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Description of a new Nearctic species of *Tragosoma* Audinet-Serville (Coleoptera: Cerambycidae: Prioninae), with species validations, new synonymies and a lectotype designation

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Abstract. *Tragosoma soror* (Coleoptera: Cerambycidae: Prioninae), a new Nearctic species, is described and compared to its North American congeners. *Tragosoma harrisii* LeConte, **revised status**, and *Tragosoma spiculum* Casey, **revised status** are both resurrected from synonymy and considered valid species distinct from *T. depsarium* (Linnaeus). The Mexican *T. nigripenne* Bates is confirmed as a valid species. *Tragosoma chiricahuae* Linsley, **new synonym**, is placed in synonymy under *T. spiculum* Casey, and *T. sodale* Casey, **new synonym**, *T. parvicolle* Casey, **new synonym**, and *T. repens* Casey **new synonym** are placed in synonymy under *T. harrisii*. *Tragosoma repens* is a junior objective synonym of *T. parvicolle*. A lectotype is designated for *T. sodale*. An updated synonymical and distributional checklist of *Tragosoma* of the world is provided.

Introduction

Tragosoma Audinet-Serville is a genus of prionine cerambycids belonging to the tribe Meroscelisini Thomson (Bezark 2016). It includes relatively large (17–36 mm) chestnut brown nocturnal beetles recognizable by their strong lateral median prothoracic tooth and the conspicuous, long, reddish-yellow setae that densely cover the ventral parts of their thorax. The great morphological similarity between some of the species combined with the significant intraspecific variation make identification to species difficult, hence the presence in collections of currently unrecognized species.

There are presently four valid species in *Tragosoma* worldwide, only one occurring outside the Nearctic region. In the latest original taxonomic treatment of the genus, Linsley (1962) recognized three species in America north of Mexico: the "Holarctic" *T. depsarium* (Linnaeus, 1767) with *T. harrisii* LeConte, 1851, *T. spiculum* Casey, 1890, and *T. repens* Casey, 1924 as synonyms; *T. chiricahuae* Linsley, 1959 from Arizona; and *T. pilosicorne* Casey, 1890 from California. Linsley (1962) overlooked the names *T. sodale* Casey, 1899 and *T. parvicolle* Casey, 1899, but these names were later placed in synonymy with *T. depsarium* by Chemsak and Linsley (1982). The Mexican *T. nigripenne* Bates, 1892 has always been considered a distinct species but its validity was questioned by Galileo (1987).

The initial purpose of my study was to ascertain if *Tragosoma depsarium* occurs in the Nearctic region. I consequently found that it is exclusively Palaearctic in distribution (Laplante 2010: 42), but no name has formally been proposed for the Nearctic species long considered conspecific with *T. depsarium*. It could be inferred that *T. harrisii*, the oldest synonym previously listed under *T. depsarium*, was its valid name. Incidentally, Bousquet et al. (2013: 274) listed *T. harrisii* as a valid species for Canada but without providing any explanation or referring to a new nomenclatural act. For nomenclatorial purpose, I here formally resurrect *T. harrisii* from synonymy with *T. depsarium* and provide diagnostic characters for distinguishing the two species from each other.

The examination of North American specimens to find constant characters distinguishing *T. harrisii* from *T. depsarium* led to the discovery of a currently unrecognized species in western United States and Canada. The study of the types of the species described by Casey and Linsley supported the conclusion that this species was undescribed. My main purpose here is to describe the new species and to distinguish it from all remaining North American species.

The examination of the types also revealed new synonymies that I propose below. The names *T. parvicolle* and *T. sodale* have not been cited in the literature for almost 80 years and their types were presumed lost (Lingafelter et al. 2014: 361). During my study, I found specimens that could potentially be the missing type material. I present an account of this interesting case with the arguments supporting the authenticity of the holotype of *T. parvicolle* and two syntypes of *T. sodale* discovered among the specimens of *Tragosoma* in the Casey collection in NMNH. One of the *T. sodale* syntypes is selected as the lectotype.

DNA barcode analyses were useful for confirming the validity of some species during this study and proved instrumental in determining the taxonomic status of *T. nigripenne*.

A checklist presents the taxonomy of *Tragosoma* following the new nomenclatural acts proposed herewith.

Materials and Methods

In addition to studying type material of *Tragosoma chiricahuae*, *T. nigripenne*, *T. parvicolle*, *T. pilosicorne*, *T. repens*, *T. sodale*, and *T. spiculum*, I examined 124 Eurasian and 709 North American specimens from the following institutions and private collections; the curator and/or preparer of the loan are given after the collection information.

ADC	Alain Drumont collection (private), Brussels (Jette), Belgium.
AFCC	Atlantic Forestry Centre, Canadian Forest Service, Natural Resources Canada, Fredericton, NB, Canada; Jon Sweeney and Ed Hurley.
BIOC	Biodiversity Institute of Ontario, University of Guelph, ON, Canada; Paul D.N. Hebert.
BYUC	Arthropod Collection, Monte L. Bean Life Science Museum, Brigham Young University, Provo, UT, USA; Shawn M. Clark.
CAS	California Academy of Sciences, Department of Entomology, San Francisco, CA, USA; David H. Kavanaugh and Vincent F. Lee.
CFIA	Centre for Plant Quarantine Pests, Entomology Unit, Canadian Food Inspection Agency, Ottawa, ON, Canada; Bruce Gill.
CGDR	Gontran Drouin collection (private), Sainte-Hénédine, QC, Canada.
CIQ	Collection d'insectes du Québec, Complexe scientifique, Ressources naturelles et Faune du Québec, Québec, QC, Canada; Céline Piché.
CMN	Canadian Museum of Nature, Entomology, Gatineau, QC, Canada; François Génier.
CMNH	Carnegie Museum of Natural History, Section of Invertebrate Zoology, Pittsburgh, PA, USA; Robert L. Davidson and Robert Androw.
CNC	Canadian National Collection of Insects, Arachnids and Nematodes, Agriculture and Agri-Food Canada, Ottawa, ON, Canada; Patrice Bouchard.
CPTO	Pierre de Tonnancour collection (private), Terrasse-Vaudreuil, QC, Canada.
CSLA	Serge Laplante collection (private), Gatineau, QC, Canada.
GLFC	Great Lakes Forestry Centre, Canadian Forest Service, Natural Resources Canada, Sault Ste. Marie, ON, Canada; Kathryn Nystrom.
GMIC	Gérard Minet collection (private), Paris, France.
HBC	Hervé Brustel collection (private), Toulouse, France.
IRSNB	Institut Royal des Sciences Naturelles de Belgique, Département d'entomologie, Brussels, Belgium; Alain Drumont.
JPHC	Jeffrey P. Huether collection (private), Geneva, NY, USA.
LFC	Laurentides Forestry Centre, Canadian Forest Service, Natural Resources Canada, Québec, QC, Canada; Jan Klimaszewski.
MNHNP	Museum National d'Histoire Naturelle, Paris, France; Olivier Montreuil and Isabelle De Miré.
MHNG	Museum d'Histoire Naturelle de Genève, Geneva, Switzerland; Giulio Cuccudoro.
MSLC	Milan Sláma collection (private), Prague, Czech Republic.
NFRC	Northern Forestry Research Centre, Canadian Forest Service, Natural Resources Canada, Edmonton, AB, Canada; David Langor and James Hammond.
NHM	Department of Entomology, The Natural History Museum, London, United Kingdom; Sharon Shute.

