote (1975) detailed the life history of *T. incurva*, including description of immature stages. Although *T. incurva* larvae may feed on commercial onions, its natural host plant is wild garlic, *Allium canadense* L., with the larvae found feeding on the bulbs. Courtship behaviour involves wing waving, “bubble blowing” and the expansion of an orange membrane from the mouthparts. They breed late in the season having one, occasionally two, generations per year. The eggs overwinter, hatching early the following spring (Allen & Foote 1975). Paiero *et al.* (2010) classified *T. incurva* as a tallgrass prairie associated species.



FIGURES 20–21. Holotype of *Tritoxa flexa*, coll.mfn-berlin.de_u_c2e921 (ZMHB). **20.** Habitus, lateral view; **21.** Type labels.

Tritoxa pollinosa Cole

(Figs 4, 11, 22, 28)

Tritoxa pollinosa Cole in Cole & Lovett, 1919: 252. Type locality: Warm Springs, Oregon, USA.

Type material examined. **HOLOTYPE** ♀, labelled: “July 7”; “♀”; “Warm Springs V[alley] [44°45′N 121°16′W]/ 1906 Or[egon]”; “♀”; “Holotype/ pollinosa [red label]”; “Tritoxa/ pollinosa/ Type Cole”; “California Academy/ of Sciences/ Type No. 511” (CAS).

Additional material examined. **USA. California:** Alpine Co., Long Valley [38.490188° -119.6087828°], 30.viii.1964, G. Tawcan (1♂, CSCA); Cedarville [41°31′N 120°10′W], eastside Mid. Lake, 13.vi.1951, H.H. Keifer (3♂, CSCA); Inyo Co., Deep Springs [37°22′N 117°59′W], 16.vii.1953, R.M. Bohart (1♂, 1♀, USNM); same data except, E.I. Schlinger (1♀, USNM; 1♀, CSCA); Modoc Co., Lake City [41°38′N 120°13′W], Frick trap, xi.1959, L. White (1♂, CSCA); Peavine, 11.vii.1949 (1♀, CSCA); Siskiyou Co., Dorris [41°57′54″N 121°55′8″W], 17.vi.1961, J. Lambert (1♀, CSCA). **Colorado:** Craig [40°31′N 107°33′W], 14.vi.1947, F.C. Harmston (1♂, USNM). **Nevada:** Eureka Co., Hwy 80, Beowawe [40°35′N 116°28′W], rest area, swept tree trunk and tree foliage, 11.vi.2001, P.H. & M.M. Arnaud (1♂, CAS); Humboldt Co., 39 mi SE Denio [41°59′N 118°37′W], 23.vi.1971, G. Steyskal (1♀, USNM); Humboldt Co., 18 mi W Denio, 17.vi.1962, R.R. Snelling (1♀, CSCA); Elko [40°50′N 115°46′W], no date or collector (1♀, USNM); Humboldt Co., McDermitt [41°59′N 117°43′W], 26.vi.1968, G.J. & A.D. Keuter (1♀, CAS); Humboldt Co., Paradise Valley [41°29′35″N 117°31′59″W], 2.vi.1964, G.D. Cooney (1♂, CAS); Orovada [41°34′N 117°47′W], 28.vi.1953, A.B. Gurney (1♂, USNM); Reno [39°31′N 119°49′W], peach, Orient survey, 27–30.vi.1944 (1♀, USNM); Washoe Co., Winne Mucca Lk. [40°07′N 119°20′W], beehives, 17.v.1969, T.W. Da-

