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Taxonomic revision of *Eunota togata* (LaFerté-Sénectère, 1841) (Coleoptera: Cicindelidae) in North America with a new subspecies from western Texas and New Mexico, United States

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Abstract. Within Nearctic Cicindelidae, Cicindelini, *Eunota togata* (LaFerté-Sénectère, 1841) (Coleoptera: Cicindelidae) exists as several distinct phenotypes, some described as subspecies whose taxonomic status has been misinterpreted. *Eunota togata togata* applies to adults marked with broadly sinuate inner margins on shiny brown elytra common across northern coastal Gulf of Mexico. *Eunota togata fascinans* (Casey, 1914), **new synonymy**, incorrectly applied to populations in western Texas and New Mexico, United States, is considered a junior synonym of *E. togata globicollis* (Casey, 1913), the predominant subspecies with broadly sinuate inner margins on coppery elytra found from eastern New Mexico and western Texas into the Southern Great Plains of North America. *Eunota togata leucophasma*, **new subspecies**, is comprised of adults with mostly white elytra that are isolated in Hudspeth County, Texas, and Doña Ana, Otero, and Torrance Counties, New Mexico. Intergrades between *E. togata globicollis* and *E. togata leucophasma*, **new subspecies**, are found sporadically in eastern New Mexico and western Texas; however, suggested intergrades between *E. togata globicollis* and *E. togata togata* in western Texas are reinterpreted as more typical of intergrades farther north in New Mexico. Adults marked with acutely sinuate inner margins on darker elytra found only in northcentral Kansas to southeast Nebraska should be referred to as *E. togata latilabris* (Willis, 1967), **new status**. All subspecies are collectively known as the white-cloaked tiger beetle. Geological conditions influencing development of saline habitats and subsequent evolution of divergent white *E. togata* subspecies in Texas and New Mexico, and darker *E. togata* subspecies in Kansas and Nebraska, are discussed and compared to more uniformly marked *E. togata* subspecies found elsewhere in North America.

Key words. Great Plains, saline habitats, Nearctic tiger beetles, geographical variation, key.

ZooBank registration. urn:lsid:zoobank.org:pub:0670AC22-7B43-4EDA-BA29-7FAC9951B48A

Introduction

Eunota was established by Rivalier (1954) for the Nearctic tiger beetle, *Cicindela togata* LaFerté-Sénectère, 1841. The monophyletic concept of *Eunota* held by Rivalier (1954) was based on unusual rudimentary sclerites within the inner sac that occupy only a small portion inside a narrow, elongated aedeagus of the male genitalia (Fig. 1–3). These sclerites are reduced in size and include a hollow flagellum; characters Rivalier (1954) considered unique to *Eunota* among Nearctic species within Cicindelidae, Cicindelini. Although *Eunota* and other Cicindelini were later classified within Carabidae, Cicindelinae until only recently (Duran and Gough 2019), subsequent reinterpretation of higher-level taxonomy for all tiger beetles based on genetic studies across all lineages, concluded Cicindelini should be classified as family Cicindelidae (Duran and Gough 2020). Furthermore, Duran and Gough (2019) pointed out that molecular studies (Vogler et at. 2005; Gough et al. 2019) provided evidence that most tiger beetle species Rivalier (1954) grouped within *Habroscelimorpha* Dokhtouroff (Dokhtouroff 1883), except its type species, *H. dorsalis* (Say, 1817) (Say 1817), were genetically very similar to *E. togata*. As a consequence, the current concept of *Eunota* has been formally expanded to include most *Habroscelimorpha* species (Duran and Gough 2019). As further evidence for supporting close relationships, *Eunota* species have similar ecological requirements satisfied by saline habitats found along ocean shorelines and estuaries, as well as margins of continental rivers, lakes, and ponds in drier climates where salt and alkali deposits develop and persist.

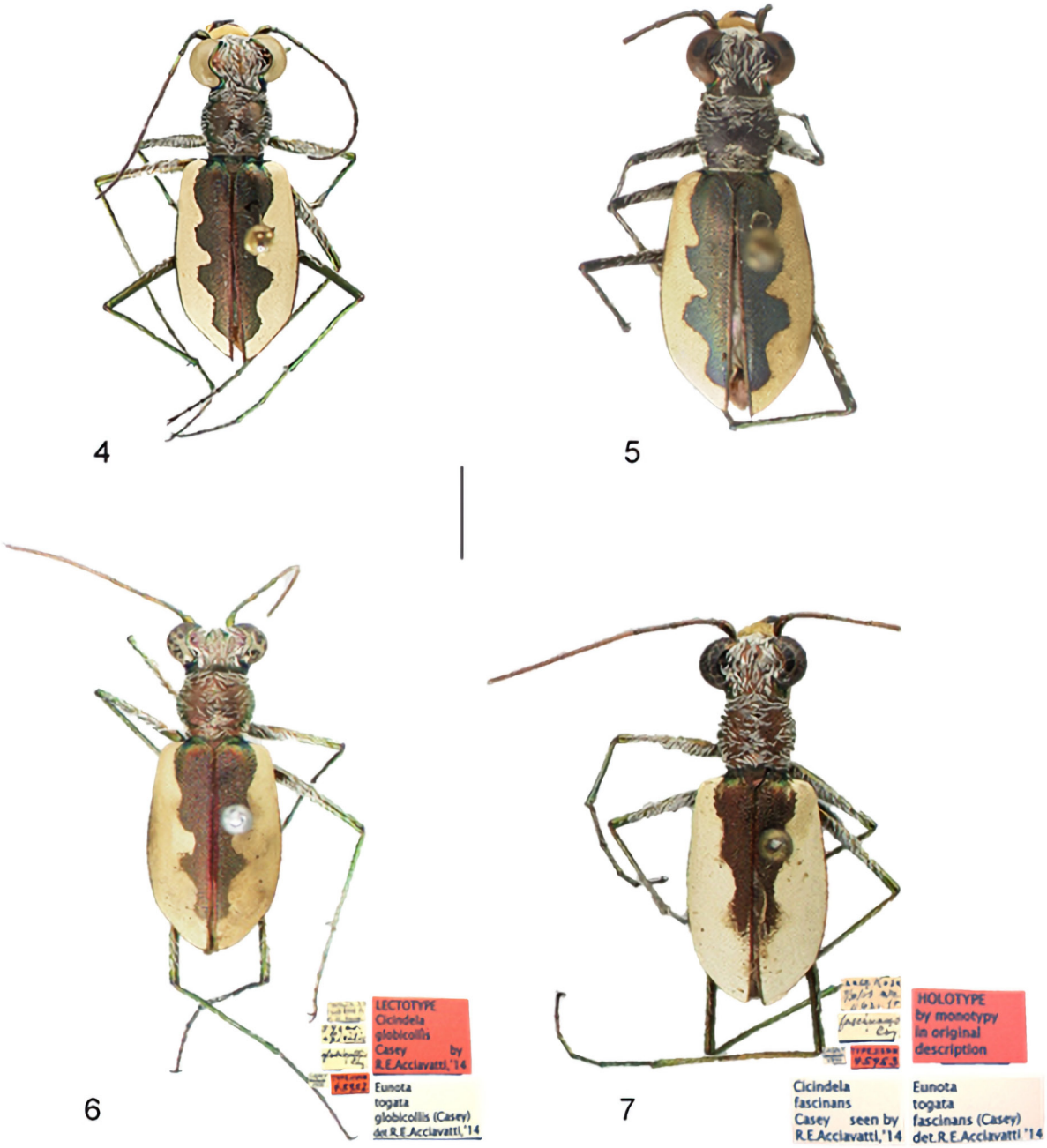
Figures 1–3. *Eunota togata* male aedeagus extended in left lateral view from three geographical limits. **1)** *E. t. togata,* Los Olmos, Kleburg Co., Texas. **2)** *E. t. leucophasma*, new subspecies, Salt Flat, Hudspeth Co., Texas. **3)** *E. t. latilabris*, Lincoln, Lancaster Co., Nebraska. Scale line = 0.5 mm.

Eunota togata adults exhibit a distinctive suite of external morphological characters, in addition to unusual aedeagus features, including: 1) labrum typically with six, erect, submarginal setae placed inward from anterior margin (some specimens with 7, others with 8), middle four grouped in pairs; 2) large, prominent eyes bulging laterally to various degrees; 3) body covered with different amounts of dense, white decumbent setae of various lengths and widths; 4) elytra with wide, white, marginal bands sinuate on their inner margins with discrete inward bulges or expanded over most or all of each elytron to various extents in different parts of its geographical range; 5) long legs with femurs and tibiae covered with white, decumbent setae.

Phenotypic variation in external morphology of *E. togata* adults in body setae and elytral maculation (Fig. 4–16, 18–22, 24–35), throughout this species' widespread geographical distribution (Fig. 50), has been well documented (Leng 1920; Willis 1967; Bousquet 2012; Pearson et al. 2015). This variation in extent of white decumbent body setae, white elytral maculation, body size, and leg length, provides important adaptations for thermal regulation and predator avoidance thereby promoting survival as tiger beetle species partition available niches in restricted habitats, such as found in saline environments (Brosius and Higley 2013).

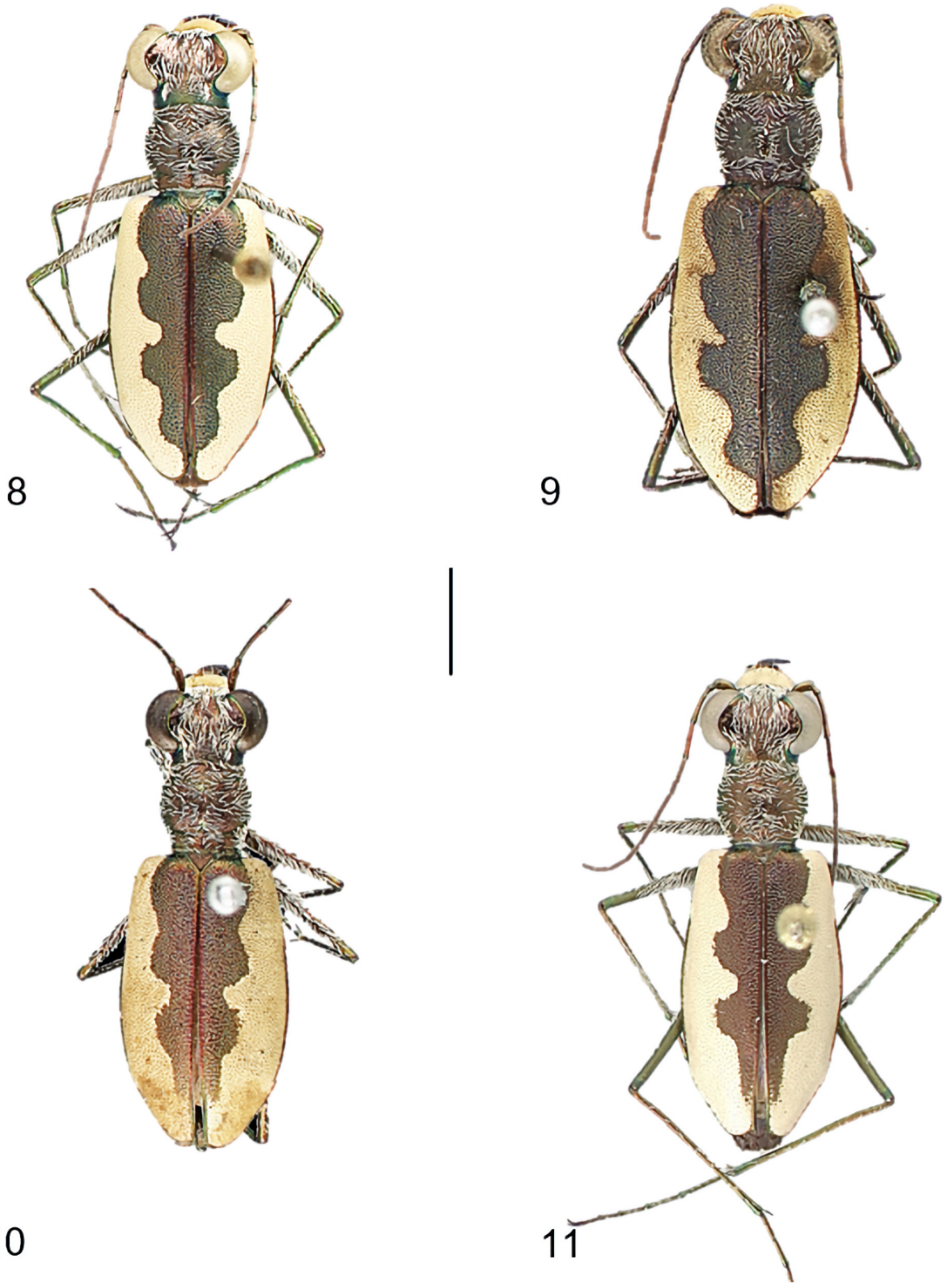
Eunota togata larvae and adults are restricted to moist saline and alkaline habitats (Willis 1967; Pearson et al. 2015). Suitable coastal habitats exist in areas with sparse vegetation on bare, open terrains, such as those found around margins of brackish ponds, estuaries, and rivers entering ocean lagoons, tidal inlets, and along seashores. Other suitable interior habitats exist around salt lakes with exposed surface salt deposits, as well as salt ponds and basins developed by evaporation in arid climates. *Eunota togata* is distributed in North America where these saline and alkaline habitats occur along the Gulf of Mexico in southern coastal United States, adjacent northeastern coastal Mexico, and southern Great Plains (Willis 1967; Bousquet 2012; Pearson et al. 2015).

Eunota togata adults occupying different geographic regions differ in body color and extent of setae coverage, plausibly allowing adults to regulate body temperatures during extremes in ambient temperatures. For

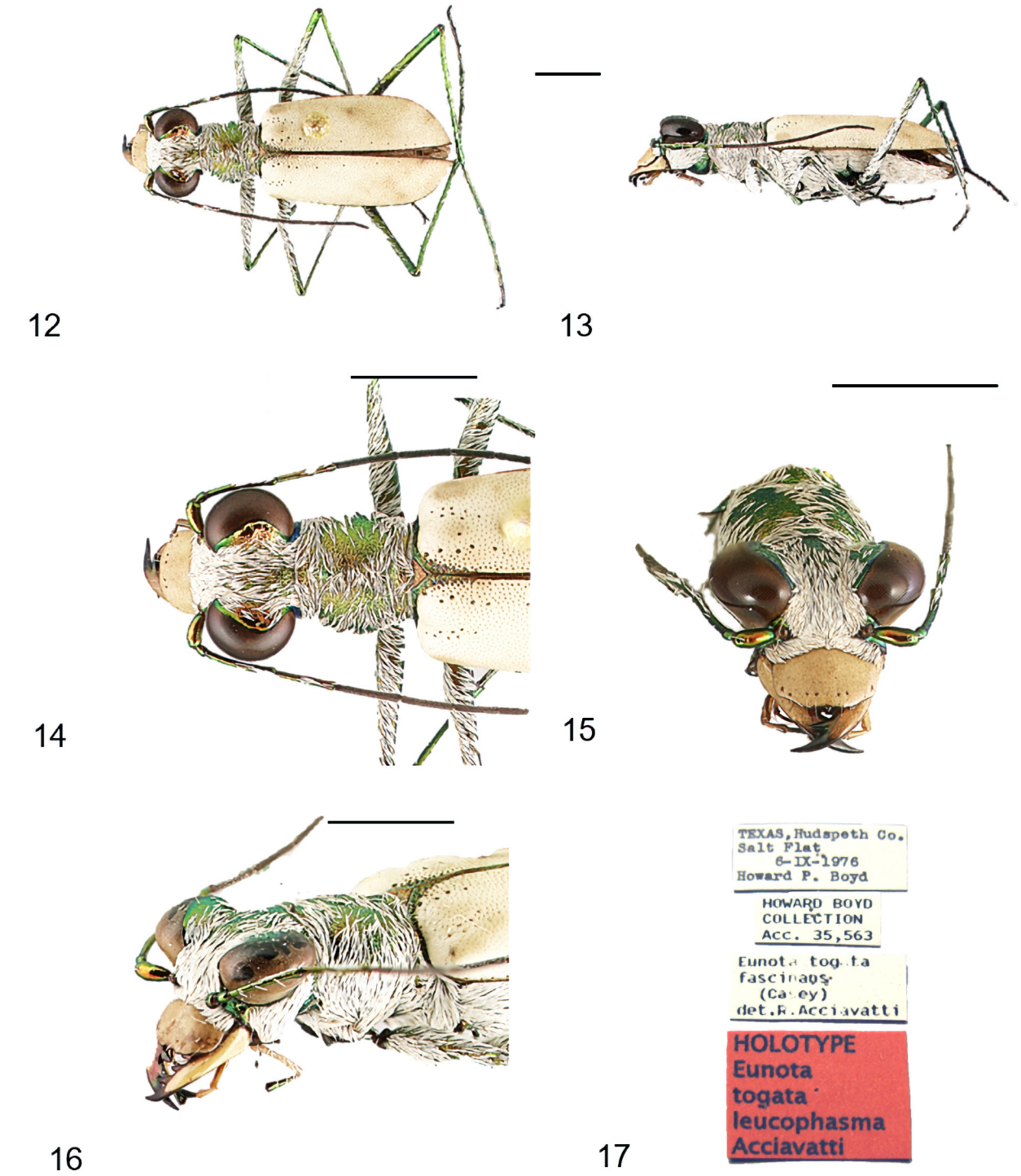


Figures 4–7. *Eunota togata* described subspecies males based on types and/or type locality specimens. **4)** *E. t. togata*, type locality, Cameron County, Texas. **5)** *E. t. latilabris,* type locality, Kackley, Kansas. **6)** *E. t. globicollis,* lectotype, Clark County, Kansas. **7)** *E. t. fascinans*, holotype, Santa Rosa, New Mexico. Scale line = 2 mm.