NMNH	Natural Museum of Natural History, Smithsonian Institution, Washington, DC, USA; Steven W. Lingafelter and David G. Furth.
PFCA	Pacific Forestry Centre Arthropod reference collection, Canadian Forest Service, Natural Resources Canada, Victoria, BC, Canada; Leland M. Humble and Jane Seed.
RBCM	Royal British Columbia Museum, Natural History Section, Victoria, BC, Canada; Nicholas Panter.
RMBC	R. Michael Brattain collection (private), Lafayette, IN, USA.
RMC	Robert Minetti collection (private), La Ciotat, France.
UASM	Strickland Entomological Museum, Department of Biological Sciences, University of Alberta, Edmonton, AB, Canada; Danny Shpeley.
UBC	Spencer Entomological Museum, Department of Zoology, University of British Columbia, Vancouver, BC, Canada; Karen Needham.
UCRC	Entomology Research Museum at UC Riverside, CA, USA; Doug Yanega.
WPTC	William and Pat Tyson collection (private), Coarsegold, CA, USA.

I based my study mostly on external morphological characters of adults. The male genitalia were studied but proved of no use in species recognition because no significant differences were found. In some instances, the difference in the shape of the median lobe and of the parameres of different species was less than the intraspecific variation observed in each of them. On the other hand, ratio of length of antennomere 3 (LA-3) in relation to length of antennomere 4 (LA-4) proved useful in the discrimination of some species. Measurements were made using a Zeiss dissecting microscope equipped with an eyepiece micrometer and converted into mm. The measures were taken from the left antenna of 226 specimens of five species, namely *T. depsarium*, *T. harrisii*, *T. nigripenne*, *T. spiculum* (= *chiricahuae*), and the new species. The ratio range of the values, their mean, and the standard deviation were calculated for each sex of the five species (Table 1). The values of LA-3 and LA-4 were plotted for males and females separately on two scatter graphs (Fig. 9, 10).

DNA barcode analyses were also useful in this study. Some of the specimens that I studied were barcoded at the Canadian Centre for DNA Barcoding (CCDB, Biodiversity Institute of Ontario, University of Guelph) using the standard high-throughput protocol described in deWaard et al. (2008). The dataset includes full length sequences (658 base pairs) obtained for eight *T. harrisii* and one *T. nigripenne*, and short sequences of 407 base pairs for one *T. pilosicorne*, one *T. spiculum*, and two of the new species described below. In addition, I included in my analyses three more barcodes from specimens that I have not studied, that is to say, full-length barcodes of one more *T. harrisii* and of one *T. depsarium*, as well as a short barcode (406 base pairs) of the new species. The barcode sources are listed here with the names of the people responsible for the records.

Canadian Forest Service, Great Lakes Forestry Centre (GLFC); Leland M. Humble.
Canadian Forest Service, Pacific Forestry Centre (PFC); Leland M. Humble.
Canadian National Collection of Insects, Arachnids and Nematodes (CNC); Patrice Bouchard.
University of Guelph, Centre for Biodiversity Genomics; CBG Collections Unit.
Staatlichen Naturwissenschaftlichen Sammlungen Bayerns (SNSB), Zoologische Staatssammlung München; Jerome Moriniere.

The sequences, along with the voucher data, images, and trace files, are deposited in the Barcode of Life Data Systems (BOLD) (Ratnasingham and Hebert 2007; www.barcodinglife.org.); the sequences are also included in GenBank (accession numbers in Fig. 11). The data are available through the following dataset (dx.doi.org/10.5883/DS-TRAG2017). Genetic distances were estimated using the Kimura 2-parameter model (Kalign sequence alignment; pairwise deletion for missing or ambiguous positions). In order to provide a visualization of the results, a Neighbor joining tree has been produced with the same distance model and alignment method (Fig. 11). The two analyses (Distance Summary and Taxon ID Tree) were performed with analytical tools available in BOLD.

The new species description includes only comparative features, i.e., those that differ in at least one of the other species of *Tragosoma*. When label data citations are verbatim, as for types, a forward slash (/) separates lines of data on an individual label, a double forward slash (//) separates data from two consecutive labels, and the following abbreviations are used: [hw] for handwritten; [p] for printed. Added information is presented in square brackets, as it is also elsewhere in the text.

Where applicable, the endings of species-group names agree in gender with that of the genus, which is neutral for *Tragosoma*, in accordance with Article 31.2 of the Code (ICZN 1999).

For the illustrations, the specimens were photographed using a Canon EOS 60D with a MP-E 65 mm or an EF 100 mm macro lens. They were placed on a custom-made specimen holder over a white background. Lighting was provided by a Canon Speedlite 600EX-RT electronic flash, and a vertical translucent white plastic cylinder was used as a diffuser. The camera was mounted on a Cognisys STKS-C StackShot macro rail automated system attached to a Kaiser RS1 stand with camera arm RA 1. Image capturing was controlled by the Canon EOS utility software. Sets of images in thin focal planes were taken for each specimen, the raw files adjusted in Adobe Bridge, converted into TIF files in Adobe Photoshop CS6, combined in Zerene Stacker 1.04, and finally edited in Adobe Photoshop CS6.

Terminology

Two structures need to be discussed. First, the relative position of the antennal features is referred to as if the antennae were oriented backward on each side of the body (Fig. 1). The antenna in *Tragosoma* species is more-or-less flattened, with the two flat faces respectively oriented dorsolaterally and ventromedially. For practical reasons the antennae are here treated as being flattened dorsoventrally, with the flattened surfaces being dorsal and ventral, and the two more-or-less sharp edges being lateral and medial. Second, in the literature on Cerambycidae, the entire lateral inflexed side of the elytron is incorrectly called the epipleuron. By homology with the same structure in other families of Coleoptera, the cerambycid epipleuron is actually the narrow rim bordering the lower edge of the inflexed side (Arnett and Thomas 2001: 6-7, as "epipleura") and the term epipleuron is used here in that sense. In *Tragosoma*, the epipleuron is flat, its face lateroventral, and clearly delimited from the inflexed side of the elytron by a strong carina.

Systematics

Tragosoma soror Laplante, new species

Fig. 1, 2, 3

Type material. Holotype. Male (body length: 31 mm), labeled: "USA: Idaho, Ada Co. / Shafer Butte, 25.VIII.2009 / from 2R*, 3R*-OH / J.D. Barbour // CNC COLEO / 00090935 // HOLOTYPE / Tragosoma / soror / S. Laplante, 2017 // HOLOTYPE / Tragosoma / soror / Laplante, 2017 / CNC No. 24393", deposited in CNC. Photos attached to the record in the CNC Collection database can be accessed at http://www.cnc-ottawa.ca/taxonomy/Specimen.php?id=1399070.