vies (2♂, 1♀, CAS). **Oregon:** Harney Co., Borax Lk., 6 mi NE Fields [42.2643°N 118.6751°W], 24.vi.1991, J.L. Furnish, J. McIver (1♂, 1♀, USNM); Harney Co., Juniper Lake [42.917° -118.344°], 18.vi.1951, B. Malkin (1♂, CAS). **Utah:** Delta [39°21'N 112°34'W], 15.vii.1941, G.F. Knowlton & F.C. Harmston (5♂, 3♀, USNM); Deseret [39°17'N 112°39'W], 27.vii.1957, G.F. Knowlton (1♀, CSCA); Manila [40°59'N 109°43'W], 13.vii.1938, G.F. Knowlton, F.C. Harmston (1♀, USNM); Vernal [40°27'N 109°32'W], 3.vi.1940, B.A. Haws (1♂, USNM); Millard Co. [39°03'N 113°06'W], 14.v.1940, R.W. Fautin (1♀, USNM). **Washington:** Granger [46°20'N 120°11'W], peach, Orient survey, 20.vii.1944 (1♂, 1♀, USNM); same data except, 24.vii.1944 (2♀, USNM); Walla Walla [46°3'N 118°19'W], 7.v.1940, H.P. Lanchester (1♂, USNM); same data except, 23.v.1940 (2♀, USNM); same data except, 15.v.1940 (1♂, USNM); Walla Walla, 7.vii.1937, R.M. & G.E. Bohart (1♀, USNM); Ritzville, 9.vi.1923, M.C. Lane (1♂, USNM); Yakima [46°36'N 120°30'W], in insectary, 26.v.1919, WDW (1♀, USNM). **Wyoming:** Red Gulch Rd. off Hwy. 14 nr. Shell [44°32'N 107°46'W], pans in barren area nr. cottonwoods, cow dung, 5–19.viii.1990, J.E. Swann (1♂, DEBU).

Diagnosis. *Tritoxa pollinosa*, as the name suggests, is immediately recognized by its silvery microtrichia. This species has wide silvery parafrontal microtrichia stripes and notably microtrichose thorax, especially the yellow microtrichia of the anepisternum, crossvein dm-m is strongly angulate usually without a stump vein and the discal hyaline crossband is interrupted along vein R_{2+3} .

Redescription. Yellowish-brown with dense areas of pruinosity. **Head:** ocellar triangle reddish brown, grey microtrichose; frons yellow to yellowish brown; silvery parafrontal microtrichose stripe extending beyond eye margin to bases of orbital setae and setulae, extending roughly halfway distance from eye to midfrons (Fig. 4), continuous with broad microtrichose parafacial; gena dark brown below narrowest part of lower eye margin; postocular microtrichia very wide in lateral view, extending from oral margin to nearly full eye height; face yellowish, often with brown medial stripe extending onto clypeus, with brown spot just under brown part of the gena; supracervical setulae yellow. Antenna with postpedicel greyish yellow, paler along inner and medially surfaces. Proboscis with yellow palpus with white pruinescence. **Thorax:** yellow to yellowish brown; scutum with pair of dark, greyish microtrichose dorsocentral vittae, with whitish microtrichia along lower margin of notopleuron; posterior portion of postpronotal lobe and postsutural scutum laterally shiny; scutellum with at least apical half shiny reddish brown, base paler often with lateral microtrichia; mediotergite shiny with brownish stripe; posterior half of pleura and upper margin of anepisternum shiny, reddish brown; prosternum to katapisternum and anepisternum with whitish to yellow microtrichia; 2 anepisternal setae. **Wing** (Fig. 11) somewhat tapered apically, brown, especially along margins of hyaline crossbands, with some faded or paler regions; costal cell with narrow hyaline band at humeral break and broad band at apical fourth in line with discal hyaline crossband; oblique subbasal hyaline crossband reaching apical third of cell dm, fading prior to wing margin; discal hyaline crossband broad, long, obliquely arched, band broken at R_{2+3} , extending to beyond distal corner of cell dm to wing margin; subapical hyaline crossband broad, strongly arched, broad posteriorly, anterior end extending proximal to crossvein r-m; crossvein dm-m angulate, usually without stump vein; anal lobe well-developed; calypter with broad white margin. **Abdomen:** dark brown; tergites 3–5 with broad anterior band of white pruinescence; sternites dark brown with greyish pruinescence; pleural membrane infuscate. **Male terminalia** (Fig. 22): inner surstylus with some 8 thick prensisetae in rough row along straight inner margin; outer surstylus shorter than base, broad, strongly arched medially, with rounded apex; subepandrial sclerite with numerous dark setae. Cercus with long apicolateral setae; apical margin tapered. Phallus long, with some 4 loops.