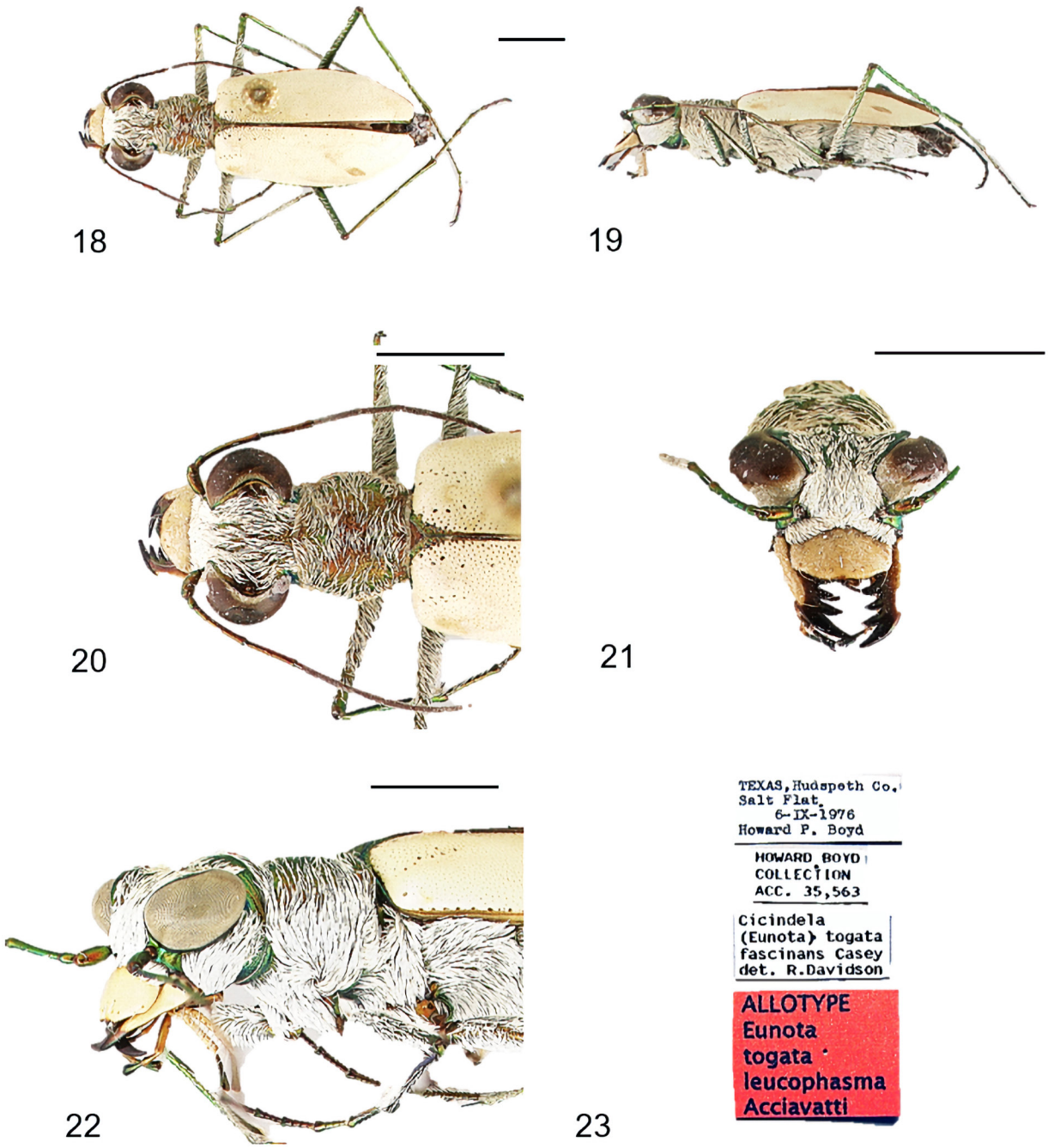
example, almost entirely white adults in open salt flats could reduce deleterious effects of higher body temperatures produced by white, encrusted surfaces in such habitats. Similarly, dark adults within confined margins of salt marshes could move between the shade of nearby vegetation to cool their bodies and sunny open areas for warmth from insolation. Differences in body setae, elytral surface texture, color and maculation, body size, and leg length, under these various environmental conditions, have led taxonomists to recognize certain *E. togata*



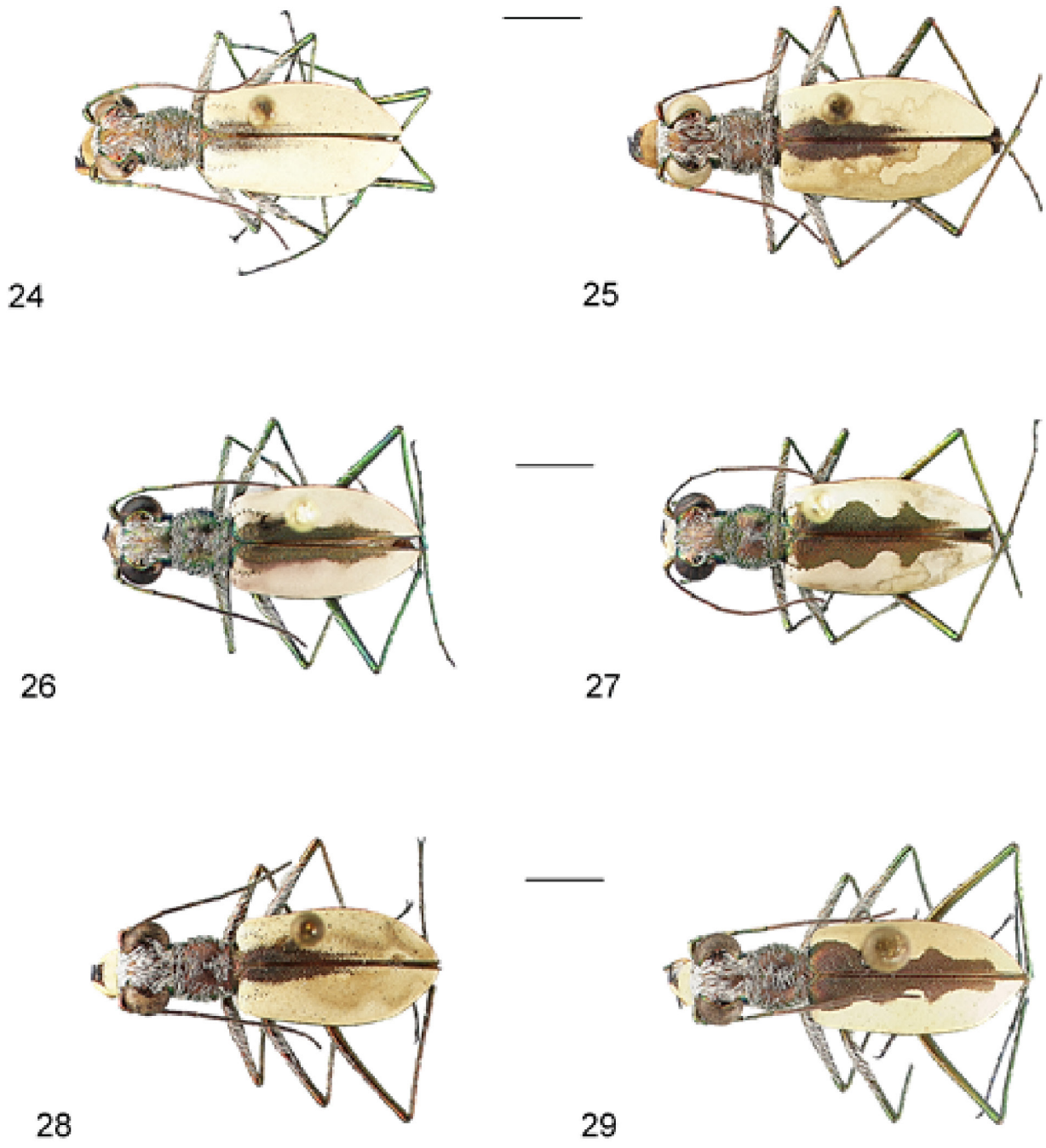
Figures 8–11. *Eunota togata* described subspecies females based on types and/or type locality specimens. **8)** *E. t. togata,* type locality, Cameron County, Texas. **9)** *E. t. latilabris*, type locality, Kackley, Kansas. **10)** *E. t. globicollis*, paralectotype, Clark County, Kansas. **11)** *E. t. fascinans*, type locality, Santa Rosa, New Mexico. Scale line = 2 mm.



Figures 12–17. *Eunota togata leucophasma*, new subspecies, holotype, male, Salt Basin, Hudspeth County, Texas. **12)** Habitus, dorsal view. **13)** Habitus, lateral view. **14)** Head, pronotum, dorsal view. **15)** Head, dorsal-anterior view. **16)** Paratype, male, head, anterior view. **17)** Holotype labels. Scale lines = 2 mm.



Figures 18–23. *Eunota togata leucophasma*, new subspecies, allotype, female, Salt Basin, Hudspeth County, Texas. **18)** Habitus, dorsal view. **19)** Habitus, lateral view. **20)** Head, pronotum, dorsal view. **21)** Head, dorsal-anterior view. **22)** Paratype, female, head, anterior view. **23)** Allotype labels. Scale lines = 2 mm.



Figures 24–29. *Eunota togata leucophasma*, new subspecies, and intergrade adults from New Mexico and western Texas. *E. t. leucophasma*, new subspecies, non-types. **24)** Male from Laguna del Perro, Torrance County, New Mexico. **25)** Female from Laguna del Perro, Torrance County, New Mexico. Intergrade populations *E. t. leucophasma*, new subspecies X *E. t. globicollis*. **26)** Male from Laguna Plata, Lea County, New Mexico. **27)** Female from Laguna Plata, Lea County, New Mexico. **28)** Male from Shafter Lake, Andrews County, Texas. **29)** Male from Shafter Lake, Andrews County, Texas. Scale lines = 2 mm.

populations as distinct subspecies throughout its large geographical range in North America (Wiesner 1992; Freitag 1999).

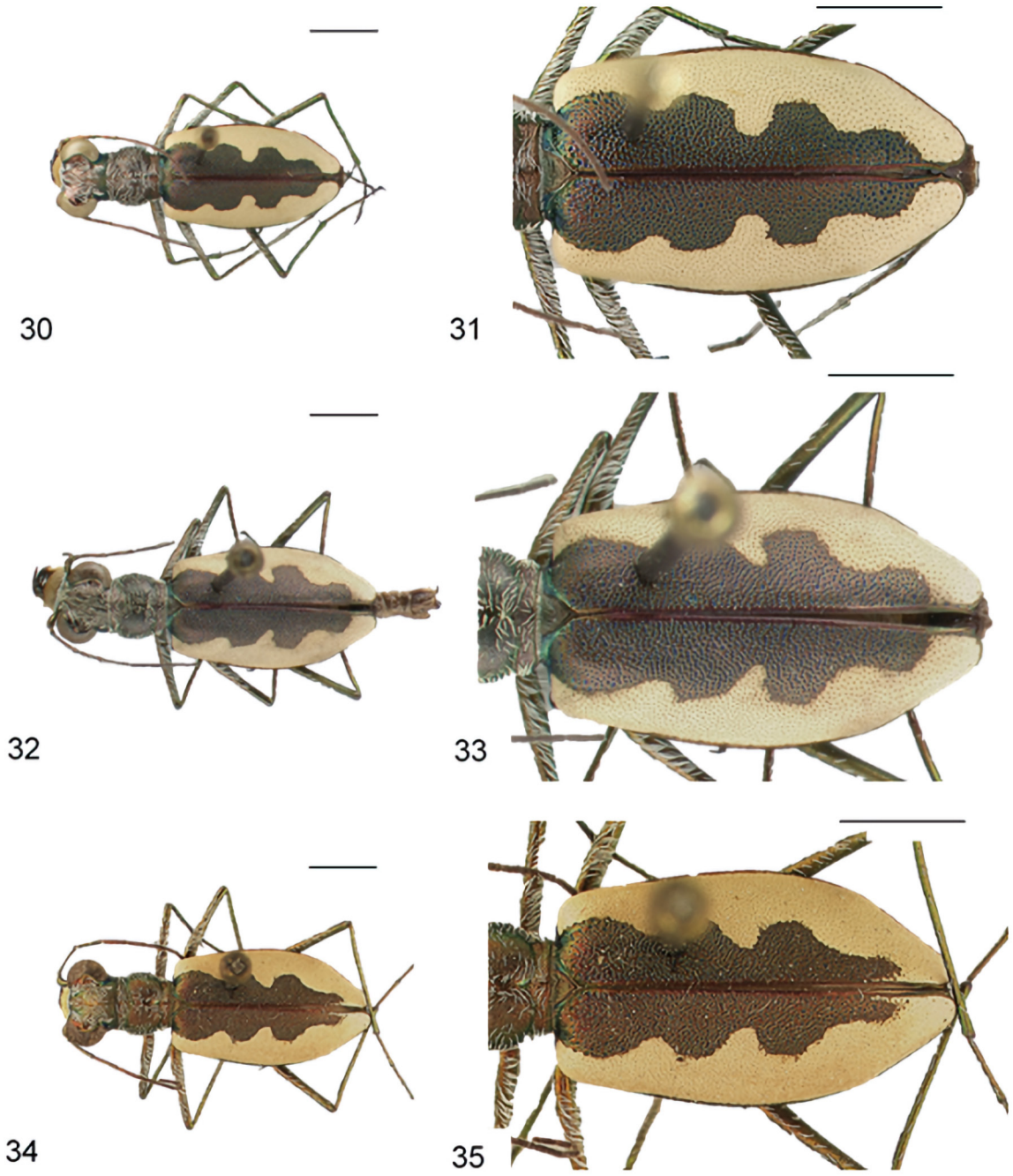
Each of several described *E. togata* subspecies, collectively known as the white-cloaked tiger beetle (Pearson et al. 2015), predominates within a well-defined geographical region in North America. *Eunota togata togata* is primarily encountered along northern coastal Gulf of Mexico with populations found northward along several river watersheds draining into this large body of water. This subspecies has maintained a rather uniform appearance wherever found. By contrast, several populations of this species within interior North America appear different enough to have been described as separate subspecies. Darker colored adults with distinctively angled markings from northcentral Kansas to southeast Nebraska were named *C. togata apicalis* Horn, 1897, now a junior synonym of *E. togata latilabris* (Willis, 1967). Slightly smaller and shiny copper adults with more rounded markings typify *E. togata globicollis* (Casey, 1913) populations centered in southcentral Kansas, whereas *E. togata fascinans* (Casey, 1914) has been applied to smaller adults with wider markings from western Texas and New Mexico. Numerical taxonomic studies by Willis (1967), however, indicated a cline exists across populations within these several states and proposed that *E. togata globicollis* prevail for all Great Plains populations. If such a cline exists as Willis (1967) maintained, application of subspecies names would have to be revised from that in current usage to properly treat *E. togata fascinans* as a junior synonym of *E. togata globicollis*. Most Cicindelidae taxonomists, however, have overlooked this synonymy. Additionally, *E. togata fascinans* has been applied indiscriminately to isolated populations in western Texas and New Mexico whose adults have almost entirely white elytra. Although these latter adults represent the most distinctive *E. togata* phenotype found anywhere, interpretation of their subspecies status has never been adequately resolved taxonomically. As a consequence, this phenotype at the known southwestern geographical limit of *E. togata* remains undescribed until now.

The new *E. togata* subspecies described later in this paper applies only to those populations from western Texas and central New Mexico. Taxonomic relationships of this new subspecies to other *E. togata* populations elsewhere in New Mexico and western Texas, as well as to Great Plains and Gulf Coast populations, are discussed. This new subspecies name, therefore, will be made available taxonomically for future comprehensive investigations, which combine life history and genetic factors with morphology (e.g. Duran et al. 2020) to assess biological validity of *E. togata* subspecies diversity throughout North America as suggested by this taxonomic revision.