Paratypes, 41 males and 28 females as follows. **CANADA**. **British Columbia.** *Central Kootenay reg. dist.*.: Castlegar, 31.VII.1974, Wv. M. (1 ♂, RBCM [RBCM ENT991-105033]). Creston, 3.VIII.1955, G. Stace Smith, Ex. cordwood (1 ♀, UBC [SEM-UBC COL-5120]). 34 mi. N Creston, 1900', 30.VII.1960, D.F. Hardwick (1 ♂, CNC [CNC COLEOPT # 06-935]). Kaslo, 25.VII, R.P. Currie (1 ♀, NMNH). West Kootenay, A.G. Lang (1 ♀, CNC [CNC COLEOPT # 06-937]). 8 km NE Nelson, N shore Kootenay Lake, 49.554°N 117.256°W, 550 m, 7.VIII.2008, LM Humble, Field No: HUM-08-1574, UV light (1 ♂, PFCA). Riondel, Riondel Road, 2500', 49.74°N116.85°W, 10-21.VIII.2009, C. Schmidt (1 ♀, CFIA). *Squamish dist.*: Squamish, Diamond Head Trail, 3200 ft., 28.VIII.1953, E. Mason (1 ♂, CNC [CNC COLEOPT # 06-936]). *West Kelowna dist.*: Westbank, German Bros. Mill Yard, VIII.2001, K.E. Hein, Lindgren funnel (1♀, CMNH). Westbank, Riverside Mill, VII.2001, K.E. Hein, Lindgren funnel traps (1♂, 1♀, CMNH). **USA. California.** *El Dorado Co.*: Kyburz Forest, 21.VII.1990, G. Minet (1 ♂, GMIC). Sequoia National Forest, 2066 m, 36°39'53"N 118°50'23"W, 28.VII.2005, P. de Tonnancour, at light (1♂, CPTO). *Fresno Co.*: Huntington Lake vicinity, Sierra Nevada, 24-25.VII.1984, Ziff (1♀, ADC). *Madera Co.*: 1 mi. SW Coarsegold, 1500', 2.VIII.2016, W.H. Tyson, at UV light (1 ♂, WPTC). *Plumas Co.*: 8 mi. NW

Chester, 5000', VIII. 1989, R.J. Lindquist (1 ♀, CNC [CNC COLEOPT # 06-941]). *San Bernardino Co.*: Wrightwood, San Gabriel Mountains, 6400', 12.VII.1994 (1♂, ADC). *Tulare Co.*: Monache Meadows, 28.VII.1917 (1♀, CNC [CNC COLEOPT # 06-946]). Almanor, 4500', 3.VIII.1965, E. & I. Munroe, black light (1 ♂, CNC [CNC COLEOPT # 06-945]). *Undefined Co.*: Yosemite National Park, VII.1989, J. & M. Sláma (2 ♂, MSLC; 1 ♀, RMC). **Idaho.** *Ada Co.*: Shafer Butte, 25.VIII.2009, J.D. Barbour (1 ♂, CNC [CNC COLEO 00090936]; 1 ♂, UCRC [UCRC ENT 301612]); Shafer Butte, 26.VIII.2009, J.D. Barbour (1 ♂, CNC [CNC COLEO 00090937]; 1 ♂, UCRC [UCRC ENT 301613]); Shafer Butte, 27.VIII.2009, J.D. Barbour (1 ♂, CNC [CNC COLEO 00090938]; 2 ♂, UCRC [UCRC ENT 301614 & 301615]). *Jefferson Co.*: Targhee National Forest, Kelly Canyon, VII.1989, J. & M. Sláma (2 ♂, MSLC); no date (1 ♀, MSLC). *Boise Co.*: 4 mi. S. Lowman, 5.VIII.1978, A.D. Allen, Ex: Ponderosa (1 ♂, RMBC). *Fremont Co.*: Targhee National Forest, Big Springs, Moose creek, VII.1995, J. & M. Sláma (1 ♀, MSLC). Vicinity of Island Park, VII.1989, J. & M. Sláma (2 ♂, 2 ♀, MSLC). *Latah Co.*: Moscow, 25.VII.1987, J.B. Johnson (1♂, MSLC). Krassel Research Station, 10.VIII.1962, M.M. Furniss, Hopk. 41329 A, at light (1 ♂, NMNH). **Montana.** *Flathead Co.*: Flathead Lake, 7.VII.1948, flight, D.H.B. Ulmer (1 ♂, 1 ♀, CNC [CNC COLEOPT # 06-938 & 06-939]). *Gallatin Co.*: West Yellowstone, 15.VIII.2008, D. Beaudry & J.-C. Lajeunie, at light (1 ♂, CPTO). West Yellowstone, 16.VIII.2008, D. Beaudry & J.-C. Lajeunie, at light (2 ♀, CPTO). West Yellowstone, 17.VIII.2008, D. Beaudry & J.-C. Lajeunie, at light (2 ♀, CPTO). **Oregon.** *Baker Co.*: Baker, 5.VIII.1957, J.H. Baker (1 ♂, NMNH). *Deschutes Co.*: Fall River, 18.VII.1968 (1 ♂, JPHC). Lapine, summer 1944-45, R.T. Gast (1♀, CMN). *Douglas Co.*: Hwy. 138, 11 mi. W. Diamond Lake, 14.VIII.1978, Lot 4, B.F. & J.L. Carr (2 ♀, NMNH). Mount Thielsen wilderness, Cascade Range, VII.1995, J. & M. Sláma (5 ♂, MSLC). *Grant Co.*: John Day, 4.VII.1961, A.I. Good (1♀, CMNH). *Jackson Co.*: Hyatt Lake, 15.VIII.1971, B. Gill (1 ♀, CMN). Prospect, 6.VIII.1978, Lot 1, B.F. & J.L. Carr (1 ♂, CNC [CNC COLEOPT # 06-943]). *Klamath Co.*: Chemult, 23.VII.1959, R.K. Eppley (1♂, CNC [CNC COLEOPT # 06-942]). Crescent, 5.VIII.1978, Lot 4, B.F. & J.L. Carr (1 ♂, CNC [CNC COLEOPT # 06-944]). Gillchrist, 8.VIII.2005, H. Novak (1♀, HBC). Sand Creek, 31.VII.1932, Lat 418, Blackwelder Collection (1 ♀, NMNH). Williamson R. Ranch, Summer 1962, Mel Fitzpatrick (1 ♀, RMBC). **Washington.** *Okanagan Co.*: Black Canyon, 1.VII.1949, E.C. Johnston (1 ♂, CNC [CNC COLEOPT # 06-940]). **Wyoming**. *Lincoln Co.*: Alpine, 21, 23.VII.2003, M. Bourandas (1♂, 2♀, CGDR).

Etymology. *Soror* (= sister), a Latin feminine noun in apposition, is used in reference to the presumed close taxonomic relationship between the new species and *T. spiculum*.