Distribution. This species is rather widespread in western USA, from California to Colorado and north to Washington (Fig. 28).

Tritoxa ra Harriot

(Figs 5, 12, 23, 29)

Tritoxa ra Harriot, 1942: 23. Type locality: Lone Pine, Inyo Co., California, USA.

Type material examined. **HOLOTYPE:** not examined. **PARATYPES:** **USA. California:** Inyo Co., Owens Valley, Diaz Lake [36°33'34"N 118°03'17"W], 7.vi.1937, T.G. Aitken (1♂, CAS); Inyo Co. Lone Pine [36°36'N 118°03'W], 6.vi.1937, L.D. Phillips (allotype ♀, CAS).

Additional material examined. **USA. California:** Inyo Co., Lone Pine [36°36'N 118°03'W], 3.vi.1937, N.W.

Frazier (1♀, CAS); same data except, 18.vi.1937 (1♂, CAS); Inyo Co., Bishop [37°21'N 118°23'W], ex *Chrysothamnus* nr *alfalfa*, 7.viii.1971, E. Paddock (1♂, CSCA); Kern Co., Bakersfield [35°22'N 119°1'W], 7.vi.1990, B. Nemmer (1♂, CSCA); Kern Co., Bakersfield, 18.vi.1941, T. Gullion (1♂, CSCA); Kings Co., Hanford [36°19'N 119°38'W], McPhail trap, 23.vii.1958, B. Vaughn (1♀, CSCA, 2♂, USNM); same data except, 25.vi.1985, B. Felleke (1♂, CSCA); Kings Co., Lemoore [36°18'N 119°46'W], McPhail trap, 10.vi.1985, L. Tickle (1♂, CSCA), same data except, Jackson trap, 4.vi.1981, J. Dunieliff (1♂, CSCA); Mojave [35°03'N 118°10'W], 22.iv.1945, G.P. Mackenzie (1♀, USNM); San Luis Obispo Co., Shandon [35°39'N 120°22'W], 1.ix.1988, J. Welch (1♀, CSCA); San Luis Obispo Co., McPhail trap, residence garden, 1.x.2005, L.H. Iegit (1♂, CSCA); Santa Barbara Co., Cuyama [34°55'N 119°36'W], Frick trap, 18.ix.1958, G. Beevor & J. Rowell (1♀, CSCA). **Nevada:** Nye Co., Ash Meadows, Fairbanks Springs [36.425°, -116.291°], 20.vi.1951, T. Frantz (1♀, CAS); Washoe Co., Winne Mucca Lk. [40°07'N 119°20'W], beehives, 17.v.1969, T.W. Davies (1♂, CAS).