Origins and Historical Treatment of Described *Eunota togata* Subspecies

Cicindela togata was the only taxon Rivalier (1954) included in his *Eunota*. Although this generic reassignment has not been always generally accepted by all taxonomists (Willis 1967; Bousquet and Larochelle 1993; Freitag 1999), it now has been firmly established (Duran and Gough 2019). Specimens of both sexes of this species likely were first discovered after 1836 along northern coastal Gulf of Mexico in the Republic of Texas. These specimens, along with those of several other undescribed tiger beetle species, were sent to prominent French coleopterists. Marquis de LaFerté-Sénectère, a French nobleman with one of the largest private beetle collections at that time (Bousquet 2016), eventually described all these newly discovered species (LaFerté-Sénectère 1841), most relevant here being *C. togata* LaFerté-Sénectère, 1841. After its description and for the remainder of the 19th Century, *C. togata* was known only from northern coastal Gulf of Mexico (LeConte 1857; Schaupp 1883). However, just before the 19th Century ended, another phenotype of *E. togata* was discovered much farther inland in Kansas and Nebraska on the Southern Great Plains of North America (Knaus 1900; Leng 1902).

Cicindela apicalis, the next named taxon to be later assigned to *E. togata,* was described from Kansas specimens collected by Warren Knaus (Horn 1897). Knaus lived in McPherson, Kansas, where he worked as a newspaper editor. While travelling through Kansas, Nebraska, and other Great Plains states, Knaus collected and studied tiger beetles and became a renowned amateur Coleopterist specializing in Cicindelidae (Knaus 1900). Specimens Knaus collected at a salt marsh near Kackley, Republic County, Kansas, were sent to German coleopterists, including Walter Horn in Berlin, who described them as *C. togata* var. *apicalis* (Horn, 1897) (Horn 1897). Unfortunately, Horn's name was preoccupied by *Cicindela apicalis* Chaudoir, 1843 (Chaudoir 1843), itself a junior synonym of *Cicindela hamata* Audouin and Brullé, 1839 (Audouin and Brullé 1839) based on Cazier (1954) and Bousquet (2012). Apparently before Horn realized this homonymy, Casey had already described two additional taxa; the first of which Horn considered synonymous with his variety, although he uncharacteristically never bothered to propose a replacement name for his *C. apicalis* (Horn 1915, 1926, 1930). Seventy years later, Willis



Figures 30–35. *Eunota togata* subspecies female elytral maculation patterns from coastal Texas, southeast Nebraska, and northcentral Kansas. *E. t. togata* from Cameron Co., Texas. **30)** Adult dorsal habitus. **31)** Adult elytra. *E. t. latilabris* from Lancaster Co., Nebraska. **32)** Adult dorsal habitus. **33)** Adult elytra. *E. t. globicollis* from Stafford Co., Kansas. **34)** Adult dorsal habitus. **35)** Adult elytra. Scale lines = 2 mm.

(1967) proposed the replacement name, *C. togata latilabris*. However, he maintained its synonymy with the next described taxon despite his research data indicating *C. togata latilabris* adults had distinctive characters that distinguished them from adults in other populations further south in the Great Plains of North America.

Cicindela globicollis was next described from specimens of both sexes collected at or near Englewood, Clark County, Kansas, 1,962 feet elevation in May and June 1903 (Casey 1913). Casey received these from Francis Huntington Snow, an Agricultural Entomology Professor and later Chancellor, University of Kansas, Lawrence, Kansas. In addition to pioneering research on agricultural insect pests, Snow established the first Entomology Museum in Kansas and became renowned for organizing 26 scientific collecting expeditions throughout Kansas, New Mexico and Arizona between 1876 and 1907 (Hyder 1953).

Cicindela fascinans was then described from a single male specimen from Santa Rosa, Guadalupe County, New Mexico, July 31, 1903, 4,626 feet elevation (Casey 1914). This specimen undoubtedly also had been collected by Snow, or one of several others traveling with him, on the Santa Fe Railroad to Congress Junction, Arizona (Hyder 1953). Casey (1914) appears to have initially considered this specimen only a variety of *C. apicalis* Horn before later describing it as a separate species. Casey (1914) distinguished males of *C. fascinans* from those of *C. globicollis* by differently shaped pronotum, labrum, and lateral elytral band inner margin. *Cicindela fascinans* had a parallel, uniformly wide pronotum, a shorter labrum without a sinuate anterior margin, and a much wider lateral elytral band with a shallowly sinuate interior margin. By comparison, *C. globicollis* had a globose pronotum, longer labrum with an evenly rounded anterior margin, and narrower lateral elytral band with a more deeply sinuate interior margin. Attempts to definitively distinguish these two taxa Casey described led to much uncertainty about their distinctiveness until Willis (1967) studied all described *E. togata* taxa.

Willis (1967) selectively sampled *C. togata* populations throughout its geographical range and numerically analyzed variation in several, external morphological characters, including elytral color, maculation and setal width. He concluded that *C. togata* populations in the central and southern Great Plains from southeast Nebraska to eastern New Mexico presented a cline in these characters and all should be referred to *C. togata globicollis*, thereby placing *C. togata fascinans* in synonym with the former taxon. Although *C. togata* populations at their geographical limits exhibited morphological extremes in elytral color and maculation, Willis (1967) did not formally establish these as separate subspecies. Northern populations, dominated by darker adults with angular interior margins of the lateral elytral bands, were only provisionally recognized as distinct under *C. togata latilabris* (Willis 1967). By contrast, the southwestern population in the Salt Basin, Hudspeth County, Texas, with completely white elytra and white setae covering much of the adult body, had more potential for recognition as a different taxon. Although that population by his analysis was shown to be distinctly different from those he studied elsewhere, Willis (1967) did not consider it represented a different subspecies. His conclusion was based on examining a few specimens from the High Plains at a locality known as Sand, Dawson County, Texas, and found them indistinguishable from those from Salt Basin, Hudspeth County, Texas. Coincidentally, a disjunctive population of a related species also has been found isolated at the Sand locality. Collection records exist there for *Eunota fulgoris albilata* (Acciavatti, 1980), the phenotype of a related species with extensive white elytra predominantly occurring in Salt Basin, Hudspeth County, Texas (Acciavatti 1980).

Almost certainly specimens Willis (1967) studied from Salt Basin had been collected in 1952 by Mont Cazier, renowned cicindelid taxonomist at American Museum of Natural History, New York, based on localities and dates on specimen labels. Although these Salt Basin specimens represent the earliest known examples of the new subspecies described in this paper, neither Cazier nor any other taxonomist recognized their uniqueness until Willis (1967) published his studies. At one or two localities in southeastern New Mexico and west Texas High Plains, certain specimens exist with wide, white maculation covering most of their elytra as mentioned earlier. Elytra of these few adults have a small, dark reddish surface surrounding the scutellum that narrowly extends posteriorly along the suture for no more than half the elytra length. However, most specimens at these localities have noticeably less extensive white elytral maculation with sinuate inner margins to their lateral bands and a large, dark reddish disc forming a distinct posterior lobe on either side of the suture separated from each apex by a wide, white apical band. Unfortunately, Willis (1967) did not analyze *Cicindela togata* populations in Tularosa and Estancia Basins of central New Mexico. His distribution map placed *C. togata* in Estancia Basin, likely based on Rumpp (1961) who misapplied *C. togata fascinans* to that population. Because Willis (1967) concluded that only *E. togata globicollis* should be applied to these populations, all populations within New Mexico were assigned to this subspecies (Acciavatti et

al. 1979). However, more recently *E. togata fascinans* has been reintroduced for populations in western Texas and central New Mexico, but *E. togata globicollis* kept for those in eastern New Mexico (Pearson, et al. 2015).

Currently within Nearctic Geadephaga (Bousquet 2012) and Cicindelinae (Pearson et al. 2015), three *E. togata* subspecies are recognized: *E. togata togata* in lower Rio Grande Valley, along northern coastal Gulf of Mexico from Tamaulipas, Mexico, to northwest Florida, and interior Texas (Acciavatti 1973), with apparently only vagrant temporary populations on Atlantic beaches in South Carolina (Pearson et al. 2015); *E. togata globicollis* in central and southern Great Plains to eastern New Mexico; *E. togata fascinans* in western Texas and central New Mexico. A fourth taxon, *E. togata latilabris*, in central Great Plains has been treated as a synonym of *E. togata globicollis* (Bousquet 2012).

Materials and Methods

Eunota togata specimens throughout its geographical distribution were morphologically compared with types and type locality specimens of described taxa. Original descriptions of all described taxa were examined to establish characters each describing author considered important to differentiate subspecies. *Eunota togata* populations were assigned to subspecies based on several criteria developed by Willis (1967): 1) occurrence limited to a well-defined geographical area, separate from those in other areas; 2) exhibiting uniform expression of characters; 3) readily differentiated by one or more characters from other populations within that species concept.

Adult specimens of *E. togata,* representing four described taxa currently assigned to three subspecies, were imaged for males (Fig. 4–7) and females (Fig. 8–11). No syntypes of nominate *Cicindela togata* (= *E. togata togata*) at National Muséum d'Historie Naturelle, Paris, France (NMHN), were examined; however, specimens were available from its type locality of Cameron County, Texas, established by Bousquet (2012) (Fig. 4, 8). Syntypes of *C. apicalis* (= *E. togata latilabris*) at Senckenberg Deutsches Entomologisches Institut, Müncheberg, Germany (SDEI), were not examined; however, an English translation of its original description (Knaus 1900) and left elytron illustration of a syntypic female (Horn 1938) were available. Additionally, one *C. apicalis* male (Fig. 5) and female (Fig. 9) from its type locality of Kackley, Kansas, from Carnegie Museum of Natural History (CMNH) were examined. Although not part of its original syntypic series, CMNH specimens almost certainly originated with Knaus who distributed them to colleagues in major museums at the time. Based on accession labels on *E. togata latilabris* specimens at CMNH, these colleagues included John Holland, preeminent American Lepidopterist and CMNH Director in 1901, and Henry Klages, an avid beetle collector in the early 1900's associated with CMNH. Fortunately, Casey's syntypes at National Museum of Natural History, Washington, D.C. (NMNH), were available and these examined with designations made of lectotype male (Fig. 6) and paralectotype female (Fig. 10) for *C. globicollis* (= *E. togata globicollis*), as well as holotype male for *C. fascinans* (= *E. togata fascinans*) (Fig. 7). Also shown, for comparison with Casey's types of these taxa, is a non-syntypic *C. fascinans* female (Fig. 11) from its type locality of Santa Rosa, Guadalupe County, New Mexico.

Additional *E. togata* study specimens were examined from these USA collections: Section of Invertebrate Zoology, Carnegie Museum of Natural History, Pittsburgh, Pennsylvania (CMNH); American Museum of Natural History, New York, New York (AMNH); University of Kansas Biodiversity Institute Natural History Museum, Lawrence, Kansas (KUNHM); Entomology Research Collections, University of Nebraska State Museum, Lincoln, Nebraska (UNSM); C. Barry Knisley Collection, Crozier, Virginia (CBKC); David Brzoska Collection, Naples, Florida (DBC); Stephen Spomer Collection, Lincoln, Nebraska (SSC); John Stamatov Collection, Armonk, New York (JSC). Images of *E. togata* specimens were provided by University of Alberta, E. H. Strickland Entomological Museum (UASM), Edmonton, Alberta, Canada. Data for *E. togata* specimens from Symbiota Collection of Arthropods Network website (SCAN 2020) provided locality records deposited at Colorado State University, C.P. Gillette Museum of Arthropod Diversity (CSUC), Ft. Collins, Colorado, USA.

High-resolution adult and genitalia images obtained with Synchroscopy Auto-Montage© attached to a Leica Stereomicroscope were processed with Paint Shop Pro© and Photo Formatting software on a Gateway© personal computer. Type labels imaged with a Nikon E2100 digital camera were similarly processed. High-altitude aerial images of type localities and ancillary locations for subspecies were obtained from Google Maps© and source credits on their bottom margins were provided by ©2020 Google.

Results

Systematic Zoology

Class Insecta Linnaeus, 1758
Order Coleoptera Linnaeus, 1758
Suborder Adephaga Schellenberg, 1806
Family Cicindelidae Latreille, 1802
Tribe Cicindelini Latreille, 1802
Genus *Eunota* Rivalier, 1954

Eunota togata togata (LaFerté-Sénectère, 1841)

Cicindela togata LaFerté-Sénectère 1841: 40.

Type status. Syntype(s) [unexamined; concept based on specimens from Port Isabel, Cameron County, Texas, at CMNH]. *Type depository*. Syntype(s) at Muséum National d'Historie Naturelle, Paris (Chaudoir Collection) (Bousquet 2012). *Type locality*. Port Isabel, Cameron County, Texas [established by Bousquet (2012)]. *Type locality note*: This taxon type locality (Fig. 42, 50) is herein fixed at a site among estuaries west of Port Isabel, Cameron County, Texas, with these GPS coordinates: 26.0410, –97.2603, 2m. *Habitat*: Salt encrusted soils in openings along margins of estuary pools.

Eunota togata (LaFerté-Sénectère, 1841): [(Rivalier 1954: 259) new generic assignment].

Cicindela togata togata LaFerté-Sénectère, 1841: [(Bousquet and Larochelle 1993: 66) assigned as nominotypic subspecies of *C. togata* LaFerté-Sénectère, 1841].

Eunota togata togata (LaFerté-Sénectère, 1841): [(Bousquet 2012: 309) reassigned as nominotypic subspecies of *E. togata* (LaFerté-Sénectère, 1841)].

Eunota togata latilabris (Willis, 1967), new status

Cicindela togata var. *apicalis* Horn 1897: 17: [(Bousquet and Larochelle 1993: 66) as primary homonym of *Cicindela apicalis* Chaudoir, 1843].

Type status. Syntypes (1♀, other ♂♀ not enumerated) (Döbler 1973; Bousquet 2012) [unexamined; concept based on specimens from Kackley, Kansas, collected by Knaus at CMNH]. *Type depository*. SDEI [formerly DEI, Eberswalde], Germany (Döbler 1973; Bousquet 2012). *Type locality*. Kakley (sic), Kansas [Kackley, Republic County]; Nebraska [in original description]. *Type locality note*: This taxon type locality (Fig. 43, 50) is herein fixed at a site within a salt marsh surrounding a small pond southwest of Kackley, Republic County, Kansas, with these GPS coordinates: 39.6897, –97.9281, 426m. This salt marsh is along Saint John's Creek within Jamestown, Kansas, Wildlife Management Area. *Habitat*: Small openings with bare, salt encrusted soils around small pond within salt marsh at type locality.

Cicindela togata latilabris Willis, 1967: [(Willis 1967: 286) replacement name for *C. togata apicalis* Horn, 1897].

Cicindela togata latilabris Willis, 1967: [(Bousquet and Larochelle 1993: 66) assigned as synonym of *C. togata globicollis* (Casey, 1913)]

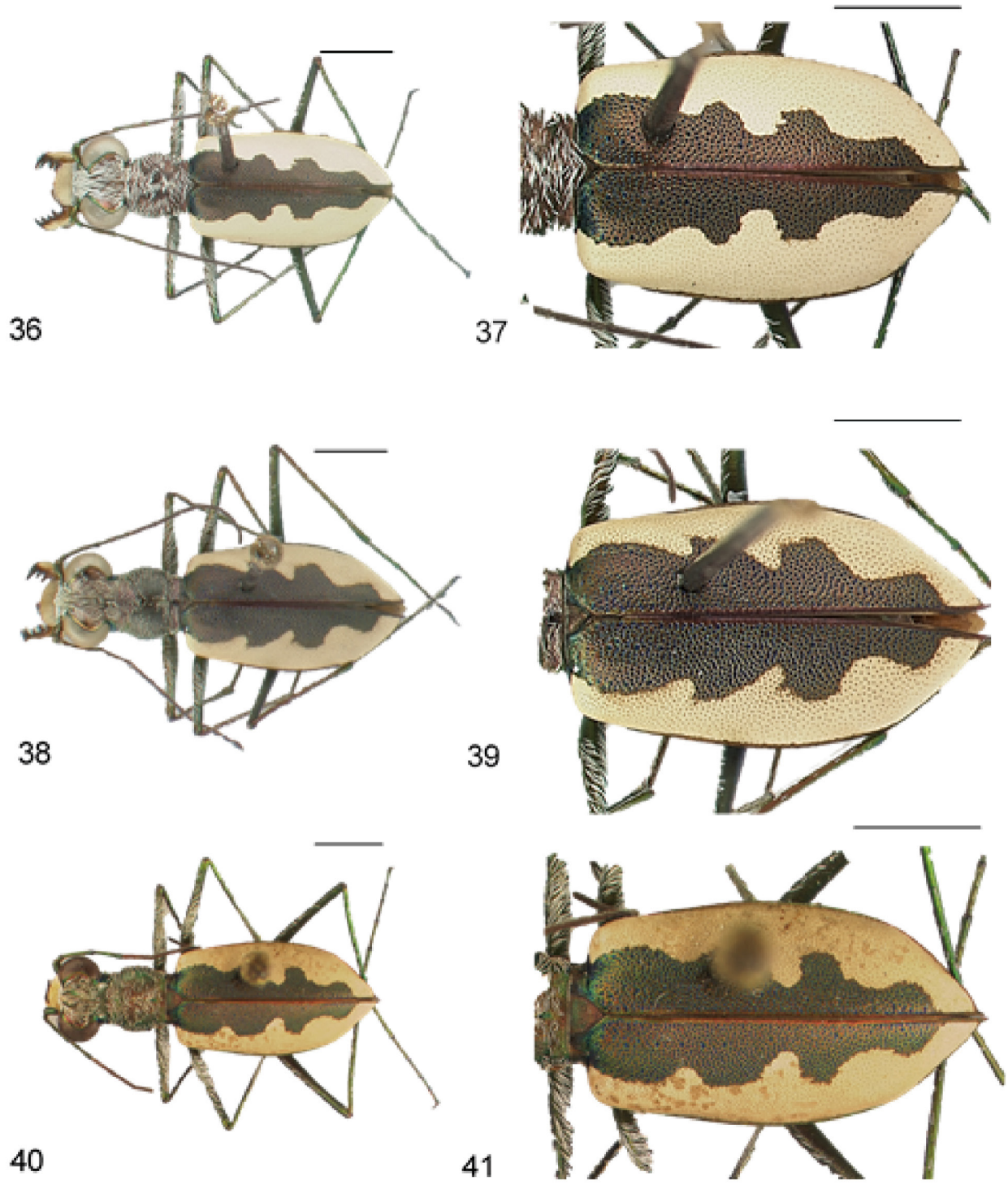
Eunota togata latilabris (Willis, 1967): [(Bousquet 2012) assigned as synonym of *E. togata globicollis* (Casey, 1913)].