Description. Male. Body length 28–33 mm. Antenna extending to apical fourth to sixth of elytron, dorsoventrally compressed from antennomere 3 on and regularly tapering toward apex, with short visible setae mostly restricted to a row along its medial edge; antennomere 3 with carina on lateral edge and poriferous area of dorsal surface extending along almost entire length, beginning close to base on the lateral side (Fig. 2); antennomeres 3 and 4 with lateroapical angle distinctly produced; ratio LA-3/LA-4 = 1.027–1.213 (mean = 1.105, n = 21) (see scatter graph, Fig. 9); antennomere 11 more than 5.5 × as long as wide. Eyes with distance between upper lobes less than width of scape. Pronotum with anterolateral angle rounded, obtusely angulate, or sometimes produced into a small triangular tooth, with median lateral process spiculiform, abruptly narrow from base, and usually projecting slightly forward; pronotal disc with deep, rather dense to contiguous punctures of variable sizes, and covered with rather long and moderately dense fine reddish-yellow setae; hypomeron finely contiguously punctate and setose along posterior margin and lower margin up to middle, and smooth to variably densely and coarsely punctate or rugose on its entire width in front of median lateral process. Scutellum rather densely finely punctate, setose. Protarsus rather wide, with tarsomere 1 as wide as long or almost so. Elytron with rather fine, shallow punctures all over, especially at base, with small almost imperceptible setae on disc, with epipleuron and lateral edge not or hardly pubescent; apical sutural spine widely triangular, shorter (often distinctly so) than maximum width of antennomere 11. Prosternum with medial area weakly convex, finely densely rugoso-punctate.

Female. Body length 30–34 mm. Structures as in male, except: antennae shorter, extending to middle of elytra, less obviously tapering toward apex; antennomere 3 narrower, with lateral carina and dorsal poriferous area beginning around middle on lateral side (Fig. 3); ratio LA-3/LA-4 = 1.144–1.367

(mean = 1.257, n = 20) (see scatter graph, Fig. 10); pronotal hypomeron moderately coarsely and contiguously punctate.

Geographical distribution. This species ranges from southern British Columbia southeastward in the Rocky Mountains to central western Wyoming and southward along the Cascade range to the Sierra Nevada and the San Bernardino Mountains in central California.

Adult activity period. July and August.

Bionomics. One specimen was collected by A.D. Allen "ex Ponderosa [pine]" [*Pinus ponderosa* Lawson (Pinaceae)] 4 mi. S Lowman, Boise County, Idaho in 1978 (RMBC), but the label data do not unequivocally indicate that the specimen developed in that tree. Ray et al. (2012) reported the discovery of eight pupae of that species, eventually reared to adult stage, in downed *Pinus* Linnaeus (Pinaceae). Label data indicate that they can be found under loose bark of pine logs, but are mostly collected at light, especially UV light, at night, in or near pine stands.

Remarks. The species described here is the one referred to as «*Tragosoma harrisi* "sp. nov. Laplante"» in Ray et al. (2012). These authors independently found in a pheromone study that the species was different from «*T. depsarium "harrisi"*» (= *T. harrisii*).

Taxonomic notes. Barcode analysis revealed that, among all species included in the DNA study, *T. spiculum* shows the most similarity with *T. soror*. A short sequence of 406–407 base pairs was obtained for each barcoded specimen of these two species. All three *T. soror*, from British Columbia, Oregon and California, clustered congruently (Fig. 11), showing an intraspecific variation ranging from 0.0–0.25% (mean = 0.16%). The interspecific variation between the only *T. spiculum* analyzed, from New Mexico, and the three *T. soror* ranged from 11.08–11.39% (mean = 11.19%).

Tragosoma soror shares with *T. spiculum* the following character states. Eyes protruding, the upper lobes separated by less than maximum width of scape; prothoracic lateral process spiculiform, often projecting slightly forward; antenna dorsoventrally compressed from antennomere 3 on and regularly tapering toward apex, with lateroapical angle of antennomeres 3 and 4 angularly produced; antennomere 3 with poriferous area covering most of the dorsal surface in males (Fig. 2) and the apical half along the lateral side in females (Fig. 3); the LA-3/LA-4 ratio inferior to 1.22 in males and inferior to 1.37 in females (Table 1); antennomere 11 long, at least 5 × its width in male. *Tragosoma soror* differs from *T. spiculum* by the eyes comparatively less protruding; by the slightly lower LA-3/LA-4 ratio on average in males (Table 1 and Fig. 9); by the pronotal disc with variably coarse and moderately dense to contiguous punctures, rather densely clothed with long fine reddish-yellow setae; and the densely, finely punctate and distinctly pubescent scutellum. In *T. spiculum*, the eyes are comparatively slightly more strongly protruding; the pronotal disc is rather finely and sparsely to moderately coarsely and densely punctate, and distinctly less setose; and the scutellum is sparsely and coarsely punctate and almost glabrous. The populations of the two species are totally allopatric, *T. spiculum* being restricted to the mountains of Arizona, New Mexico, and Colorado. The two species form a distinctive group within the genus that I call the spiculum group.

Although the new species is morphologically close to *T. spiculum*, in collections the specimens of that species were mixed with those of *T. harrisii* under the name *T. depsarium*, most likely because of their distinctly setose pronotum. The populations of *T. soror* are sympatric with those of *T. harrisii* in western North America. *Tragosoma harrisii* differs from *T. soror* by antennomere 3 with the poriferous area covering less than the apical two-thirds, often beginning around middle in male (Fig. 4), and restricted to apical one fourth or less in female (Fig. 5); by the ratios LA-3/LA-4 superior to 1.25 in males (see Table 1 and scatter graph, Fig. 9), and superior to 1.38 in females (see Table 1 and scatter graph, Fig. 10) that show no overlap with those calculated for *T. soror* (LA-3/LA-4 inferior to 1.22 in males and inferior to 1.37 in females; see Table 1); by the lateral prothoracic process usually wide at base, forming a widely triangular projection.

Tragosoma soror is partially sympatric with *T. pilosicorne* in California and southern Oregon (distribution of the latter species in Chemsak 1996: 130). Both species have the extent of the poriferous area of antennomere 3 (Fig. 6) and the shape of the median lateral prothoracic process similar. Specimens of *T. pilosicorne* readily differ by the following character states, which are unique among species of the genus: elytron with distinct, deep, and rather dense punctures at base in male, less so in female but still more than in any other species; epipleuron and lateral margin of the inflexed side densely pubescent, especially in apical area; antenna with its entire surface covered with rather long subappressed setae (Fig. 6). Those features show that *T. pilosicorne* is a morphologically isolated species in the genus.