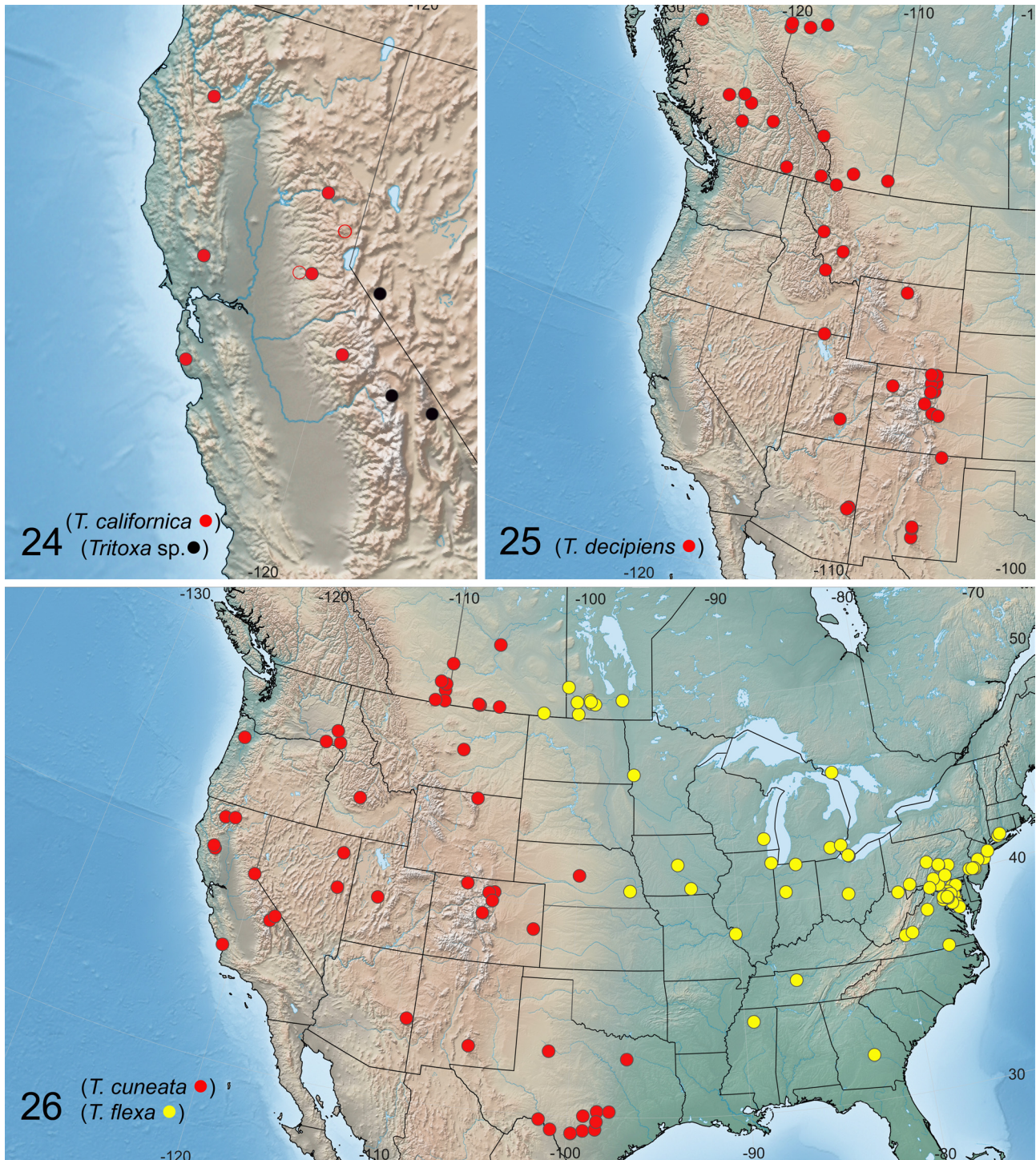
Diagnosis. *Tritoxa ra* may be easily recognized by a relatively wide silvery band of parafrontal microtrichia, combined with a stump vein proceeding from an angulation on crossvein dm-m which points towards the wing margin. The inner surstylus is distinctive with two rows of numerous strong prensisetae at base and outer surstylus short, broad, with apex expanded.



FIGURES 22–23. Male terminalia of *Tritoxa* species, posterior view. 22. *T. pollinosa*; 23. *T. ra*.