Eunota togata globicollis (Casey, 1913)

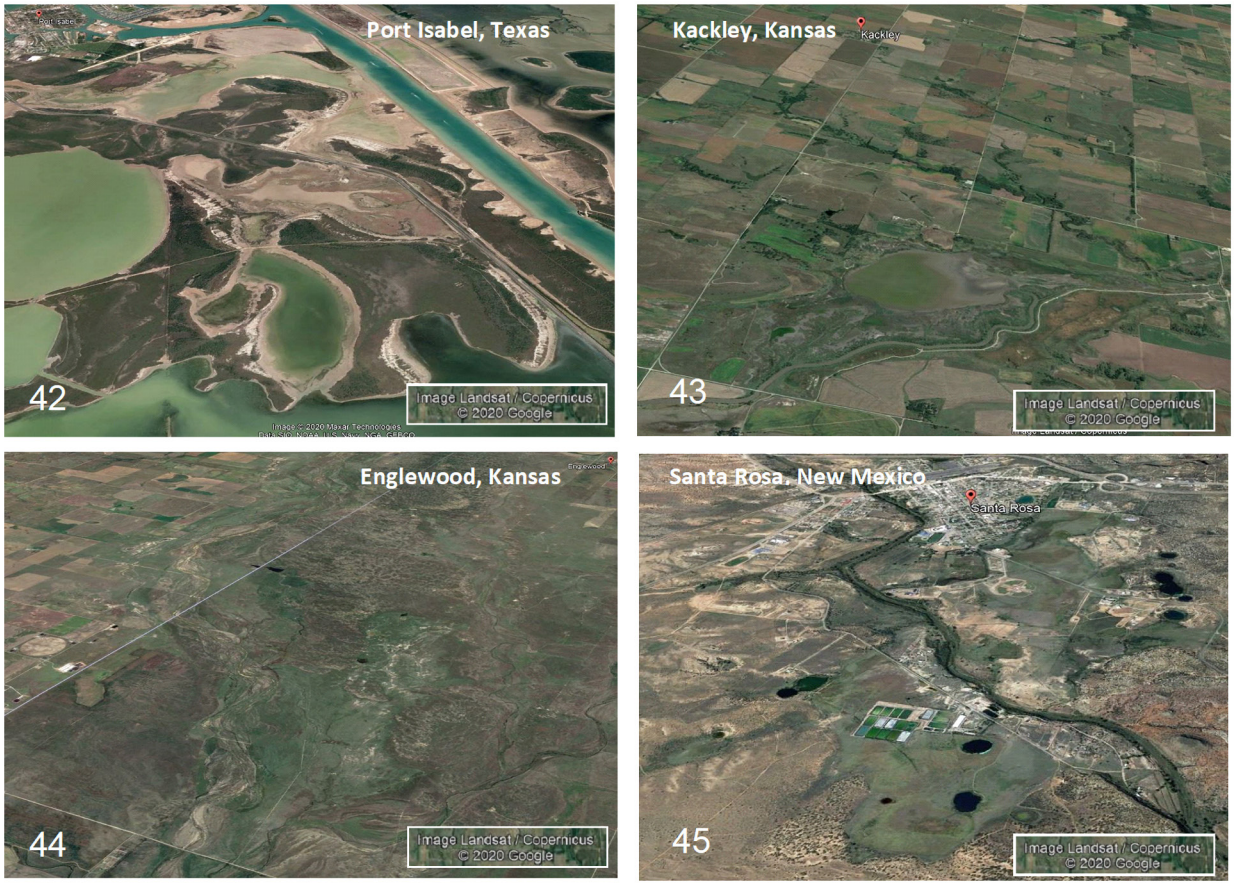
Cicindela globicollis Casey 1913: 35.

Type status. LECTOTYPE, male (Fig. 6) [by present designation].

Type labels. "Clark Co. Ks / June 1962 ft. / FH Snow"; "59 var. / apicalis"; "globicollis / Csy."; "CASEY / bequest / 1925";"TYPE USNM / 45952"; "LECTOTYPE / Cicindela /globicollis / Casey by/R.E.Acciavatti,'14"; "Eunota / togata / globicollis (Casey) / det.R.E.Acciavatti,'14" [formats of labels in Fig. 6]. Paralectotypes, one female (Fig. 10), one male [here designated], each labelled with locality label, Casey determination, Casey bequest, TYPE USNM, paralectotype and determination labels similar to lectotype. *Type depository*. Lectotype and two paralectotypes at NMNH, Washington, D.C., USA. *Type locality*. Clark County, Kansas, [in original description]. *Type locality note*: Based on a small series of specimens at KUNHM, collected by Professor Snow and associates with same lectotype label data, this taxon type locality (Fig. 44, 50) is herein fixed at a Cimarron River site east of Englewood, Clark County, Kansas, with these GPS coordinates: 37.0370, –99.7784, 565m. This site adjoins an Oklahoma state boundary shown as a blue line running diagonally near left side of Fig. 44. *Habitat*: Salt encrusted soils of marshy riverine margins.



Figures 36–41. *Eunota togata* subspecies male elytral maculation patterns from coastal Texas, southeast Nebraska, and northcentral Kansas. *E. t. togata* from Cameron Co., Texas. **36)** Adult dorsal habitus. **37)** Adult elytra. *E. t. latilabris* from Lancaster Co., Nebraska. **38)** Adult dorsal habitus. **39)** Adult elytra. *E. t. globicollis* from Stafford Co., Kansas. **40)** Adult dorsal habitus. **41)** Adult elytra. Scale lines = 2 mm.



Figures 42–45. *Eunota togata* described taxa type localities. **42)** *E. t. togata*, TL: Port Isabel, Cameron Co., Texas; coastal saltwater estuaries. **43)** *E. t. latilabris*, TL: Kackley, Republic Co., Kansas; salt marsh and brine pond on Saint John's Creek. **44)** *E. t. globicollis,* TL: Englewood, Clark Co., Kansas; saline banks of Cimarron River. **45)** *E. t. fascinans*, TL: Santa Rosa, Guadalupe Co., New Mexico; saline soils from freshwater ponds above Pecos River.

Cicindela togata globicollis Casey, 1913: [(Bousquet and Larochelle 1993: 66) assigned as distinct subspecies of *C. togata* LaFerté-Sénectère, 1841].

Eunota togata globicollis (Casey, 1913): [(Bousquet 2012: 309) assigned as distinct subspecies of *E. togata* (LaFerté-Sénectère, 1841)].

Cicindela fascinans Casey, 1914, new synonymy

Cicindela fascinans Casey 1914: 23.

Type status. HOLOTYPE, male (Fig. 7) [by monotypy]. *Type labels.* "Santa Rosa / 7/31/03 N.M. / 4626 ft"; "fascinans/ Csy."; "CASEY / bequest / 1925"; "TYPE USNM / 45953"; "HOLOTYPE / by monotypy / in original / description"; "Cicindela / fascinans / Casey seen by / R.E.Acciavatti,'14"; Eunota/togata / fascinans (Casey) / det.R.E.Acciavatti,'14" [formats of labels in Fig. 7]. *Type depository*. USNM, Washington, D.C., USA. *Type locality*. Santa Rosa, [Guadalupe County] New Mexico [in original description]. *Type locality note*: This taxon type locality (Fig. 45) is herein fixed at site associated with several small, fresh water, artesian ponds created by collapsed sink holes south of Santa Rosa, Guadalupe County, New Mexico, above Pecos River with these GPS coordinates: 34.9118, −104.6695, 1400m. *Habitat*: Bare, salt encrusted soils developed downslope by water seepage from small ponds.

Cicindela togata fascinans Casey, 1914: [(Willis 1967: 286) considered a junior synonym of *C. togata globicollis* Casey, 1913].

C. togata fascinans Casey, 1914: [(Bousquet and Larochelle 1993: 66) removed from synonymy with *C. togata globicollis* Casey, 1913].

Eunota togata fascinans (Casey, 1914): [(Bousquet 2012: 309) assigned as distinct subspecies of *E. togata* (LaFerté-Sénectère, 1841)].

Eunota togata leucophasma, new subspecies

Diagnosis. This new subspecies can be distinguished from *E. togata globicollis* (Casey) occurring in western Texas and New Mexico as follows: 1) small body size; 2) large, elongate white labrum with 4–8, erect submarginal setae, medial four grouped in pairs (most specimens with six); 3) head nearly flat on dorsum with large eyes only slightly prominent dorsally, but extremely bulging laterally; 4) white decumbent setae densely covering nearly all exposed body segments except ventrally on head and medially on metathorax and abdomen; 5) decumbent setae wide and elongate; 6) third and four male antennomeres with numerous white, decumbent setae in addition to erect sensory setae; 7) legs with long femurs, tibiae and tarsi, posterior legs extremely long, especially those of males; 8) elytra in nearly all specimens completely white except for narrow, metallic copper suture, in a few specimens copper color is expanded slightly around scutellum.

Description. *Body sizes*. Holotype, male (Fig. 12–16), elytral apex to labrum 10.5 mm, elytra at widest point 3.4 mm. Allotype, female (Fig. 18–22), elytral apex to labrum 12.0 mm, elytra at widest point 3.6 mm. Paratypes, body lengths, males 8.0–10.7 mm; females 9.0–12.2 mm. *General habitus*. Body dorsally mostly white; dense wide decumbent white setae cover most of head, sparser on pronotum; elytral surface almost completely white; body ventrally metallic copper green, pleura and sterna almost entirely obscured by dense wide decumbent white setae. *Head.* Mandibles moderately long, four teeth beyond large basal molar, proximal three teeth of similar size and acutely angled, apical tooth large, long, distinctly curved downward, most prominently in male; lateral outer margins ivory, all teeth dark brown black, one to a few decumbent white setae near mandible base on some specimens. Labrum ivory, large, anterior labral margin with a small medial tooth flanked by a slight to prominent bulge on each side; six to eight thin erect submarginal setae, middle four paired on either side of medial tooth, one to several white decumbent setae medially on some specimens of both sexes; clypeus, frons, genae obscured by dense decumbent white setae; vertex with sparser decumbent white setae; small areas laterad of antennal insertions and mesad of eyes glabrous; large areas behind eyes and ventrally on head glabrous; antennal scape with a single sensory seta (rarely a second seta present), proximal third and fourth antennomeres with decumbent white setae (besides primary erect setae) in clusters near distal ends in most males, these setae sparse or lacking in some male, and completely absent in all females; eyes only slightly prominent dorsally, but extremely bulging laterally; maxillary and labial palpi testaceous except for a dark apical segment on both sexes. *Prothorax.* Pronotum subquadrate and globose in dorsal profile, widest at middle with lateral margins uniformly arcuate; anterior and posterior sulcus shallowly grooved; dorsally with moderately wide decumbent white setae covering nearly all of surface and oriented mostly transversally, setae denser at margins and along a central band, setae sparser on each side of center; surface finely rugose with copper reflections centrally becoming mostly green laterally; proepisterna entirely covered with dense wide decumbent white setae oriented dorsoventrally; surface finely rugose with copper reflections. *Pterothorax.* Laterally all sclerites entirely covered with dense wide decumbent white setae oriented dorsoventrally; surface finely rugose with copper reflections; female coupling sulcus of mesepisterna forming a deep pit near its dorsal margin barely visible under dense decumbent white setae. *Elytra*. Dorsal surface smooth, completely white except for narrow, metallic suture and wider metallic area at extreme inner angles adjoining scutellum; epipleura pale with scattered white decumbent setae basally; apices microserrulate. *Abdomen.* Male with anterior six sterna almost entirely covered with dense white decumbent setae and terminal sternite pale brown with scattered setae; females with anterior four sterna almost entirely covered with dense white decumbent setae and terminal two sternites non-metallic dark purple black with scattered setae. *Legs*. Trochanters pale and covered with decumbent white setae, anterior two pairs with an erect subapical setae, posterior pair glabrous; femurs and tibiae covered with white, decumbent setae. *Male genitalia.* Fig. 2. Slim, elongated aedeagus body of nearly uniform width throughout most of its length except for narrow, right-angled basal section, and abruptly tapered distal section with a distinctive arcuate tip bent upward and more sclerotized on outer margin than most of its body; internal sclerites small in size, few in number, concentrated near middle at base of outer half of aedeagus, comprised of a hollow curved tubular flagellum, a thin transverse sclerite, a larger shield, and two needle-like structures.

Remarks on genitalia. For comparison, Fig. 1–3 each show a male aedeagus representative of three *Eunota togata* subspecies at their geographical limits: 1) Fig. 1—*E. togata togata*, Los Olmos, Kleburg Co., Texas; 2) Fig. 2—*E. togata leucophasma*, new subspecies, Salt Flat, Hudspeth Co., Texas; 3) Fig. 3—*E. togata latilabris*, Lincoln,

Lancaster Co., Nebraska. With only slight differences observed in each aedeagus for internal sclerites and their apical tips uniformly sized and shaped, it can be concluded that these three described taxa represent a single species.

Primary types. Holotype, male, labeled (Fig. 17), "TEXAS, Hudspeth Co. / Salt Flat / 6-IX-1976 / Howard P. Boyd" (black typeset), "HOWARD BOYD / COLLECTION / Acc. 35,563" (black typeset), "Eunota togata / fascinans / (Casey) / det. R. Acciavatti" (black typeset), "HOLOTYPE / Eunota / togata / leucophasma / Acciavatti" (red label with black typeset). Allotype, female, labeled (Fig. 23), same label data and format as holotype, also labeled "ALLOTYPE / Eunota / togata / leucophasma / Acciavatti" (red label with black typeset). Three paratypes (2♂1♀) (CMNH) with same label data as holotype, also labeled "PARATYPE / Eunota / togata / leucophasma / Acciavatti" (blue label with black typeset).