Species validations, synonymies, and lectotype designation

Tragosoma harrisii **LeConte, 1851**

Laplante (2010: 42) stated that none of the North American taxa previously considered as synonyms of *Tragosoma depsarium* (Linnaeus, 1767) were conspecific with it and that the latter was exclusively Palaearctic in distribution. It could therefore be inferred that *T. harrisii* LeConte, 1851, the oldest name available in the list of synonyms of *T. depsarium*, was implicitly the valid name for the most widespread North American species. The reinstatement of *T. harrisii*, **revised status**, as a valid species is formally proposed here. I have not studied the type of *Cerambyx depsarius* but examined the four photographs of a syntype, a female, in the Linnean Society insect database (Linnean Society of London 2017). Since the type matches the female specimens of *T. depsarium* studied, I assumed that it is conspecific with the only species known from the Palaearctic zone and so based my concept of that species on the 124 Eurasian specimens examined. I have also not seen types of *T. harrisii*, but I examined photographs of a syntype in the MCZ Type Database (Museum of Comparative Zoology 2010); the images clearly show a female specimen on which the features of the pronotum and antennomere 3 confirm that the numerous eastern specimens of *Tragosoma* I examined are conspecific with it. Furthermore, considering its type locality ("Newfoundland; Connecticut"), I concluded that LeConte's type is conspecific with the only species of *Tragosoma* known from northeastern North America. The main differences between the two species are as follows. Males of *T. harrisii* have the pronotal hypomeron rough, covered with contiguous punctures all over (Fig. 7); males of *T. depsarium* have the pronotal hypomeron mainly smooth, showing at most few scattered variably coarse punctures anterior to the lateral spine (Fig. 8). Males of *T. harrisii* also have the medioanterior part of the prosternum distinctly less convex than in *T. depsarium*. Females of *T. harrisii* have the middle of the prosternum rugose with a rather dense punctation; females of *T. depsarium* have the middle of the prosternum smooth between the rather sparse punctures. The difference of the two species was confirmed in a genetic distance analysis performed with full-length barcodes of nine *T. harrisii* included in the dataset (from New Brunswick [1], Ontario [1], Manitoba [1], Alberta [5] and British Columbia [1]) and one *T. depsarium* (from Bavaria, Germany). The specimens of *T. harrisii* clustered congruently with an intraspecific variation ranging from 0.15–1.70% (mean = 0.72%) and the interspecific variation between them and the specimen of *T. depsarium* ranged from 12.25–12.81% (mean = 12.49%) (Fig. 11).

I observed much morphological variation among specimens of *T. harrisii*, especially in the shape of the median prothoracic process. The surface covered by the poriferous area on the dorsal face of the antennomere 3 also tends to be larger in western specimens, particularly in the southwest. The genetic distance of 1.70% observed between the barcodes of some specimens of *T. harrisii* included in the dataset reflects that intraspecific variation (Fig. 11). Furthermore, when the barcode of one more *T. harrisii* excluded from the dataset was included in an analysis of the genetic distances with the nine *T. harrisii* of the dataset, the intraspecific variation obtained between the 10 specimens was 0.15–3.62% (mean = 1.21%), and the distance between the added specimen and the nine others, 2.81–3.62% (mean = 3.15%). This is an indication that, as presently conceived, *T. harrisii* may be a complex of closely related species and the specimen excluded from the dataset could be a distinct species. Study of more specimens is needed to confirm that hypothesis and eventually resolve the taxonomy of that complex. *Tragosoma harrisii*, as variable as it may be, shows marked morphological similarities with *T. depsarium* and *T. nigripenne*, and together they constitute what I recognize as the depsarium group.

Tragosoma spiculum **Casey, 1890 and *T. chiricahuae* Linsley, 1959.**

Examination of the holotypes of *T. spiculum* [type locality: "New Mexico (Las Vegas)"] (NMNH) and *T. chiricahuae* [type locality: "Chiricahua Mts, Cochise Co., Arizona"] (CAS) showed that they are conspecific. *Tragosoma spiculum*, **revised status** is the senior synonym and it is therefore the valid name for the species currently known as *T. chiricahuae*, **new synonym.** Leng (1920: 266) listed *T. spiculum* as the southwestern North American subspecies of *T. depsarium*, with *T. pilosicorne* [type locality: "California (Mt. Diablo)"] as a synonym. Because the name *T. spiculum* has been used as valid after 1899, this prevents from using the provision of Article 23.9 of ICZN (1999) to declare *T. spiculum* a *nomen oblitum* and *T. chiricahuae* a *nomen protectum*. Since *T. chiricahuae* has not often been cited in the literature, at least not as a species of economic or ecological importance, I consider the impact on the stability of nomenclature minimal.

Tragosoma repens **Casey, 1924**

I studied the only specimen (male) of *T. repens* in Casey's collection in NMNH. In its original description, Casey (1924: 226) provides the following information "Utah (southwestern); Length (♂) 24.5 mm; width 8.0 mm.", but does not designate a holotype or mention how many specimens his description is based on. However, Lingafelter et al. (2014: 4) consider a single measurement (rather than a range) given by Casey, and the fact that the specimen label data agree with the published record, as an implicit indication that there was only one specimen. They therefore regard the specimen under that name in NMNH as the holotype by monotypy (ICZN 1999, Art. 72.4.1.1 and 73.1.2). My measurements of length and width of the specimen coincide within a fraction of a millimeter with the single set of measurements given by Casey in the original description and support the type status accepted by Lingafelter et al. (2014: 309, Fig. 143, g, h). The specimen is obviously a representative of the depsarium group and its morphological characters fall within the range of the variation observed in *T. harrisii*. I consider *T. repens*, **new synonym**, to be a junior synonym of *T. harrisii*.

Tragosoma parvicolle **Casey, 1899 and *T. sodale* Casey, 1899**

Casey (1899) described (as *T. parvicollis* and *T. sodalis*) these two species in a key to the species of *Tragosoma* but no specimens labeled as syntypes could be found for either name in Casey's collection in NMNH. According to S. Lingafelter (pers. comm.), there have never been any specimens so labeled in the Smithsonian collections. Neither is there an entry in the typewritten catalogue of the Thomas Lincoln Casey collection bequeathed to the NMNH, prepared in 1933 and 1934 under the supervision of L.L. Buchanan. Yet, two syntypes of *Pemphus opacus* Casey (Carabidae), described in the same article, are in Casey's collection and recorded in the catalogue under number 46011. Lingafelter et al. (2014: 361) listed both (as *T. sodalis* and *T. parvicollis*) in their Appendix 5 among the primary types that probably belong to the NMNH but are presumed lost or wrongly deposited in another institution. The two names have also not been used in the literature for almost 80 years. Except for records of the two species from New Mexico by Knauss (1904: 156), I found no other citations for them in the literature until the 1980s. It is noteworthy that Casey himself, when revisiting the taxonomy of *Tragosoma* in 1924, did not mention the two names as if he had forgotten that he had described them 25 years earlier. Linsley (1962) also ignored these taxa in his treatment of *Tragosoma* for North America. The names finally reappeared in the literature as junior synonyms of "*T. depsarius*" in a checklist of Cerambycidae (Chemsak and Linsley 1982: 8).

Casey (1899: 98-99) wrote about *T. parvicolle*: "Length 24.8 mm.; width 8.0 mm. Utah (southwestern) — Mr. Weidt." Casey (1924: 226) provided almost the same information about *T. repens*: "Length (♂) 24.5 mm.; width 8.0 mm. Utah (southwestern).—Weidt." Incidentally, in his 1924 paper, Casey added after the description of *T. repens* "This species has been named in my collection for many years but evidently I neglected to publish it." Casey described the prothorax of *T. parvicolle* as being "very broadly and feebly rounded at sides, with the process slender, abrupt and spiculiform", and that of *T. repens* as having "the lateral spine triangular, sharp and median, the sides before and behind it feebly oblique." An examination of the holotype of *T. repens* (NMNH) showed that it matches both descriptions and I conclude that Casey forgot that he described *T. parvicolle* in 1899 and described *T. repens* 25 years later, in 1924, from the same specimen. Casey (1899: 99) did not designate a holotype or specify on how many specimens he based his description of *T. parvicolle* but, for the same reason mentioned above for *T. repens* (ICZN 1999, Art. 72.4.1.1 and 73.1.2), the specimen should be considered as the holotype by monotypy. I added a red label to the specimen reading: "Holotype / *Tragosoma parvicolle* / Casey, 1899 / teste S. Laplante 2017." The specimen is thus the holotype of both *T. parvicolle* and *T. repens*. *Tragosoma parvicolle* is therefore a senior objective synonym of *T. repens*, which consequently makes *T. parvicolle*, **new synonym**, a junior synonym of *T. harrisii*.