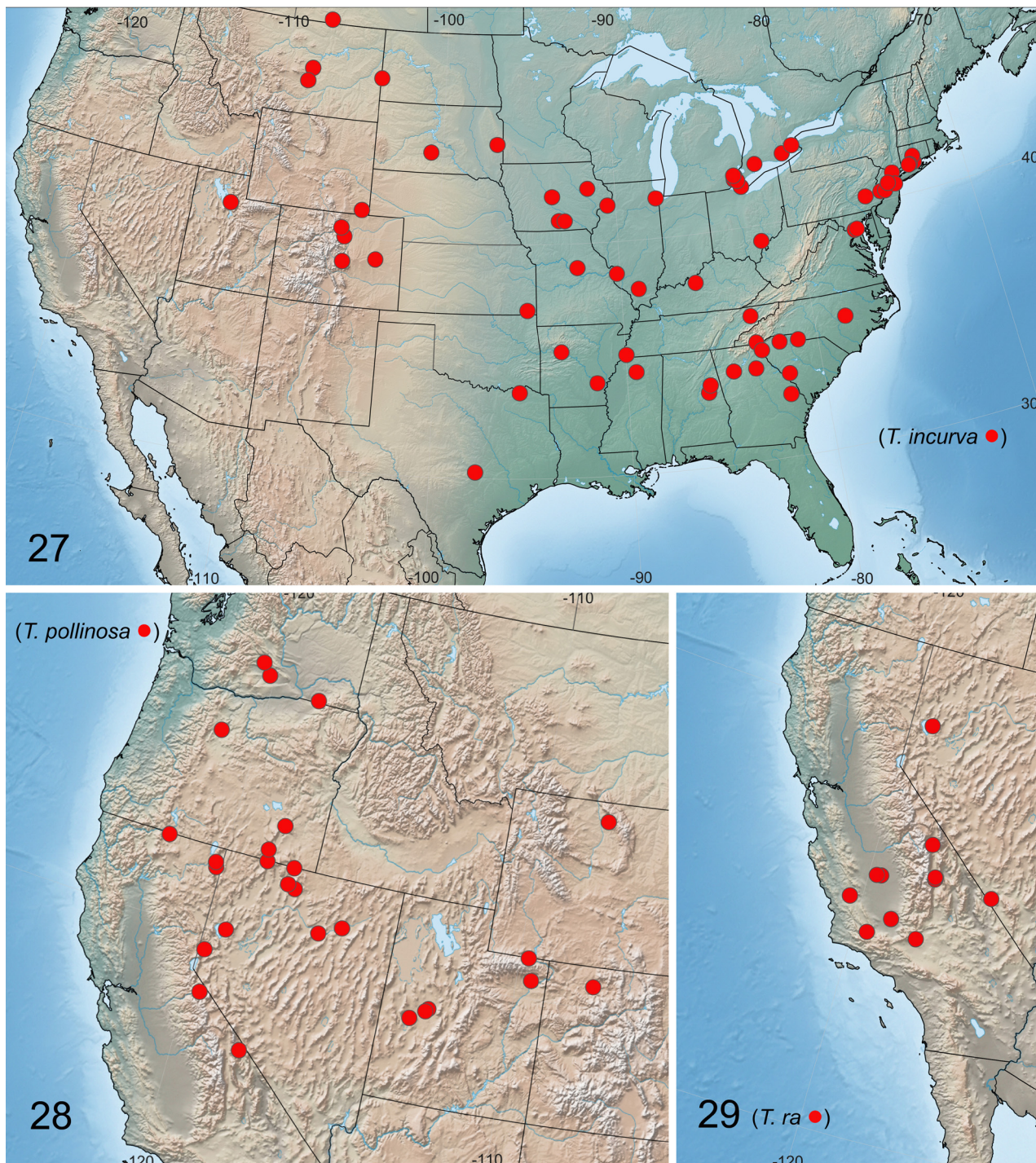
Redescription. Entirely yellowish with abdomen brownish dorsally. **Head:** ocellar triangle reddish brown, pruinose; frons yellow to yellowish brown; silvery parafrontal microtrichose stripe extending to bases from eye margin to orbital setae and setulae, extending roughly 1/4 to 1/3 distance from eye to midfrons (Fig. 5), continuous with broad microtrichose parafacial; gena dark brown below narrowest part of lower eye margin; postocular microtrichia as wide as parafrontal microtrichia in lateral view, extending from oral margin to middle of eye; face greyish-yellow laterally, with brown spot just under brown part of the gena; supracervical setulae yellow. Antenna with postpedicel mostly yellow. Proboscis with yellow palpus. **Thorax:** yellowish to brown; scutum with pair of dark, greyish microtrichose dorsocentral vittae, with yellow microtrichia to suture and medially to scutellum; often posterior portion of postpronotal lobe and postsutural scutum laterally shiny; scutellum with apical half to posterior margin shiny reddish yellow; mediotergite with brownish stripe; pleura shiny, yellow to reddish yellow, lightly clothed in whitish microtrichis when viewed obliquely; area surrounding katepisternal seta reddish brown; whitish microtrichose band above fore coxa; 2 anepisternal setae. **Wing** (Fig. 12) rounded apically, brown, especially along margins of hyaline crossbands, with some faded or paler regions; costal cell with narrow hyaline band at humeral break and at apical fourth in line with discal hyaline crossband; often hyaline area from apical region of Sc to R₁; oblique subbasal hyaline crossband reaching beyond mid-length of cell dm, fading prior to wing margin; discal hya-