Paratypes: Ninety-seven additional paratypes, each labeled with "PARATYPE / Eunota / togata / leucophasma / Acciavatti" (blue label with black typeset), and locality, collector, quantity by sex, and source collection, are listed chronologically within Texas and New Mexico by county as follows: *TEXAS:* "Salt Flat, Tex. / Hudspeth Co. / VIII-19-1952", "M. Cazier / R. Schrammel", "Cicindela/togata globicollis / Casey / det. H. L. Willis,1965" (6♂2♀)(AMNH); "TEXAS: Hudspeth Co., Salt Flat, 3400 ft., 28 August 1973, TX-5, R.R. and M.E. Murray" (1♀) (CMNH); "TEXAS Hudspeth Co. / 6 mi. E. Dell City at / Salt L. 21-VII-1974", ″W.A. Iselin / Collector" (1♂) (CMNH); "US: TEXAS/ Hudspeth Co. / Salt Flat at black / light 17-VI-1975 / W.A. Iselin, leg." (1♂3♀)(CMNH); "TEXAS Hudspeth / Co, Salt Flat / 11-VIII-1975", "alkali lake shore / leg. J. Stamatov" (2♂3♀)(JSC); "TEXAS Hudspeth Co. / 2 mi. E. Dell City at / blk. light 15-VIII-1976 / W.A. Iselin, leg." (4♂)(CMNH); "TEXAS Hudspeth / Co. Salt Flat / 6-IX-1976", "alkali mud flat / leg. J. Stamatov" (1♂5♀)(JSC), "USA TEXAS / Hudsbeth [*sic*] Co. / Salt Flat / 18-VIII-1978 / Coll. J. Stamatov" (1♂)(JSC); "TX Hudspeth Co. / HY.62-5mE-Salt Flat / D. Brzoska 25-VIII-1979" (3♀)(DBC); "TX, Hudspeth Co. / 5 mi. E Salt Flat / 9 VIII /81 / Col. C.B. Knisley" (1♀)(CBKC); "TX. Hudspeth Co. / Salt Flat / 27 July 1985 / J. Glaser" (3♂5♀) (CMNH); "USA: Texas: Hudspeth Co. / Salt Flat, 1-VIII-1985 / J. Stamatov Collector" (1♂) (JSC), "TX. Hudspeth Co. / Salt Flat / 2 Aug 1985 / J. Glaser" (3♂1♀) (CMNH); "TX- Hudspeth Co. / HY.62-5mE-Salt Flat / D. Brzoska 16-IX-1986" (3♂1♀)(DBC); "TEXAS Hudspeth Co. / 15 IX 1986 / Coll. J Stamatov" (2♂5♀)(JSC); "TX- Hudspeth Co. / HY.62-5mE-Salt Flat / D. Brzoska 20-VIII-1987" (2♂4♀)(DBC); "TEXAS Hudspeth Co. / 7 mi. E Salt Flat / 19 VII 1992 / Coll. J. Stamatov" (1♀) (JSC); "USA:TX- Hudspeth Co. / HY.62-7mW-Salt Flat / D. Brzoska 22-VII-1993" (1♂)(DBC); "TX: Hudspeth Co. / 5 mi. E. of Salt Flat / 2 Sept. 1994 / leg. S.M. Spomer" (1♂1♀) (SSC); "USA:TX HUDSPETH CO. / HY.62-5mE-Salt Flat / 31°45′31"[N];104°38′97″W / D. Brzoska 9-VIII-1997" (2♂1♀)(DBC); "TEXAS: Hudspeth / Co.,9 km E of Salt / Flat, Rts. 62/180 / at pull off, 9-VIII- / 2005, C.B. Knisley" (4♂6♀)(CBKC); "TEXAS: Hudspeth /Co., E of Dell City, / Linda Lake, So. of / State Line Rd., 4-/ VIII-2005, Knisley" (1♀) (CBKC); "TEX. Hudspeth Co. / 5mi.E Salt Flat / 5-VII-1971 / Lawton/Willis" (1♀) (KUNHM). *NEW MEXICO:* "NM, Doña Ana Co. / White Sands MR / 1 km W of Lake Lucero / 27-VII-2000 / Col. Knisley, Hill" (1♂)(CBKC); "NM – Otero Co. / Hy.70 – mm 20 / D. Brzoska 17-IX-1988" (1♀)(DBC); "USA:NM – Otero Co. / 9 m SW, 4.5 m E- / Alamogordo (off Hy.82) [actually off Hy.70] / D. Brzoska, 17-VII-1993" (1♂1♀)(DBC); "USA:NM OTERO CO. / 4m E Hy.70 @ mm 202 / (SE [actually SSW] Alamogordo) / 32°44′05"[N]; 106°08′24″W / D. Brzoska 10 -VIII-1997" (1♂)(DBC); "NM, Otero Co. / White Sands MR / Target Salt Lake, RR 6 / 27-VIII-2000 / Col. Knisley, Hill" (2♂2♀)(CBKC); "NEW MEXICO: Otero Co. / 8miSE Cienega,6.7miE / TX 1576 at TX/NM Line / 32°00.29′N; 104°59.75′W, 1118m, 8 August 2001 / bare alkali flat, uv / light, S.M. Clark / Robert E. Acciavatti" (2♂1♀)(CMNH).

Type locality. Texas: Hudspeth County, 9 km E Salt Flat, Texas, along US 62/US 180 (Fig. 46). Type locality is 1105 meters above sea level with latitude 31°45′15.7″N and longitude 104°59′25.35″W at 28.5 km southeast of Dell City, Texas. Type locality GPS mapping coordinates are 31.7525, −105.0158. This site lies centrally in Salt Basin, a conspicuous geographic feature of northeastern Hudspeth County, Texas, and southeastern Otero County, New Mexico, as a large Pleistocene lake remnant, sustained with aquifers and surface flooding.

Type locality note. Site is located between Salt Flat, Texas, and eastern edge of large, white salt flat along major east-west, paved highway downslope from agricultural irrigation circles on right side of Fig. 46. Type locality is accessible from a roadside pull-off and parking area on north side of US 62/US 180. Although this specific locality was chosen as its type locality, this new subspecies undoubtedly occurs throughout Salt Basin for it has been collected at several accessible saline and alkali habitats there. One such site in northern part of Salt Basin lies in

Figures 46–49. *Eunota togata leucophasma*, new subspecies, type locality (TL), paratype locality (PTL), ancillary locality (AL), intergrade locality (IL). **46)** *E. t. leucophasma*, new subspecies, TL: Salt Flat, Hudspeth Co., Texas; expansive salt flats in Salt Basin. **47)** *E. t. leucophasma*, new subspecies, PTL: Alamogordo, Otero Co., New Mexico; salt ponds east of US 70 in Tularosa Basin. **48)** *E. t. leucophasma*, new subspecies, AL: Willard, Torrance Co., New Mexico; alkali lake complex of Laguna del Perro, Estancia Basin, Willard, New Mexico. **49)** *E. t. globicollis* X *E. t. leucophasma*, new subspecies, intergrade: IL: O'Donnell and Tahoka, Lynn Co., Texas: alkali lakes on Llano Estacado (Staked Plains) in High Plains of western Texas.

Otero County, New Mexico, east of Dell City, Texas, just north of Texas/New Mexico State Boundary in upper left of Fig. 46.

Paratype localities. New Mexico: Doña Ana County, Lake Lucero; New Mexico: Otero County, salt ponds along and east of US 70 southwest of Alamogordo (Fig. 47); New Mexico: Otero County, Salt Target Lake, White Sands Missile Range.

Geographical variation. *Eunota togata leucophasma*, new subspecies, populations occur in Torrance County, New Mexico, east of Willard at the salt and alkaline lakes complex (Laguna del Perro) within Estancia Basin, and at Laguna Encino and smaller lakes in Encino Basin to the east (Fig. 48). Individuals from these populations are not considered paratypes because a majority lack completely white elytra (Fig. 24, 25); rather their dark elytral color becomes narrowly expanded along the suture except the posterior quarter is covered by white maculation so no dark posterior lobe is evident, traits typical of specimens in Estancia Basin.

Type depositories. Holotype at CMNH; allotype and 25 paratypes at CMNH; remaining paratypes distributed as follows: 8 paratypes to AMNH; 1 to KUNHM; 2 to UASM; 1 to UNSM; 2 to SSC; 17 to CBKC; 21 to DBC; 21 to JSC.

Etymology. This feminine singular subspecific name, *leucophasma*, combines Latin *leukos* and *phasma*, both derived from Greek λευκός and φάσμα, signifying "white" and "phantom or apparition." Subspecies name refers to adult appearance from their extensive white elytra and decumbent setae covering almost all body segments and legs, thereby, making them appear as brilliant, white ghostly forms running over white-encrusted, dry soil surfaces of their habitat.

Habitats. *Eunota togata* adults occur on a variety of habitats associated with saline and alkaline soils. Label data on *E. togata leucophasma*, new subspecies, types indicate this subspecies was collected from bare alkali flat, alkali lake shore, and alkali mud flats. Published habitat records for other populations of *E. togata* in New Mexico include damp alkaline flats of an alkaline sink at Laguna del Perro, Torrance County, NM (Lawton and Willis 1974; Johnson 1975a, 1975b).

Adult behavior. *Eunota togata* adults are gregarious and occur in large numbers during peak emergence in suitable habitats, especially on damp substrates along edges of ponds and ditches with water. Adults are wary during daylight hours and when disturbed run in a zig-zag pattern before taking flight, often for moderate distances. Notable is their presence in these open, hot substrates during the day while co-occurring species seek shade under vegetation. During hours of darkness, *E. togata* adults are attracted to ultraviolet wavelengths from fluorescent tubes, as well as, visible wavelengths from lanterns. Adults around these light sources often remain motionless for short periods, allowing this behavior to be exploited to capture specimens.

Geographical distribution. *Eunota togata leucophasma*, new subspecies, is confined to Salt Basin of west Texas into adjoining New Mexico and Tularosa Basin and Estancia Basin of central New Mexico (Fig. 50). Intergrade populations between *E. togata leucophasma*, new subspecies, and *E. togata globicollis* exist in central Pecos River

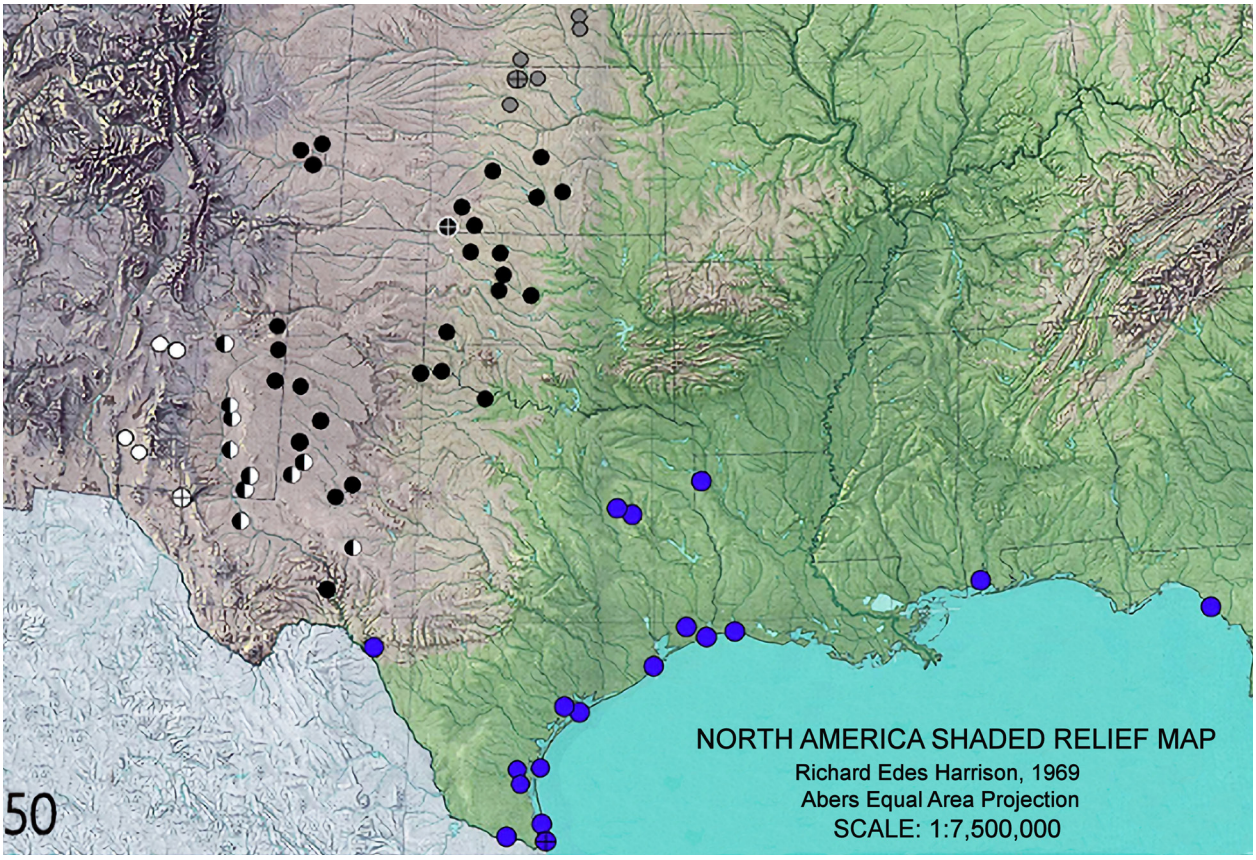


Figure 50. *Eunota togata* geographical distribution in the United States from study specimens. ● = *E. t. togata*; ● = *E. t. latilabris* ; ● = *E. t. globicollis* ; ○ = *E. t. leucophasma*, new subspecies; ◐ = *E. t. globicollis* × *E. t. leucophasma*, new subspecies, intergrade. ⊕ = type locality of each subspecies.

Valley of eastern New Mexico and at several locations in Permian Basin of southeastern New Mexico and western Texas. Other populations of this species in western Texas and eastern New Mexico are assignable to *E. togata globicollis*.

Comparison with other *Eunota togata* subspecies. Detailed collection data for *E. togata* examined from western Texas and New Mexico specimens are in Appendix 1. As stated previously, not all *E. togata* specimens from populations within western Texas and eastern New Mexico are taxonomically assigned to either *E. togata leucophasma*, new subspecies, or *E. togata globicollis*; rather, these represent intergrade populations between these two subspecies. Assigning populations to either subspecies, or giving them intergrade status, was based on defining elytral maculation characteristics for each subspecies. *Eunota togata leucophasma*, new subspecies, adults have only these maculation characteristics: 1) white maculation entirely covering each elytron or wide without distinct sinuate inner edge and occasionally with small white mark extending toward scutellum; 2) dark surface color limited to anterior area around scutellum and along suture, but never forming a rounded lobe along suture projecting posteriorly into white band across posterior elytral margins. *Eunota togata globicollis* adults have several maculation characteristics: 1) white maculation as a lateral band with sinuate inner edge and three obvious bulges projecting inward onto dark disc surface; 2) dark surface color forming a distinct lobe or narrow projection extending posteriorly along suture into the white band across posterior elytral margins. Intergrade populations between these two subspecies have adults with both types of elytral maculation.

Application of these elytral maculation characteristics provide the following assignments for several populations in New Mexico and western Texas. *Eunota togata leucophasma*, new subspecies (Fig. 24, 25) occurs in Torrance County, New Mexico, around numerous salt and alkaline playas of Estancia Basin. The playa complex in the foreground of Fig. 48 is known as Laguna del Perro, whereas Laguna Encino and smaller playa lakes appear in the distance. Intergrade specimens between *E. togata globicollis* X *E. togata leucophasma*, new subspecies, (Fig. 26–29) occur at several locations: Bitter Lake and Bottomless Lakes, Chaves County, New Mexico; Laguna Plata, Lea County, New Mexico; Shafter Lake, Andrews County, Texas; unnamed lake near O'Donnell, in Lynn County, Texas. Intergrade status is suspected for populations occurring around several small, alkali lakes on Llano Estacado (Staked Plains) in High Plains of western Texas, such as those found around Tahoka, Lynn County, Texas (Fig. 49). Regrettably, specimens from these sites were absent from collections borrowed for study likely due to accessibility issues because these lakes are located on privately owned ranches. An intergrade population of *E. togata globicollis* and *E. togata togata* from Reeves County, Texas, has been recorded based on intermediate position of sutural spine on elytra for some females (Willis 1967). Although this variant has been seen on specimens, most specimens exhibit elytral maculation typical of intergradation between *E. togata globicollis* and *E. togata leucophasma*, new subspecies; thereby making it reasonable to conclude this population represents an intergrade between these two subspecies rather than as Willis (1967) reported.

Identification Key to *Eunota togata* subspecies

1. Elytra entirely white on most specimens; colored disc surface when present confined to suture and small area at its extreme base surrounding scutellum, at most narrowly extended partway along suture, never extended broadly into apical quarter as a posterior lobe; white decumbent setae wide and dense, noticeably obscuring metallic surface color on head, all pleura and sterna; basal antennomeres with a few to several scattered wide, white setae in addition to narrower sensory spines; west Texas and central New Mexico . . . . . ***E. togata leucophasma*, new subspecies**

— Elytra white only along lateral margins; colored surface dark brown or coppery brown or green on all specimens; maculation forming bands with sinuate inner margins bulging onto dark disc surface in several places; colored disc surfaces on each elytron joined along suture in apical quarter to form a broadly rounded posterior lobe ending at white apical margin; white decumbent setae narrow and dense, noticeably exposing metallic body color on head, all pleura and sterna; basal antennomeres with only sensory spines **2**

2(1). Elytral maculation forming bright, creamy-white, wide bands with inner margins extending beyond middle of disc; inner margins of bands with several broadly rounded bulges protruding onto shiny elytral disc; surface metallic copper or green to shiny brown (in both live and dead specimens) . . . **3**

— Elytral maculation forming dull, dirty-white, narrow bands confined to lateral third with inner margins ending at or before middle of disc; inner margins of bands with anterior two bulges small, middle one acutely narrowed and reduced in size or absent on some specimens, posterior bulge broadly rounded, all protruding onto dull elytral disc; surface olive green (in live specimens) to dark brown (in dead specimens); north central Kansas to southeast Nebraska. . . . . ***E. togata latilabris* (Willis), new status**

3(2). Body dorsally with elytral surface and pronotum metallic coppery red, occasionally with contrasting green reflections on head and prothorax; prothorax globose; punctures on elytral disc discrete, small, width less than interval between each, often aligned transversely; elytral apices each shallowly rounded in female, shallowly conjoined in male; female elytral sutural spine positioned close to each separately rounded apex; eastern New Mexico and western Texas eastward to central Oklahoma and central Kansas . . . . . ***E. togata globicollis* (Casey)**

— Body dorsally with elytral surface and pronotum shiny brown to coppery brown to green; prothorax subquadrate; punctures on elytral disc granulate, wide, width equal to interval between each, formed into a network; elytral apices each broadly rounded in female, acutely conjoined in male; female elytral sutural spine greatly retracted anteriorly along each separately rounded apex; Gulf Coast Texas to Florida, and Tamaulipas, Mexico . . . . . ***E. togata togata* (LaFerté-Sénectère)**

Discussion

Geological history of Permian Basin and its influence on *E. togata* habitats. Differential salt deposition in the extensive Permian Basin of western Texas and New Mexico influenced development of the variety of saline sediments found beneath that basin (Keller et al. 1980). It is hypothesized that differences in these sediments influenced surface saline habitats which over time influenced evolution of two *E. togata* subspecies found in different parts of that basin. The Permian Basin includes Salt Basin in Texas and New Mexico on its western margin, as well as the large Delaware Basin in southeastern New Mexico and western Texas, and the even larger Midland Basin in west Texas (Keller et al. 1980). Voluminous salt sediments from shallow, inland seas began accumulating to different depths in Salt Basin compared to Delaware Basin during the Permian Period and continued to be differentially built up within more recent Pliocene and Pleistocene Epochs creating the thickest salt deposits in Salt Basin (Keller et al. 1980). Thicker deposits would likely be less deleted by rain and wind erosion over time, and consequently such extensive salt deposits would have been continuously exposed at the surface to create and maintain white, saline and alkali soils throughout long time periods. During these later two epochs, a higher Permian Basin Central Platform developed dividing Delaware and Midland Basins (Keller et al. 1980). Not only did this higher platform receive much less salt deposition than surrounding deeper basins, but also over time wind continually eroded these thinner platform salt deposits to form the elevated and flattened Llano Estacado (Staked Plains) on the High Plains of western Texas. Wind erosion consequently reduced exposed salt deposits making them less extensive and not as persistent in this uplifted portion of Permian Basin compared to salt deposits found farther west along former shallow interior sea estuaries within Salt and Delaware Basins themselves. The extent of salt deposits and resulting saline soil types in various parts of the Permian Basin are postulated to have favored survival of the varied *E. togata* phenotypes in western Texas and New Mexico (Fig. 50): 1) *E. togata leucophasma*, new subspecies, in large, white, saline soil habitats; 2) *E. togata globicollis* in small, dark, saline soil habitats; 3) intergrade populations between these two taxa sporadically found in certain smaller, isolated, saline localities.