About *T. sodale*, Casey wrote "Length 26.0-28.0 mm., width 9.6 mm. Colorado." Therefore, it can be inferred that he had at least two syntypes from Colorado. Three specimens labeled "Col." have been found in Casey's collection (NMNH) among the nine specimens placed under *T. harrisii*. One of them, a male measuring 30 mm long and 10 mm wide, labeled "harrisi - 7" cannot be regarded as a syntype because of its body size. The second specimen, a female measuring 28 mm long and 9.6 mm wide, is labeled: [1, small, white, rectangular label]: "Boulder / Co. Col." [p] // [2, small, white, rectangular label]: "CASEY / bequest / 1925" [p] // [3, white rectangular label]: "Casey determ. [p] / harrisi - 8 [hw]". The third specimen, a male measuring 27.5 mm long and 9.7 mm wide, is labeled: [1, small, white, rectangular label]: "Col." [p] // [2, small, white, rectangular label]: "♂" [hw] // [3, small, white, rectangular label]: "CASEY / bequest / 1925" [p] // [4, white, rectangular label]: "Casey determ. [p] / harrisi - 9 [hw]". Since these last two specimens match the original description of *T. sodale*, including the body measurements within a fraction of a millimeter, they are probably original type material of the taxon. I therefore consider that they represent at least part of the syntypes of *T. sodale* that were eventually misplaced among specimens of *T. harrisii* in Casey's collection. Considering that these syntypes are not labeled as such, and were considered to be lost for a long time, I designate the male specimen "harrisi - 9" as the lectotype. I added a red label to it reading: "Lectotype / Tragosoma sodale / Casey, 1899 / des. S. Laplante 2017". I added a yellow label to the female specimen "harrisii – 8" with the following: "Paralectotype / Tragosoma sodale / Casey, 1899 / des. S. Laplante 2017." I found them conspecific with the specimens of *T. harrisii* examined, so *T. sodale*, **new synonym**, is placed in synonymy under *T. harrisii*.

***Tragosoma nigripenne* Bates, 1892**

This taxon, described from Durango, Mexico, is currently valid and has always been regarded as a distinct species. Galileo (1987: 177) questioned its validity because of the variability of character states previously used to distinguish it from "*T. depsarium*" (including *T. harrisii*), notably the form of the median lateral prothoracic process. However, Galileo decided to keep it as a valid species because her hypothesis was based on insufficient material. I studied specimens of *T. nigripenne* from the state of Durango, 17 males and 12 females from CNC, NHM, MNHNP and IRSNB. Early in my study, I observed that the *T. nigripenne* morphological characters studied fell within the range of the variation observed in *T. harrisii*, and found no reliable diagnostic characters that could separate the two species with confidence. I considered then, like Galileo, the possibility that the two taxa be synonyms. I noted though that the specimens from Durango had the median lateral prothoracic process less developed on average than in most *T. harrisii* studied. The ratios LA-3/LA-4 obtained for the two species, both in males and females (Table 1), and the scatter graphs (Fig. 9 and 10) show that they largely overlap although they slightly differ. Therefore, LA-3/LA-4 is not a good diagnostic character but indicates however that these species are possibly distinct. A full barcode (658 base pairs) was obtained from a specimen (CNC) collected near the type locality in Durango and compared with barcodes from the same dataset of nine *T. harrisii* mentioned in the *Tragosoma harrisii* section above. The analysis showed that the difference between the *T. nigripenne* specimen and the nine *T. harrisii* ranged from 3.77–4.77% (mean = 4.28%) (Fig. 11). Barcodes of additional *T. nigripenne* specimens are needed to confirm this difference but this value supports the validity of *T. nigripenne* and I consider it as a distinct species.

Three of the presumed syntypes of *T. nigripenne* were studied, two males and a female, out of five currently present in NHM. All of them have the same first four labels: [1, small, round, white disc with pale blue margin]: "SYN- / TYPE" [p] // [2, rectangular, white label]: "Ciudad, / Durango. / Höge." [p] // [3, rectangular, white label]: "Tr. E. Soc. 1892. / 92-90" [p] // [4, rectangular, white label]: "Tragosoma [p] / nigripenne, [hw] / Bates [hw]". One of the males (no. 1), the one re-pinned through the left elytron and with a gelatin capsule under it containing the right mesothoracic leg and the apical three antennomeres of an antenna, bears a fifth label, a larger, rectangular, white one, entirely handwritten: "Tragosoma / nigripenne / Bates ♂". I have also studied four more specimens that could potentially be syntypes, each showing a collecting label similar to those in NHM, two females in MNHNP (via collection Oberthür) and two, a male and possibly a female (antennae and abdomen missing), in IRSNB. The fact that I saw more than one male among the presumed type series despite Bates's (1892: 146) statement to the effect that "All the examples are females, except one" casts doubt on the authenticity of the supposed syntypes. The fact that each of all those specimens bears the same data label may indicate that they are from the same collecting series, and therefore genuine syntypes, and that Bates wrongly identified the sex of some specimens. Further research is needed to find all the original syntypes and to show their authenticity.

Checklist of the world species of *Tragosoma*

Here is a catalogue of the *Tragosoma* species of the world resulting from the new nomenclatural acts proposed herewith. The six known species are listed in alphabetic order with their synonyms and geographical distribution. The original combination of each taxon is given with the reference to the original description, the type locality, the type status, and the type repository. The geographical distribution data are taken from Chemsak (1996), Drumont and Komiya (2010), Monné (2017), and the locality data collected during the study.

***Tragosoma* Audinet-Serville, 1832**

Tragosoma Audinet-Serville, 1832: 159. Type species: *Cerambyx depsarius* Linnaeus, 1767 [= *Tragosoma depsarium* (Linnaeus)] by monotypy.

***Tragosoma depsarium* (Linnaeus, 1767)**

Cerambyx depsarius Linnaeus, 1767: 624. Type locality: "Svecia" [Sweden] (syntype in the Linnean Insect Collection of the Linnean Society of London).

Distribution: Europe and Siberia.

***Tragosoma harrisii* LeConte, 1851**

Tragosoma harrisii LeConte, 1851: 107. Type locality: "Newfoundland; Connecticut" (syntypes in MCZ). **Revised status.**

Tragosoma sodalis Casey, 1899: 98. Type locality: "Colorado" (lectotype, in NMNH, here designated). **New synonym.**

Tragosoma parvicollis Casey, 1899: 99. Type locality: "Utah (southwestern)" (holotype, by monotypy, in NMNH). **New synonym.**

Tragosoma repens Casey, 1924: 226. Type locality: "Utah (southwestern)" (holotype, by monotypy, in NMNH). **New synonym.**

Distribution: Canada, Mexico, USA: Northeastern USA north to Labrador, west to southern Northwest Territories and British Columbia, south along the Rocky Mountains to northern Mexico (Chihuahua), along the Cascade range and the Sierra Nevada to southern California.