line crossband narrow, continuous from R_1 , broader posteriorly, long, obliquely arched, extending to beyond distal corner of cell dm to wing margin along M_4 ; subapical hyaline crossband broad, strongly arched, broad, anterior end extending proximal to crossvein $r-m$; crossvein $dm-m$ angulate at mid-length, with short stump vein; anal lobe well-developed; calypter with broad white margin. **Abdomen:** broad brown bands on anterior two-thirds of some tergites; sternites yellow; pleural membrane infusate. **Male terminalia** (Fig. 23): inner surstylus with double row of 5–7 thick prensisetae along inner margin; outer surstylus shorter than inner surstylus, broad, expanded apically, strongly arched mesally with blunt tip; subepandrial sclerite with strong dark setae. Cercus with short apicolateral setae; apical margin tapered. Phallus long, with some 3 loops.



FIGURES 24–26. Distribution of *Tritoxa* species. **24.** *T. californica* sp. nov. (incl. unconfirmed records (red open circles)) and *Tritoxa* sp.; **25.** *T. decipiens* sp. nov.; **26.** *T. cuneata* and *T. flexa*.

Distribution. This species is known from the southern half of California and two neighbouring counties in Nevada (Fig. 29).



FIGURES 27–29. Distribution of *Tritoxa* species. 27. *T. incurva*; 28. *T. pollinosa*; 29. *T. ra*.

***Tritoxa* sp.**
(Figs 13, 24)

Material examined. USA. California: Inyo Co., Deep Springs [37°22'N 117°59'W], Malaise trap 9A-3P, 24/25.v.1974, J. Slansky and M. Wasbauer (1♀, CSCA); Mono Co., Rock Ck Cpgd [37°28'N 118°43'W], 4.vii.1967, P.H. Arnaud (1♀, CAS). **Nevada:** Lyon Co., 7 mi NW Wellington [38°45'N 119°22'W], Malaise trap 8A-12M, 28.v.1974, M. Wasbauer, J. Slansky (2♀, CSCA).

Diagnosis. This species has the general appearance of *Tritoxa cuneata*, but is distinguished by wider silvery parafrontal microtrichose stripe together with the discal hyaline crossband extending beyond cell dm, nearly reaching the wing margin (Fig. 13).

Distribution. This unnamed species is known from Inyo and Mono counties in California and Lyon County in Nevada (Fig. 24).

Remarks. This species is known only from four female specimens. Males are required to confirm its species status through the comparison of the male terminalia.

Discussion

Tritoxa is a Nearctic genus with seven described species and an additional species known only from females collected in California and Nevada. The genus is widespread across the United States with two species occurring in the East, extending into southern Ontario, Canada. In western North America, six described species are widely distributed. Future studies should focus on further establishing the distribution of *Tritoxa* in California, with emphasis on discovering male specimens of the undescribed species. In addition, exploration of the host range for all species is recommended to expand the relatively poor ecological knowledge of this genus.

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