Evolution of *E. togata* in western Texas and New Mexico in large, white, saline soil habitats. Mostly white *E. togata leucophasma*, new subspecies, is hypothesized to have evolved in expansive, white saline habitats maintained by deep Permian Period salt deposits in large, intermountain basins of internal drainage in this arid part of Southwest North America. Presently, *E. togata leucophasma*, new subspecies, is restricted to three intermountain basins: 1) Salt Basin of Hudspeth County, Texas, and Otero County, New Mexico; 2) Tularosa Basin of Doña Ana and Otero Counties, New Mexico; 3) Estancia and Encino Basins, Torrance County, New Mexico (Fig. 50). Willis (1967) considered *E. togata* precursors had a widespread distribution in southern North America during

late Tertiary Period or Pleistocene Epoch. It is suggested here that this subspecies diverged while isolated around evaporating lakes in these basins. Isolation resulted from reduced dispersal opportunities for adults confined to shrinking habitats under gradually drier climatic conditions in the Southwest creating remnant alkaline and salt lakes which still exist in these basins. Within Salt Basin, expansive, white, salt flats with numerous smaller depressions (Fig. 46) are all that remain of a large Pleistocene lake (Kreitler and Sharp 1990). Most of this lake has evaporated except for a small, intermittent remnant, Lake Lucinda, at its lowest elevation situated centrally along its western edge. Salt Basin is recharged by artesian subsurface flow from aquifers hydrologically recharged by water originating to the east in the Guadalupe Mountains and Pecos River (Kreitler and Sharp 1990). Dissolved salts deposited on the surface have accumulated to form deep, horizontal saline and gypsum layers. The flat surface layers become periodically inundated by summer thunderstorms, but surface water is only temporary as it readily evaporates due to prevailing high temperatures and constant windy conditions. Much of Salt Basin at present consists of expansive, bare to sparsely vegetated salt flats, interconnected by former lake bottoms of varied dimensions, all of which become covered with white, saline and gypsum deposits during frequent extended dry periods (Kreitler and Sharp 1990). Similarly, Tularosa Basin contains vestiges of Pleistocene Lake Otero which presently consists of Alkali Flat, a large depression at its lowest southern end leading to intermittent Lake Lucero, along with numerous smaller, isolated alkali ponds and gypsum flats scattered across the Tularosa Basin (Fig. 47) (Allen et al. 2009). Laguna Estancia within Estancia Basin, and a smaller Laguna Encino in its own basin to the east, also existed during wetter periods of the Pleistocene; however, a progressively drier climate reduced Lake Estancia to a complex network of alkali lakes known as Laguna del Perro along the western edge of the Estancia Basin (Fig. 48), and created the few scattered, smaller alkali lakes in the Encino Basin (Meinzer 1911). All these basins originally formed during the Permian as parts of shallow seas depositing salt sediments of varied thicknesses, or receding to expose them, at frequent intervals (Keller et al. 1980). As stated earlier, selection pressures of surviving in isolation on expansive, white, salt flats typical of large, persistent saline and alkali habitats like Salt Basin, are hypothesized to account for *E. togata leucophasma*, new subspecies, evolving their extensive white elytra and abundance of wide body setae and for having maintained that appearance under fairly stable habitat conditions during the present interglacial period. Threats to population stability for this subspecies at its type locality are likely to result from detrimental conditions created by anthropogenic changes in hydrology within the Salt Basin (Knisley et al. 2014), as well as from altered Anthropocene climatic conditions.

Evolution of *E. togata* in western Texas and New Mexico in small, dark, saline soil habitats. Darker *E. togata globicollis* are hypothesized to have evolved in smaller more localized saline habitats. In contrast to thick, Permian salt deposits of Salt Basin, such deposits within Delaware Basin are much thinner (Keller et al. 1980). This has created smaller and shallower alkaline and salt lakes in Delaware Basin such that any white, saline and alkali soils developing around these likely would not have persisted for as long as those in Salt Basin on the western margin of Permian Basin. Small lakes typically have more vegetation surrounding each one than surrounds vast, open habitats typical of the larger Salt Basin. It is postulated that within these smaller eastern Delaware Basin habitats, conditions beneficial for survival and reproduction of white *E. togata leucophasma*, new subspecies, dispersing from the Salt Basin, would become unsuitable with time making this phenotype rare in this basin. Unsuitable conditions would develop when the bare, salt encrusted margins of small habitats at these sites diminish in size or are eliminated as darker soil accumulates. Darker soil color may result from more rainfall, higher ground water levels, and denser ground vegetation; all conditions disadvantageous to survival of predominantly white individuals. Rather, adults with less maculation resembling *E. togata globicollis* gradually would be favored on darker soil surfaces at these sites. Hypothetically, adults of this dark phenotype would present more cryptic body silhouettes against dark soils because their expanded patterns of dark, background elytral color could reduce predation pressure on those adults whose dorsal color matches the darker soil surfaces.

Recognition of *E. togata* intergrade populations in western Texas and New Mexico. Compared to distinctive *E. togata leucophasma*, new subspecies, within several basins of western Texas and New Mexico, readily recognizable from *E. togata globicollis* in the southern Great Plains, several *E. togata* populations in western Texas and New Mexico represent phenotypes considered intergrades. Intergradation between *E. togata leucophasma*, new subspecies, and *E. togata globicollis*, well documented by specimens with broadened elytral maculation (Fig. 7, 11, 26–29), are scattered among typical eastern New Mexico *E. togata globicollis* populations. These are found in New

Mexico from Guadalupe County southward in Pecos River Valley through Chaves County where it enters Delaware Basin, Eddy and Lea Counties (Fig. 26, 27), and farther southward into Trans-Pecos west Texas (Fig. 50). Intergrade populations also occur sporadically in saline and alkali habitats on High Plains and Midland Basin of western Texas (Fig. 28, 29). Some adults in these isolated locations exhibit intergrade maculation of wide, white, lateral elytral bands expanded inward to such an extent that dark, reddish dorsal disc color bulges only slightly outward or remains narrowly confined to the sutural margins becoming apically pinched off by the white band across posterior elytral apices. However, most adults throughout this region have white, lateral bands with distinctly sinuate inner margins forming several broad, inwardly rounded bulges. Dark reddish dorsal color on each elytron broadly join posteriorly across elytra to form a distinct, posterior rounded lobe that ends on each side of suture a short distance before reaching apical spine. This elytral maculation pattern (Fig. 6, 10, 34, 40) typifies *E. togata globicollis* adults farther east across the southern Great Plains of Texas, Oklahoma, southeastern Colorado, into central Kansas (Fig. 50). Most adults of this subspecies throughout this region fall within 9 and 12 mm in body length except at saline Cedar Lake, Gaines County, Texas, with noticeably larger specimens of 12 to 14 mm.

Evolution of *E. togata* intergrade populations in western Texas and New Mexico in smaller, isolated, saline localities. Intergrade populations hypothetically could have evolved on uplifted portions of Permian Basin Central Platform after *E. togata* adults occasionally survived dispersal during late Tertiary Period from large estuary salt flats on margins of inland seas to smaller, isolated, saline habitats surrounded by vegetation within the elevated platform. Although some adults resembling *E. togata leucophasma*, new subspecies, apparently persisted in isolated saline habitats on the platform after their arrival, most populations evolved morphological adaptations that were advantageous to survival within smaller saline habitats. These included maculation resembling *E. togata globicollis,* and in some localities, larger body size not typical of most populations in the region. Permian Basin Central Platform covers most of Andrews and Gaines Counties, Texas, where in certain smaller, isolated, saline sites evidence of intergradation between these two subspecies exists with some *E. togata* adults exhibiting fully white maculation among an overwhelming number of those with reduced maculation, and in other sites adults of larger body size occur.

Geological history of central Great Plains and its influence on *E. togata* habitats. Evolution of differences in the darker, dorsal colors characteristic of two, central Great Plains *E. togata* subspecies, *E. t. latilabris* and *E. t. globicollis,* plausibly has been influenced by dark colored soils developed in habitats altered by geologic history of the Great Plains since the Permian. Salt deposition and the soils derived from associated sediments, as well as aquifers and glaciation, all have played important roles in the development and persistence to varied degrees of suitable saline environments for these subspecies within each major drainage. Early in Permian Period, salt sediments were deposited in shallow seas of varied depths throughout the central Great Plains (Sawin and Buchanan 2002). The Arkansas River drainage from central Kansas into Oklahoma is underlain by Hutchinson Salt Member, a massive bed of almost pure salt up to 500 feet thick, developed in an isolated shallow embayment of a southern ocean that persisted throughout most of the Permian (Sawin and Buchanan 2002). This vast salt bed is restricted to an expansive area beneath and centered on what is now the Great Bend region of central Kansas and extends southward into Oklahoma. Later, saline aquifers developed above this bed within younger Cretaceous shales subsequently deposited along ancient seashores and river deltas (Sawin and Buchanan 2002). These saltwater aquifers crop out at the surface to create numerous exposed saline habitats varying in size from smaller saline deposits along Salt Fork Arkansas River and Cimarron River in southern Kansas, to larger salt plains, such as those at Quivira National Wildlife Refuge and Cheyenne Bottoms in central Kansas, and Great Salt Plains in northern Oklahoma. However, despite the presence of these massive salt beds in Arkansas River drainage within the Great Plains, salt water aquifers since the Pleistocene have not produced any surface saline habitats as expansive, nor likely as permanent, as the large salt flats that exist within the Permian Basin of western Texas and New Mexico, and they likely never did. If such large flats had existed in the Great Plains since that time, it seems plausible that these would have favored evolution of some widely maculated *E. togata* adults in a remnant population within the central Great Plains of North America comparable in maculation to adults found in the High Plains of west Texas. Without such expansive salt flats, only *E. togata latilabris* and *E. togata globicollis,* the two subspecies with darker, dorsal color and narrow lateral elytral maculation, apparently were favored for survival. *Eunota togata latilabris* would be favored on small, dark, saline soils at the northeastern limit of the species in Nebraska

and northcentral Kansas, and *E. togata globicollis* on red bed, saline soils in central Great Plains from northcentral Kansas to Oklahoma and western Texas.

Evolution of *E. togata* in Nebraska and Kansas Great Plains in small, dark, saline soil habitats. Survival of *Eunota togata latilabris* in the central Great Plains is postulated to result from its restriction to localized saline deposits in areas with darker soils. Adults of this dark subspecies have their darkest elytral color, dull olive green, while alive, but remain dark brown after death. This subspecies is restricted to smaller saline habitats scattered across northcentral Kansas into southeastern Nebraska. The geographical distribution for this subspecies (Fig. 50) encompasses that part of central Great Plains, from north of the major divide between Kansas River drainage in the northern half of Kansas and southern Nebraska lying south of Platte River, to Arkansas River drainage occupying southcentral Kansas. By contrast, *Eunota togata globicollis* with its brighter coppery elytra, dominates larger saline habitats south of Great Bend along Arkansas River in central and southern Kansas southward into Oklahoma and northwest Texas (Fig. 50). This subspecies also occurs farther west on salt flats along Arkansas River and saline habitats of reservoir margins within that drainage basin in southeastern Colorado (Kippenhan 1994).

Evolution of *E. togata* in Kansas, Oklahoma, Texas Great Plains in red bed, saline soil habitats. It is hypothesized that *E. togata latilabris* and *E. togata globicollis* evolved because Arkansas River and Kansas River drainages differ in soil types resulting from differential Permian sedimentation associated with each major drainage. Large areas of the Great Plains within Arkansas River drainage in central Kansas and northern Oklahoma are covered with red soils derived from Permian Red Beds (Willis 1967). These Red Beds formed from fluvial sediments deposited along ancient riverbanks, in river floodplains, and where river deltas entered shallow seas covering interior North America throughout Permian Period (Evans 2015). Permian Red Beds do not extend northward into Kansas River drainage in northern Kansas nor into southeastern Nebraska; although soils there are dark in color, just not red. Willis (1967) provided further evidence about local habitat conditions south of Kansas River into central Kansas southward into northern Oklahoma where red beds exist and suggested red soils there may have influenced evolution of *E. togata globicollis* populations.

Evolution of *E. togata* in Great Plains dark shale, saline soil habitats. As discussed earlier, Arkansas River drainage is underlain by deep salt layers; however, Kansas River drainage lacks such sedimentary layers (Bayne 1972). Habitats with dark, salty surface soils in this latter drainage are almost exclusively associated with watercourses where Permian and Pennsylvanian marine shales deposited in deeper waters have been exposed, leaching surface brine and creating localized salt marshes (Parker 1911). Northcentral Kansas within Kansas River drainage is known to have a dozen such salt marshes, all relatively small in size (Parker 1911), compared to those larger salt plains listed earlier in central and southern Kansas and Oklahoma. With time, exposed saline surfaces providing favorable habitats in any given salt marsh, may become limited as they are covered by vegetation and aeolian deposits. Before becoming completely unsuitable, however, salt marshes would be expected to favor survival of individuals with less maculation. As Willis (1967) concluded for *E. togata globicollis*, adults with coppery elytra prevail where red soils predominate. Similarly, adults with darker, dull olive green elytra typical of *E. togata latilabris* hypothetically could have survival advantage on darker soils. Survival of these phenotypes might be enhanced by increased opportunities to shelter along vegetated edges in smaller habitats, thereby providing more shade with lower surface temperatures to help adults maintain their optimal body temperatures, and refuges to escape predation as Brosius and Higley (2013) suggested. These two dark subspecies are characterized by their more cryptic body silhouettes resulting from expanded patterns of dark, dorsal background color plausibly reducing predation pressure on adults even in smaller open saline habitats.

Recognition of Great Plains *E. togata* subspecies. Differences in several key characters distinguish *E. togata latilabris* in Nebraska and northcentral Kansas from *E. togata globicollis* in northcentral Kansas and Oklahoma to western Texas. The former Great Plains taxon, assignable to *E. togata latilabris* (Fig. 5, 9, 32, 33, 38, 39), differs from the latter Great Plains taxon by these adult characters: 1) elytra more extensively dark, brown; 2) elytra with acutely angled medial projections small or missing on the inner margins of narrow, dull and dirty white, lateral bands; 3) larger body size. In his visualization of morphological characters analyzed, Willis (1967) indicated all *E. togata* populations in this northeastern part of its range, here considered to represent *E. togata latilabris*, were clustered close together separately from populations farther south, here representing *E. togata globicollis*.

Influence of Great Plains glaciation on *E. togata*. Adverse impacts of glaciation during the Pleistocene on Great Plains *E. togata* populations almost certainly was most pronounced on populations in northcentral Kansas and Nebraska that had existed there during interglacial periods. With the advance of glaciers, ancestral *E. togata latilabris* populations, isolated in smaller saline habitats at their northern limits, would have been driven southward or extirpated. Those resembling *E. togata globicollis* in larger saline habitats on their southern limits likely survived, if favorable conditions still existed within compressed climatic zones accompanying altered conditions (Willis 1967). With post-glacial climatic warming as glaciers retreated after the last Wisconsin Glaciation, ancestral *E. togata* adults likely dispersed northward. Populations that again became isolated in smaller, suitable northern habitats are hypothesized to have evolved adults resembling *E. togata latilabris*, the phenotype favored under those conditions. During the current interglacial period, climatic conditions have remained favorable for survival of this subspecies up to the present. However, detrimental conditions created within the Anthropocene may eventually reduce prospects for survival of any local, northern Great Plains tiger beetle population (Brosius and Higley 2013).