***Tragosoma nigripenne* Bates, 1892**

Tragosoma nigripenne Bates, 1892: 146. Type locality: "Ciudad, Durango" (syntypes in NHM, IRSNB and MNHNP).

Distribution: Mexico: Durango.

***Tragosoma pilosicorne* Casey, 1890**

Tragosoma pilosicornis Casey, 1890: 492. Type locality: "California (Mt. Diablo)" (holotype, by monotypy, in NMNH).

Distribution: USA: California and southern Oregon: Costal range and Sierra Nevada.

***Tragosoma soror* Laplante, new species**

Tragosoma soror Laplante, new species. Type locality: " Idaho, Ada Co. Shafer Butte" (holotype, by original designation, in CNC).

Distribution: Canada and USA: Southern British Columbia southeast to western Wyoming, south along the Cascade range to central Sierra Nevada and central Coast range in California.

***Tragosoma spiculum* Casey, 1890**

Tragosoma spiculum Casey, 1890: 492. Type locality: "New Mexico (Las Vegas)" (holotype, by monotypy, in NMNH). **Revised status.**

Tragosoma chiricahuae Linsley, 1959: 127. Type locality: "Cave Creek Canyon, Chiricahua Mts, Cochise County, Arizona" (holotype, by original designation, in CAS). **New synonym.**

Distribution: USA: Southern Rocky Mountains (southern Colorado, New Mexico) and isolated mountains in southeastern Arizona.

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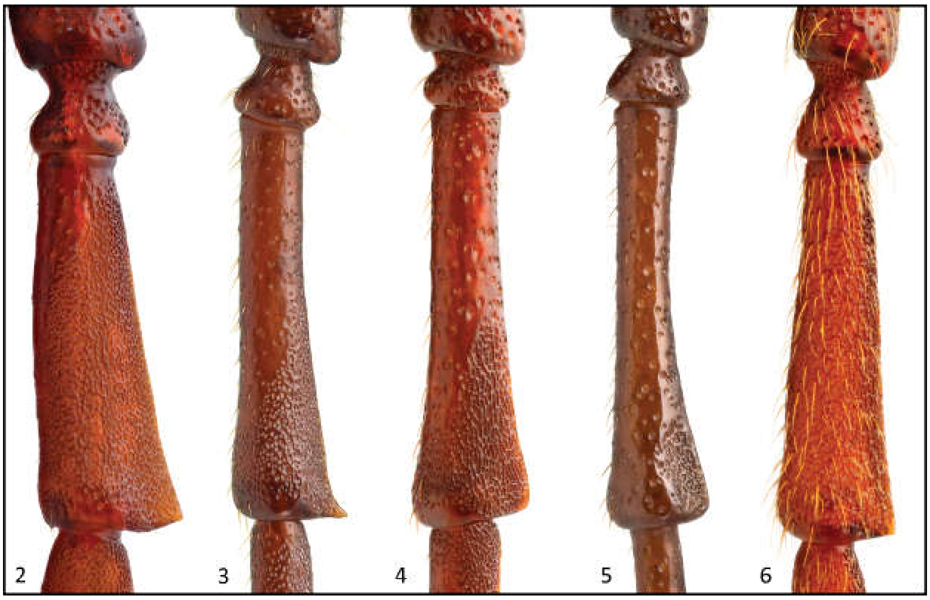
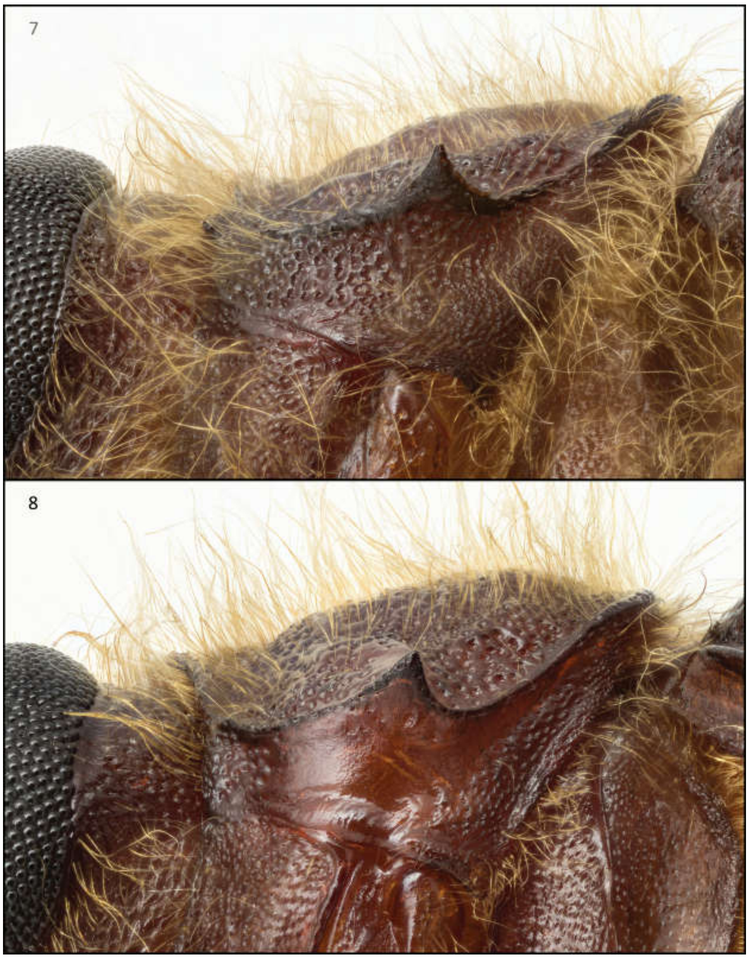
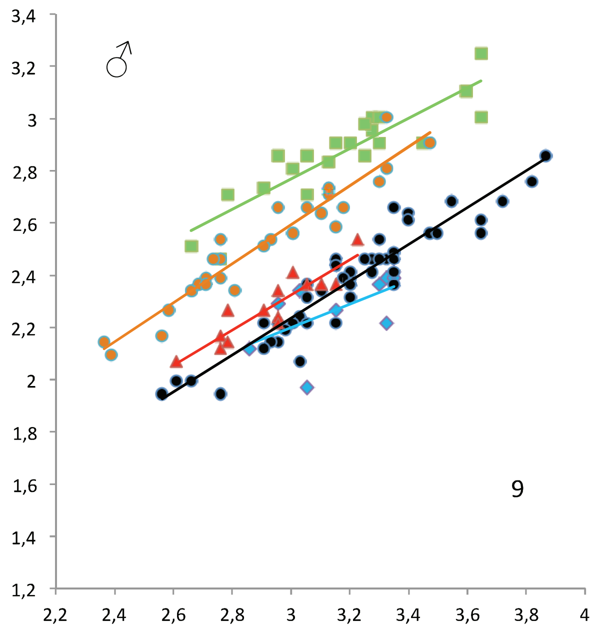
Figure 1. Dorsal habitus of a *T. soror* male paratype from Alpine, Lincoln Co., WY, USA.