Distinguishing between Great Plains and Gulf Coast *E. togata* subspecies. *Eunota togata globicollis* in southcentral Great Plains, and *E. t. togata* along Gulf of Mexico, have similar elytral patterns of broad lateral bands; however differences in several external morphological characters distinguish their adults. Great Plains specimens versus Gulf Coast specimens differ by these characters: 1) larger bodies with brighter, metallic coppery red to green elytra versus smaller bodies, shiny coppery brown to dark green elytra; 2) more robust head with less laterally protruding eyes versus head with larger, protruding eyes; 3) more globose prothorax versus more parallel prothorax; 4) punctures on elytral disc smaller, discrete versus larger, often coalescing punctures; 5) elytral apices more acute versus broadly rounded; 6) terminal sutural spine on female elytra located close to each separately rounded apex versus spine located along suture anteriorly retracted from each apex. Careful comparison of images for Great Plains specimens (Fig. 6, 10, 34, 35, 40, 41) and Gulf Coastal specimens (Fig. 4, 8, 30, 31, 36, 37) reveals these differences.

Intergradation between Great Plains and Gulf Coast *E. togata* subspecies. The position of a sutural spine on female elytral apices provides the most obvious character to distinguish *E. togata globicollis* from *E. togata togata*. Otherwise, adults of these two *Eunota* subspecies appear superficially similar in their elytral maculation over much of their ranges. Although the position of the sutural spine provided Willis (1967) with evidence for intergradation between *E. togata globicollis* and *E. togata togata* in Reeves County, Texas, along Pecos River Valley, the existence there of intergradation between these two subspecies requires reinterpretation for a couple of reasons. First, elytral maculation and dorsal color in west Texas adults more closely matches those features on adults farther north along Pecos River than on adults seen farther south in coastal Gulf of Mexico. Comparison between these two subspecies shows elytral maculation varies more for west Texas adults and includes some expanded patterns that resemble intergrades with *E. togata leucophasma*, new species, that all but eliminate the dark coppery color apically on at least posterior half of elytra. By contrast, elytral maculation on Gulf Coast adults forms a much more uniformly discrete pattern. The dark elytral color consistently forms a broadly rounded posteriorly projecting lobe along the suture that extends apically almost to the narrow, white margins across the rounded elytral apices. Second, only a small portion of Reeves County adult females have a slightly retracted sutural spine, and none are retracted to the extent evident on Gulf Coast females. On Gulf Coast females, retracted elytral sutural spines arise much farther anteriorly from the extreme elytral apices nearly at the posteriorly projecting dark lobe, whereas elytral sutural spines arise on females of all other subspecies closer to their white, rounded elytral apices.

Morphological uniformity of Great Plains and Gulf Coast *E. togata* subspecies. Within the remaining southern Great Plains throughout southern Kansas into Oklahoma, northern Texas and eastern New Mexico, the uniformity of clustering for morphological characters in his analysis led Willis (1967) to conclude all these regional populations represented only *E. togata globicollis*, a conclusion supported by the present study. Similarly, he concluded that most southern populations along northern Gulf of Mexico region were nominate *E. togata togata* (Fig. 50). Of all subspecies he studied, this latter subspecies presents the most consistent elytral maculation and sutural spine characters (Fig. 4, 8, 30, 31, 36, 37) throughout its wide, established geographical distribution from as far west as Del Rio, Val Verde County, Texas, along northern Gulf of Mexico from Tamaulipas, Mexico, across

coastal and interior East Texas, to northwest Florida, but apparently only temporarily in South Carolina. An exception to this uniformity, however, is found in the population in Dixie County, Florida. Adults of both sexes in this last location include many individuals with most femurs noticeably tawny and lacking metallic reflections, a feature most obvious on metathoracic legs. Also, elytral apices on these adults tend to be more acutely rounded with slightly longer subapical spines than found in populations further to the west along Gulf Coast. However, females in all populations assignable to *E. togata togata* consistently have this sutural spine originating, not at elytral apices as for all other subspecies, but noticeably retracted anteriorly from each rounded apex which confirms their subspecific identity.

Conclusions

Eunota togata populations in Salt Basin, Texas, and further north in Tularosa and Estancia Basins, New Mexico, have been incorrectly assigned to *E. togata fascinans*. This subspecies most closely resembles *E. togata globicollis* when comparing males (Fig. 6 with Fig. 7) and females (Fig. 10 with Fig. 11) of these two named taxa. From this comparison, it can be concluded that both taxa refer to the same subspecies concept. As a consequence of its later publication date, *E. togata fascinans* must be considered a junior synonym of *E. togata globicollis*. Notwithstanding this, taxonomists up to the present time have completely misapplied the *E. togata fascinans* epithet to populations found in several western Texas and New Mexico basins despite Willis (1967) over fifty years ago reaching the same conclusion about this synonym. Inexplicably, one or the other of Casey's names has been misapplied to *E. togata* from these basins; Rumpp (1961) first misused *C. togata fascinans* in the Estancia Basin, and later Willis (1967) incorrectly applied *C. togata globicollis* to populations in all three basins. Study of *E. togata fascinans* holotype, and other adults from its type locality, has revealed that Casey's subspecies represents nothing more than an intergrade between *E. togata leucophasma*, new subspecies, and *E. togata globicollis* typical of adults occurring sporadically from Pecos River Valley around Santa Rosa, New Mexico, southward into western Texas.

Eunota togata leucophasma, new subspecies, holotype male (Fig. 12) and allotype female (Fig. 18), from these several western Texas and New Mexico basins, represents a phenotype distinctly different from either taxa Casey described. *E. togata leucophasma*, new subspecies, adults in Estancia Basin compared to adults in Salt and Tularosa Basins, only rarely have totally white elytra, but otherwise exhibit characters presented in the key couplet for this subspecies. Rather, the elytral maculation of nearly all specimens examined from Estancia Basin (Fig. 24–25), has extensive, white lateral elytral bands interrupted by reduced areas of dark, reddish color on the disc and around the scutellum. This dark color, narrow and short in some specimens, but wide in others, extends only partially along the suture making the posterior third of the elytra completely white on the majority of adults. Because of this variation, adults examined from Estancia Basin, Torrance County, New Mexico, have not been included in the type series of *E. togata leucophasma*, new subspecies, described in this paper, even though they represent this subspecies.

Eunota togata subspecies exemplify phenotypic plasticity for a species locally adapted to saline habitats. Suitable habitats for this species surround the multitude of alkali and salt lakes, ponds, and marshes distributed across the southern Great Plains of North America, as well as along beaches in bays, estuaries, and inland saline marshes of northern coastal Gulf of Mexico region. The varied ecological conditions found across such a wide geographical area with diverse local habitats plausibly may differentially influence survival and reproduction of adults for each *E. togata* subspecies. Life history factors (e.g. larval instar duration, adult emergence times, and adult foraging, mating and predator avoidance behaviors) important for survive and reproduce under specific local habitats, may differ at the extreme geographical limits of the species. Studies to ascertain if significant differences in such factors do exist could be conducted where distinct phenotypes in this revision are considered different subspecies. It is plausible that populations at these geographical limits may have diverged, not only in life history factors, but also in morphological details and genotype, to be considered insipient cryptic species. Comparative morphological study of *E. togata* external structures (female coupling sulcus) and internal structures (everted male aedeagus sclerites) involved in promoting reproductive isolation, could be combined with genetic studies using specimens from these geographical limits. It may also be relevant to include additional populations in such studies given phenotypic expression of other morphological characters (larger body size, leg

length variation, and pigmentation differences) observed in isolated localities within the general geographical distribution. To successfully accomplish such studies, it will be important not only to continue study of curated specimens already available in museum and collections, but also obtain new specimens from localities where collecting has been neglected and difficult because of remoteness and accessibility challenges. There may be an urgency to accumulate new specimens from such poorly represented populations, because increased risk of destabilizing habitats through destruction and pollution created by human activity may extirpate local populations during the ensuring decades of the Anthropocene.

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Appendix 1

Detailed specimen label data for each subspecies, except for that presented earlier for *E. togata leucophasma*, new subspecies, type specimens, are listed below by country, state, county, and collection year, for most adults examined in this study. Additionally, label data are similarly listed for specimens from populations considered intergrades of *E. togata leucophasma*, new subspecies, X *E. togata globicollis* in New Mexico and western Texas, United States. Taken together, all the data from study specimens document distributions for *E. togata* subspecies throughout nearly the entire range of this species in North America: *E. togata leucophasma*, new subspecies, from western Texas and New Mexico; *E. togata globicollis* from New Mexico and Texas to Oklahoma and Kansas; *E. togata latilabris* from Kansas and Nebraska: *E. togata togata* from Alabama, Florida, Louisiana, and Texas, United States; Tamaulipas, Mexico. As a source reference for future studies, the data also include available facts about each subspecies and certain intergrades between them: 1) geographical locality, often with latitude/longitude or GPS coordinates; 2) collection dates; 3) collector(s); 4) collection habitat; 5) sexes of most study specimens; 6) museums and collections from which specimens included in this revision originated. The geographical locality data were utilized to produce the distribution map for *E. togata* subspecies and intergrade populations depicted in Fig. 50.

Eunota togata leucophasma, new subspecies, in US: New Mexico

NEW MEXICO: Torrance Co.: Mountainair, 24-VII-1965 (1♂)(KUNHM), 23-VII-1965 (1♂)(CMNH); Willard, 26-VII-1966 (1♂1♀), 7-IX-1972 (4♀)(CMNH); 5 mi. E Willard, Laguna del Perro, 31 Aug 1968, R.D. & M.F. Ward (6♂9♀)(CMNH); 7 mi. E Willard, 20-VII-1969, G.C. Gaumer (2♀)(CMNH); 7.2 mi. E. Willard, 4-VIII-1971, Lawton/Willis (3♂1♀)(KUNHM); E of Willard, Laguna del Perro, 25 July 1972, C.de Wendler-Funaro (2♂)(CMNH); 7 mi. E Willard, 6000 ft., 23-VII-1972, R.E. Acciavatti, vegetation in salt flat (4♂4♀)(CMNH); 7 mi. E Willard at playa lake, 6100 ft., 1-VIII-1973, R.E. Acciavatti, (2♂2♀)(CMNH); 7 mi. E Willard at playa lake, 6100 ft., 26-IX-1973, R.E. Acciavatti, (1♀)(CMNH); 1 mi. E. Willard, 31-VII-1973, Walter Johnson (1♂1♀)(CMNH); 7 mi. E. Willard, 12-IX-1974, Walter Johnson (2♀)(CMNH); 9 mi E Willard, 6-VIII and 28-VIII-1975, Col. C.B. Knisley (16♂10♀)(UNSM); 7 mi. E Willard at playa lake, 6100 ft., 7-IX-1974, R.E. Acciavatti, (2♂)(CMNH); 12 mi. N Willard at playa lake, 6100 ft., 7-VIII-1976, R.E. Acciavatti, (1♂3♀)(CMNH); 12 mi. N Willard at playa lake, 6100 ft., 10-IX-1976, R.E. Acciavatti, (2♂3♀)(CMNH); 4 mi. E Willard, 6-IX-1981, Davidson, alkaline lake (5♂7♀)(CMNH); 7 mi. E Willard,

Laguna del Perro, Rt. 60, 27 July 1986, Howard P. Boyd , dry run-off to alkali salt lake (9♂6♀)(CMNH); 10 km E Willard, 34°35′52.6″N, 105°55′32.6″W, 3 Aug 1996, Laguna del Perro, open playa, 1846m, John Stamatov (2♂)(CMNH); 22 km SW Encino, 34°29′01″N, 105°35′46″W, 1842m, 26 July 2000, R. Acciavatti, J. Glaser, Pinos Wells Salt Lake, saline and brackish stock ponds at margin (1♀)(CMNH); 2.5 km S of Encino, Rt. 3, 4-VIII-2000, Col. Knisley, Hill (1♂1♀)(CBKC); Pinos Wells, S of Negra Rd., between playas, [34.44852,-105.594245], 11-VIII-2013, C.B. Knisley (1♂1♀)(CBKC); Pinos Wells, S of Negra Rd., between playas lakes, 34°29.467′N,105°48.788′W, 22-VIII-2013, W. Anderson (3♀)(CBKC).

***Eunota togata leucophasma*, new subspecies, X *E. t. globicollis* intergrades in US: New Mexico and Texas**

NEW MEXICO: Chaves Co.: 8 mi. NE Roswell, 13-VI-1965, Harold L Willis (1♂1♀)(KUNHM); Bottomless Lakes St. Pk., 10.7 mi E, 4 mi. S. Roswell, 5-VIII-1971, Lawton/Willis (1♂)(KUNHM); 13 mi. NE Roswell, Bitter L. Wldf. Ref., 5-VIII-1971, Lawton/Willis (1♀)(KUNHM); US 70 at Pecos R., blk. Light, 18-VI-1975, W.A. Iselin (1♂1♀)(CMNH); Bottomless Lakes St. Pk., 28-VIII-1983, Col. C.B. Knisley (1♂4♀)(UNSM); Bottomless Lakes St. Pk., 28-VII-1988, Col. C.B. Knisley (1♂1♀)(CBKC); Bottomless Lakes S.P., overflow area west, 29-VII-2000, Col. Knisley (2♂)(CBKC); Bitter Lake NWR, Unit 4 west, 29-VII-2000, Col. Knisley, Hill (3♀)(CBKC); Salt Creek Wilderness ca. 16 mi. NNE Roswell, 33°34.136′N, 104°22.878′W, 28-IX-2003, D.A. Pollock (3♂)(CMNH).

NEW MEXICO: Eddy Co.: 6 mi. E, 2 mi. N Loving, Salt Lake, 11, 12-VI-1965, Harold L. Willis (5♂)(KUNHM); Salt Lake, Rt. 128, 0.8 mi. E of Rt. 31, 23-IX-2000, Col, Hill, Knisley (1♂1♀)(CBKC); Rt. 360, 5 mi. N Rt. 62-180, 30-VII-2000, Col, Knisley, Hill (4♂2♀)(CBKC); Rt. 128, 2-4 mi. E of Rt. 31, 30-VII-2000, Col, Knisley, Hill (1♀)(CBKC).

NEW MEXICO: Guadalupe Co.: Santa Rosa, Bass Lake, 25-VII-1965, G.W. Byers (1♂)(KUNHM); Santa Rosa, Hwy. 91, Power Dam, 3-VIII-1985, D. Brzoska (5♂14♀)(DBC); Santa Rosa Power Dam Lk., 27 July 1986, Howard P. Boyd (2♂5♀)(CMNH); 4 km SE Santa Rosa, 34°54.71′N, 104°39.99′W, 1395m, 27 July 2000, R. Acciavatti, J. Glaser, State Fish Hatchery, on salt coated clay in sparse vegetation (7♂5♀)(CMNH).

NEW MEXICO: Lea Co.: Hwy. 62-7 mi. E Eddy Co[unty Line], 3-VIII-1985, D. Brzoska (1♀)(DBC); Hwy. 62-7 mi. E Eddy Co[unty Line], 32°33.80′N, 103°41.95′W, 8-VIII-1997, D. Brzoska (1♂)(DBC); 3 mi. W Laguna Plata, N of Rt.243 @ RR tracks, 20-VII-2000, Col. Knisley, Hill (4♂,4♀)(CBKC); Laguna Toston, 2 mi. E Halfway, 30-VII-2000, Col. Knisley, Hill (2♀)(CBKC); Laguna Plata, NW of Halfway, 26-VII-2001, Col. Knisley and Hill (1♂4♀)(CBKC).

TEXAS: Andrews Co.: 8 mi. NW, 3.5 W Andrews, Shafter L., 11-VI-1965, Harold L. Willis (8♂8♀)(KUNHM); 5 mi N and 4 mi. W. of Andrews, Shafter L., 8 Aug. 1967, R.D. and M.F. Ward (22♂,44♀)(CMNH), (5♂2♀)(KUNHM); Shafter Lake, 8 mi. N Andrews, July 17, 1986, Howard P. Boyd (6♂11♀)(CMNH); Shafter Lake, 16 Sept 1996, J. Stamatov (10♂15♀)(CMNH); 12.9 km N Andrews, 32°24.09′N, 102°38.58′W, 948m, 17 July 2000, Shafter Salt Lake, wet bare salt-coated silty salt lake edge, R. Acciavatti, J. Glaser (5♂ 9♀)(CMNH); 8 mi. NNW Andrews at Shafter Salt Lake, 32°24.07′N, 102°38.53′W, 960m, 16 August 2001, u.v. light on moist edge of salt lake, R. Acciavatti, S. Clark (1♀)(CMNH); Shafter Lake Rd. 1967, 950m, 32°24.7′N, 102°39.1′W, 19-X-2004, D. Brzoska (8♂4♀)(DBC).

TEXAS: Dawson Co.: Sand [W of Lamesa on US 180 near Andrews County line] 21-VIII-1948 (2♂) (CMNH).

TEXAS: Lynn Co.: O'Donnell, 17-VII-1963, 24-VII-1968, 22-VII-1970 (1♂5♀) (CMNH) (1♀) (KUNHM).

TEXAS: Reagan Co.: Big Lake, 20-VII-1965 (1♀) (CMNH); Hy.67-2 mi. E.-Rd. 155, 2-VIII-1990, D. Brzoska (5♂4♀) (DBC).

TEXAS: Reeves Co.: 5 mi. SE of Pecos, L. Toyah dry lake, 8 Aug. 1967, R.D. and M.P. Ward (2♂8♀)(CMNH); near Pecos, Jct. Rt. 17 and I-20, 12-VIII-1981, R. Davidson (3♂5♀)(CMNH); Belmorhea Lk., 18-VII-1986, D. Brzoska (1♂5♀)(DBC).

***Eunota togata globicollis* in US: New Mexico and Texas**

NEW MEXICO: Quay Co.: 5.5 km ENE San Jon, 35°06.88′N, 103°16.30′W, 1224m, 28 July 2000, R. Acciavatti, J. Glaser, old US 66, alkali pond, bare shore on salt encrusted clay (2♂6♀)(CMNH); Revuelto Creek, 1.9 mi. E of Hwy. 54 on Hwy. 469, 23 July 2017, leg. S.M. Spomer (1♂)(SSC).

NEW MEXICO: Roosevelt Co.: Salt Lake, Arch, 23, 30-VI-1961 (2♀)(CMNH); 4 mi. E, 1 mi. S Arch, Salt Lake, 9-VI-1965, Harold L. Willis (1♂2♀)(KUNHM); Grulla NWR, E Shore of Salt Lake, 27-IX-1999, Col. Jim Hill (2♂7♀)(CBKC).

TEXAS: Bailey Co.: Coyote L., 9-VI-1965, H. Willis (1♂4♀) (KUNHM); Coyote Lake, 16-IX-1988, D. Brzoska (4♂3♀) (DBC).

TEXAS: Childress Co.: Red River nr. Childress, 16-VIII-1971, sand flat, leg. J. Stamatov (1♂1♀) (CMNH).

TEXAS: Gaines Co.: Potash Lk., 21-VIII-1948 (1♂1♀)(CMNH); McKensey Lake (Cedar Lk.), 16.IX.1966, J. Stamatov (3♀)(CMNH); Cedar Lake, 1-VIII-1988, D. Brzoska (5♂5♀)(DBC); Cedar Lake, 16-IX-1988, D. Brzoska (1♀)(DBC); 24 mi. NE Seminole, Cedar Salt Lake, 32°50.58′N, 102°15.27′W, 929m, 17 August 2001, damp, open lake bed, Shawn M. Clark, Robert E. Acciavatti (6♂10♀)(CMNH).

TEXAS: Howard Co.: 10 mi. SW Big Springs, 7 July 1978, R.D. Ward (16♂11♀)(CMNH); 12.7 km WSW Big Spring, 32°12.43′N, 101°36.19′W, 744m, 17 July 2000, Sulphur Springs Draw, dry bare salt-coated sandy salt pond edge, R. Acciavatti, J. Glaser (5♂3♀)(CMNH).

TEXAS: Mitchell Co.: Colorado City, 17-VII-1917, L.A. Stephenson (1♂)(KUNHM); Colorado River, Rt. I-20, July 17, 1986, Howard P. Boyd (1♀)(CMNH).

TEXAS: Terrell Co.: Herman Chandler Ranch, alkali dome, 30.433,-101.733, 1 July 1959, G.E. Ball and family (12♂10♀) (UASM).

TEXAS: Terry Co.: 10 mi. E. of Brownfield at Mound L. 8 Aug. 1967, R.D. and M.F. Ward (2♀) (CMNH).

TEXAS: Wichita Co.: Hwy US 281 at Red River, 30-VII-1965, near stagnant water, G. C. Gaumer (1♀) (KUNHM).

Eunota togata globicollis in US: Colorado, Kansas, and Oklahoma

COLORADO: Bent Co.: west of Hasty on Hwy. 50, salt flat, 38.109,-102.986, 1036m, 2 July 1990, M. Kippenhan and H. Evans (2 specimens)(CSUC).

COLORADO: Kiowa Co.: Upper Queens Reservoir State Wildlife Area (Neeskah Reservoir), 38.296,-102.661, 873m, 11 Sept 1997, D. Leatherman (17 specimens)(CSUC); Sheridan Lake, 34.467,-102.292, 992m, 15 Aug 1997, D. Leatherman (8 specimens)(CSUC).

COLORADO: Otero Co.: Cheraw Lake, 38.099,-103.513, 1177m, 27 Aug 2003, D. Leatherman (6 specimens) (CSUC).

KANSAS: Barber Co.: 3 mi SE of Hazelton, 27-VIII-1963, 12-VII-1964, 9-IX-1964, small salt flat, Harold L. Willis (1♀)(CMNH)(1♂7♀)(KUNHM).

KANSAS: Butler Co.: west edge El Dorado, Hwy. 196, Harold L. Willis, bare salt flat (1♂2♀) (KUNHM).

KANSAS: Clark Co.: near Englewood, May 19-June 1903 [most with June or June 19, 1962 ft.], F.H. Snow and party (89♂77♀) (KUNHM) [TYPE LOCALITY]; June, 1962 ft., F.H. Snow (1♀) [Carn. Mus. Acc. 2949] (CMNH).

KANSAS: Kiowa Co.: Belvidere, 5-VII-1912, W. Knaus (2♀)(UASM); (Belvidere, 10-VI-1937, W. Benedict (1♂3♀)(KUNHM); 1 mi. N Belvidere, 30-VIII-1963, Harold L. Willis (1♂3♀)(KUNHM).

KANSAS: McPherson Co.: 1½ mi. E Galva, 31-VII-1964, 2-X-1964, Harold L. Willis (3♂5♀)(KUNHM).

KANSAS: Sedgwick Co.: 1 mi. N,1.3 mi. E Greenwich, 26-VIII-1963, Harold W. Willis, small salt flat near salt creek (1♂)(KUNHM).

KANSAS: Stafford Co.: Salt Marsh, 25-VI-1933, M. B. Jackson (9♂9♀)(KUNHM); Big Salt Marsh, 11 mi. NE of Hudson, 8-X-1961, 31-V-1962, 5-VI-1963, 31-V-1964, Harold L. Willis bare salt flat, salt flat near outlet stream at NE corner of marsh (3♂3♀)(CMNH) (18♂26♀)(KUNHM); Quivira Nat. Wild. Reg., 23-V-1966, J. Glaser (2♂2♀) (CMNH).

OKLAHOMA: Alfalfa Co.: 3 mi. E. Cherokee, 5-VI-1962, 4-VI-1963, 21-VIII-1963, 27-VIII-1963, 12-VII-1964, Harold L. Willis, small salt flat W Great Salt Plains Natl. Wildlife Refuge (6♂15♀)(KUNHM); Great Salt Plains, 27 Aug 1960, 1 Sept. 1968, R. & A. Graves (44♂46♀)(CMNH).

OKLAHOMA: Beckwith Co.: 3 mi. S Carter, 13-VII-1964, Harold L. Willis (3♀) (KUNHM).

OKLAHOMA: Blaine Co.: 7½ mi. S, 4 mi. W Okeene, 28-VIII-1963, Harold L. Willis (1♀)(KUNHM).

OKLAHOMA: Garfield Co.: ½ mile NW Drummond, 28-VIII-1963, 21-VI-1964, 14-VII-1964, 10-IX-1964, Harold L. Willis, small salt flat near salt creek (10♂12♀)(KUNHM).

OKLAHOMA: Jackson Co.: 3 mi. S Eldorado, 13-VII-1964, Harold L. Willis (6♂5♀) (KUNHM).

OKLAHOMA: Logan Co.: Guthrie, VI-1916 (1♀) (CMNH).

OKLAHOMA: Woods Co.: 2½ mi. SW Plainview, 3-VI-1963, 29-VIII-1963, 22-VI-1964, 8-VI-1965, Harold L. Willis (7♂8♀)(KUNHM); Plainview, 4-VII-1970, banks of Cimarron River (1♀)(CMNH).

Eunota togata latilabris in US: Kansas and Nebraska

KANSAS: Lincoln Co.: 3 mi. W, 2 mi. S Barnard, 16-VI-1963, 7-IX-1963, 14-VI-1964, 30-VII-1964, 8-VIII-1964, 8-VII-1965, 20-VII-1967, Harold L. Willis, small salt flat, bare salty spot in field (21♂19♀)(KUNHM) (2♂3♀)(CMNH); 11 mi. N Lincoln, 26-VIII-1962, 7-VI-1963, 7-IX-1963, 14-VI-1964, 20-VIII-1967, Harold L. Willis, small salt flats (7♂9♀)(KUNHM).

KANSAS: Republic Co.: Kackley, VII (2♂8♀) [Klages Coll'n C. M. Acc. 11414](CMNH); 4 mi. W, 1 mi. S. Kackley, 18-VI-1963, 6-IX-1963, 13-VI-1964, 14-IX-1964, 8-VII-1965, Harold L. Willis, small salt flat (9♂11♀) (KUNHM) [TYPE LOCALITY]; 4 mi. NW Jamestown, 14-IX-1964, Harold L. Willis (2♀)(KUNHM); 1 mi. S, ½ mi E Talmo, 18-VI-1963, 6-IX-1963, 14-IX-1964, Harold L. Willis (17♂15♀)(KUNHM) .

NEBRASKA: Lancaster Co.: Lincoln, Salt Basin, June 16, September 24, 1898 (2♀)(UNSM); Lincoln, Salt Basin, June 18, 1900 (5♂3♀); Lincoln, Salt Basin, July 24, Aug. 29, Sept. 11, Sept. 22, 1906, R.H. Wolcott (3♂2♀) (UNSM); Lincoln, July 3, 1909, C.H. Gable (8♂3♀)(UNSM); Lincoln, June 21, 1912, R.W. Dawson, L.M. Oates (4♂11♀)(UNSM); Lincoln, 6 August 1963, K.L. Knight, on salt flat (1♂1♀)(KUNHM); Lincoln, Salt Lake, 19-VI-1963, 6-VIII-1964, 26-VIII-1964, 7-VII-1965, Harold L. Willis (12♂17♀)(KUNHM); City of Lincoln, 40°49′28.2″N, 96°45′14.7″W, 26 July 1970, open flats in salt marsh on west side I-80, John Stamatov (23♂27♀) (CMNH); Lincoln, Salt Lake, 17-VII-1971 Lawton/Willis (6♀)(KUNHM); Lincoln, I-80 [Hwy.], 8-VII-1977 (4♂5♀)(UNSM); Lincoln, [T11N, R6E, Sec 2],[T11N, R6E, Sec 11], 30 Jul 1990, M. Clausen (3♂1♀)(UNSM); Arbor Lake WMA, 5-VII-1996, VIII-16-1998, M.L. Jameson, salt marsh/salt flat (4♂2♀)(UNSM).

NEBRASKA: Nuckolls Co.: Superior, VII (2♂3♀) [Car. Mus. Acc. 210, Klages Coll'n C. M. Acc. 11414] (CMNH).

NEBRASKA: Saunders Co.: Ceresco, Aug. 8, 1906, R.H. Wolcott (2♂)(UNSM); 1 mi S Ceresco, 7-VII-1965, H.L. Willis (1♀)(KUNHM).

Eunota togata togata in US: Alabama, Florida, Louisiana, Texas

ALABAMA: Mobile Co.: Mobile, VIII-1914 [H. Klages Coll'n. C.M. Acc. 11414] (1♂) (CMNH); Dauphin Island, 18-X-1916 (1♀) (CMNH); Coden, 30-VI-1917, H. P. Downing (2♀) (UASM).

LOUISIANA: Cameron Par.: Cameron, 17-VI-1948, R.T. McDermott (3♂1♀)(KUNHM); Hackberry, Calcasieu Lake, 14-VII-1964, R. & A. Graves (8♂9♀)(CMNH).

LOUISIANA: Caddo Par.: 4 mi. N Greenwood, 25 May 1969, J. R. Stewart (1♂2♀) (KUNHM).

FLORIDA: Dixie Co.: Rt. 361, 7 mi. S Jena, at light, 4-VI-1984, Howard P. Boyd (1♀)(CMNH); Rocky Point, Hwy. 361, 12 mi. S Steinhatchee, 5 August 1989, R. E. Acciavatti (1♀)(CMNH).

TEXAS: Aransas Co.: 5 mi. S Rockport, 16-VII-1964, R. & A. Graves (3♂2♀)(CMNH); Goose Island, 10-VII-1972, Walter Johnson (1♂1♀)(CMNH).

TEXAS: Brazoria Co.: Freeport, 15-VII-1964, R. & A. Graves (10♂8♀)(CMNH); 0.5 mi. S 5 mi. N San Luis Pass, 28 July 1971, Walter N. Johnson (2♂)(CMNH).

TEXAS: Cameron Co.: Port Isabel, 20-23 June 1948, G. E. Ball (6♂5♀)(UASM); 2 mi. W Boca Chica, 5 June 1961, at light, George W. Byers (3♂)(KUNHM); Port Isabel, 17-VII-1964, R. & A. Graves (1♂1♀)(CMNH); Port Isabel, 19-28 June 1977, J.D. Glaser (18♂14♀)(CMNH); South Padre Island, 19-28 June 1977, J.D. Glaser (11♂7♀)(CMNH); 5 mi. W Port Isabel, 21 June 1977, J.D. Glaser (1♂1♀)(CMNH); Boca Chica Island, 20-VIII-1978, tidal flat, J. Stamatov (1♀)(CMNH). [TYPE LOCALITY].

TEXAS: Calhoun Co.: Magnolia Beach, 16-VII-1964, R. & A. Graves (6♂8♀) (CMNH).

TEXAS: Galveston Co.: Galveston, 11-VIII-1971, Lawton/Willis (3♂3♀) (CMNH); Galveston, May, F.H. Snow (8♂14♀) (KUNHM).

TEXAS: Hidalgo Co.: Anzalduas County Park, 16-VII-1964, 22-X-1982, sandy field, J. Stamatov (1♀)(CMNH).

TEXAS: Hardin Co.: Sour Lake, 25-V-1966, on sandy flat, G.C. Gaumer (2♂2♀)(KUNHM); Sour Lake, 27 July 1971, W. Johnson (2♀)(CMNH); 1.5 mi N Sour Lake, 11-VIII-1971, Lawton/Willis (1♂5♀)(KUNHM).

TEXAS: Harris Co.: Seabrook, 8-VIII-1965 (2♂3♀) (UASM).

TEXAS: Jefferson Co.: 10 mi. W Sabine Pass, 11-VII-1959, J. Wagner (3♂5♀)(CMNH); Along Hwy. 87, 9-VII.1966, on sandy flat, G.C. Gaumer (1♂1♀)(KUNHM); Salt Marsh, 7 mi. SW Sabine Pass, 10-VII-1972, W. Suter (14♂15♀)(CMNH).

TEXAS: Kenedy Co.: 4 mi. N Sarita, 17-VII-1964, R. & A. Graves (1♂1♀)(CMNH); Los Olmos Creek, 29 June 1977, J.D. Glaser (1♂3♀)(CMNH).

TEXAS: Kleberg Co.: Rivieria Beach, 18 June 1948, G. E. Ball (3♂1♀)(UASM); Los Olmos Creek, 21-VIII-1978, sandy creek bed, J. Stamatov (2♂1♀)(CMNH).

TEXAS: Nueces Co.: Port Aransas, 17-VII-1964, R. & A. Graves (2♂4♀)(CMNH); 6 mi SE Corpus Christi, Mustang Island, 24 Aug 1978, sweep near pond, W. Suter (2♂3♀)(CMNH).

TEXAS: San Patricio Co.: Aransas Pass, 16-VII-1964, R. & A. Graves (1♀) (CMNH).

TEXAS: Smith Co.: 2.5 mi. W Teaselville, Saline Ck., 1-IX-1971, R. E. Acciavatti (4♂3♀)(CMNH).

TEXAS: Val Verde Co.: Del Rio, 22 June 1927, 955 ft., Wickham (1♂) (CMNH).

TEXAS: Van Zandt Co.: 1 mi. S Grand Saline, at lantern, 12-VIII-1971, R. E. Acciavatti (3♂2♀)(CMNH).

TEXAS: Willacy Co.: Salt Flat E. of Port Mansfield, 16-IV-1981, Howard P. Boyd (29♂27♀) (CMNH); Raymondville, 19 Oct 1992, J.D. Glaser, (2♀) (CMNH).

Eunota togata togata in MEXICO: Tamaulipas

TAMAULIPAS: Tampico, 3 July 1996, E. Fisher, D. Verity (1♂) (CMNH).