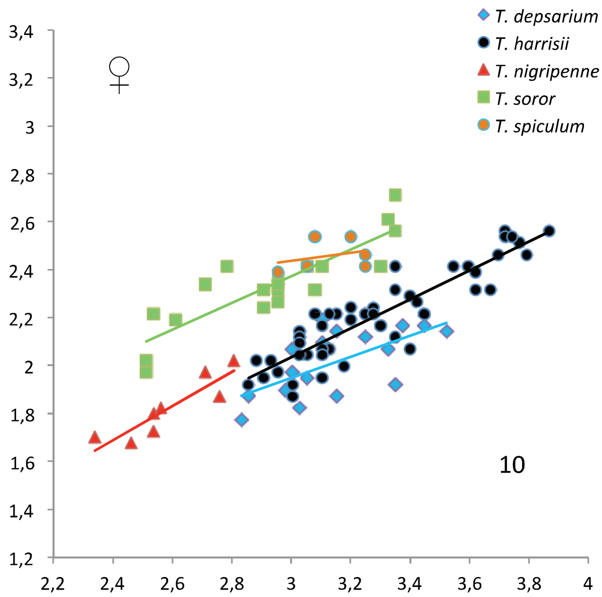


Figures 2–6. Right antennomeres 2-3 of *Tragosoma* (lateral side on the right). **2)** *T. soror*, male. **3)** *T. soror*, female. **4)** *T. harrisii*, male. **5)** *T. harrisii*, female. **6)** *T. pilosicorne*, male.



Figures 7–8. Left pronotal hypomeron of male *Tragosoma* in ventrolateral view. **7)** *T. harrisii*. **8)** *T. depsarium*.





Figures 9–10. Scatter plots with medians of LA-3 (on horizontal axis) in relation with LA-4 (on vertical axis) measured (in mm) for samples of *T. depsarium*, *T. harrisii*, *T. nigripenne*, *T. soror*, and *T. spiculum*. **9)** For males. **10)** For females.

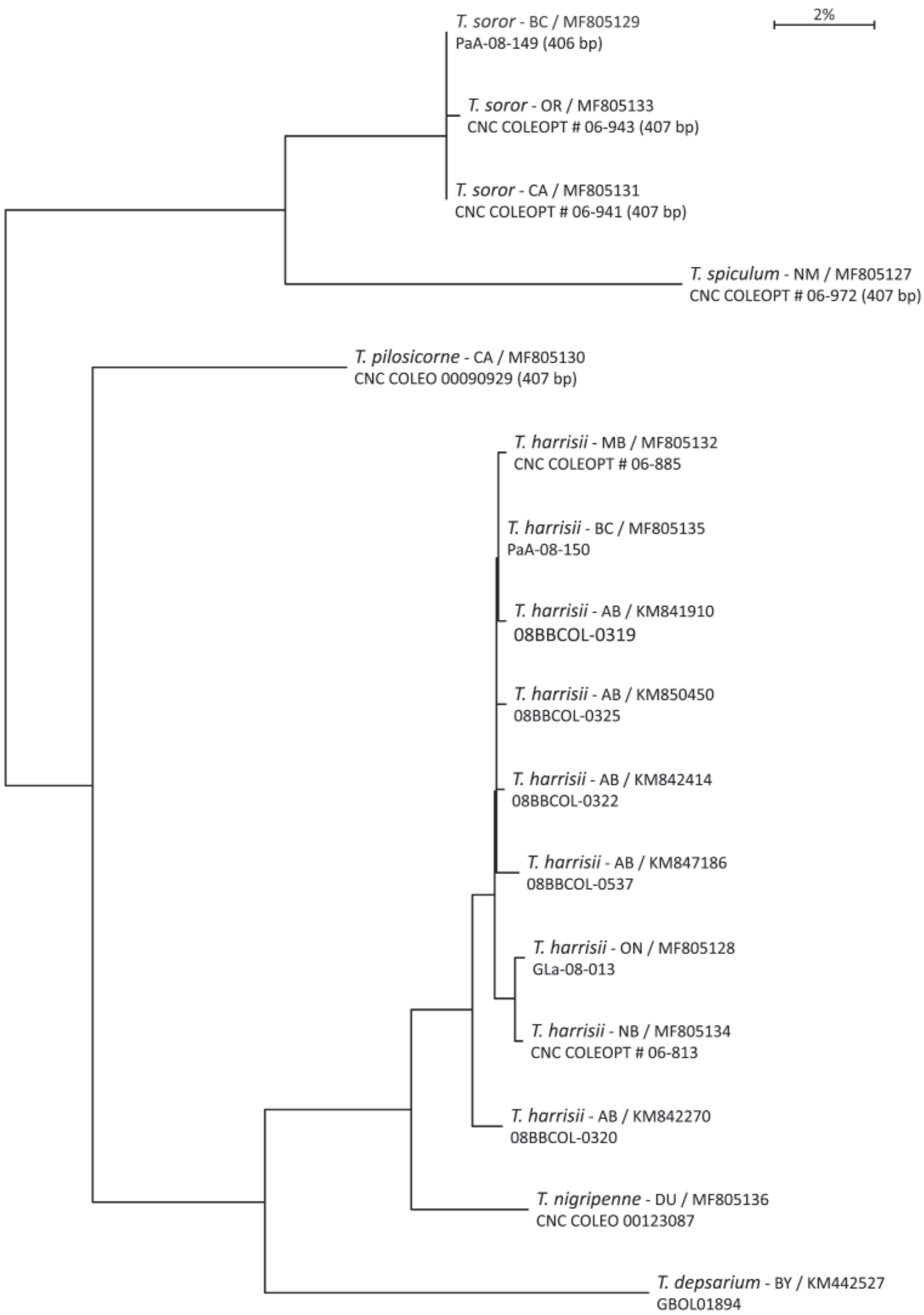


Figure 11. Neighbor joining tree for the 16 barcodes of *Tragosoma* included in the dataset; each record with province or state of origin, GenBank accession number, and sample ID. Full length sequences (658 base pairs) analyzed, unless otherwise indicated in parentheses.

Table 1. Summary of ratios of Length of antennomere 3/Length antennomere 4 (LA-3/LA-4) calculated for samples of males and females of five species of *Tragosoma*.

	ratio range	ratio mean	1 standard deviation	n
T. depsarium ♂	1.290 – 1.550	1.395	0.076	10
T. harrisii ♂	1.259 – 1.464	1.347	0.041	50
T. nigripenne ♂	1.228 – 1.333	1.287	0.031	14
T. soror ♂	1.027 – 1.213	1.105	0.045	21
T. spiculum ♂	1.087 – 1.219	1.152	0.032	30
T. depsarium ♀	1.416 – 1.744	1.567	0.084	17
T. harrisii ♀	1.388 – 1.643	1.491	0.059	50
T. nigripenne ♀	1.375 – 1.474	1.422	0.041	8
T. soror ♀	1.144 – 1.367	1.257	0.057	20
T. spiculum ♀	1.214 – 1.347	1.274	0.046	6