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The Scarabaeoid Beetles of San Diego County, California Part I. Introduction and Diagnosis of Families Glaresidae, Trogidae, Pleocomidae, Geotrupidae, Ochodaeidae, Hybosoridae, and Glaphyridae

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ABSTRACT.—Scarabaeoid beetles are diverse in San Diego County, California, with 8 families, 53 genera, and approximately 150 species represented. Vegetation communities in the county are likewise diverse and directly responsible for supporting the diversity of scarab beetles. Part I of the Scarabaeoid Beetles of San Diego County, California presents data on 18 species in the following 7 families: Glaresidae (1), Trogidae (4), Pleocomidae (2), Geotrupidae (5), Ochodaeidae (3), Hybosoridae (1), and Glaphyridae (2). This group of diverse beetles is adapted to a wide variety of terrestrial habitats where they feed upon hair, feathers, carrion, other decomposing organic matter, and plants.

INTRODUCTION

The superfamily Scarabaeoidea is one of the largest groups of beetles, containing approximately 2200 genera and 31,000 species worldwide (Jameson and Ratcliffe 2002). According to Smith (2003) there are 12 families, approximately 170 genera, and 2000 species in the United States, Canada, and nearctic Mexico. This diverse group is adapted to a wide variety of terrestrial habitats on all continents except Antarctica and eats a variety of materials, including fungi, plants, carrion, hair, feathers, dung, or other decomposing organic materials. A few species are predators on other insects. Scarabaeoid beetles, or scarabs, are characterized by having platelike antennal segments, or lamellae. Their robust bodies often have powerful legs adapted for burrowing in rotten wood or soil. Scarabs are usually black, brown, yellowish brown, reddish brown, or green. A few species are metallic or scaled with blotched or striped patterns. The larvae or grubs are whitish and C-shaped with a distinct head and well-developed legs.

Scarabaeoid beetles are abundant in San Diego County, with 8 families, 53 genera, and approximately 150 species represented. Part I of this series covers 18 of the county's species in the following 7 families: Glaresidae (1), Trogidae (4), Pleocomidae (2), Geotrupidae (5), Ochodaeidae (3), Hybosoridae (1), and Glaphyridae (2). The family Scarabaeidae, which accounts for approximately 130 of 150, or 87% of the scarab beetle species in San Diego County, will be treated in subsequent parts of this series. Part II will cover the subfamilies Aphodiinae and Scarabaeinae, part III the Melolonthinae, and part IV the Dynastinae, Rutelinae, and Cetoniinae.

COLLECTING IN SAN DIEGO COUNTY

Several preeminent beetle taxonomists spent time collecting in San Diego County during the 19th century (Essig 1931). John L. LeConte was in California during 1850 while employed as a surgeon in the U. S. Army and collected in San Diego County and other parts of the state. George H. Horn was active in the California Volunteers during the Civil War from February 1863 to April 1865 and spent time collecting Coleoptera at Warner Springs during his service. Frank E. Blaisdell moved to San Diego in 1871 and then to a ranch near Poway in 1875. Blaisdell collected throughout the county and amassed a huge collection of beetles, including many scarabs. His collection of 200,000 specimens now resides at the California Academy of Sciences, San Francisco.

Oliver N. Sanford moved from Massachusetts to San Diego in 1872 and collected beetles throughout the region for nearly 30 years. He sent specimens to LeConte, Horn, and others and sold his collection to Blaisdell in 1891. George H. Field, a long-time collector, moved to San Diego County in 1889 and collected in many remote areas of San Diego and Imperial counties and Baja California, Mexico. He furnished much of his material to Henry C. Fall, Edwin C. Van Dyke, and Blaisdell. Thomas L. Casey collected in California from San Diego to Eureka in 1885 and 1886. Though Casey described many species of scarabs from California many of his names proved to be synonyms of species described previously by LeConte, Horn, and others.

The first modern listing of beetles in San Diego County was compiled by Ian Moore (1937). The list included 81 species of scarabs

and was based largely on the collections of Blaisdell and Field. A. R. Hardy, A. V. Evans, D. K. Faulkner, J. W. Brown, S. E. Haskins, and R. L. Parks collected in the county at various times from the 1960s through the 1990s. These entomologists were responsible for collecting much of the material from San Diego County now in museums. McPeak began collecting scarab beetles in the county in 1966 and through August 2007 spent nearly 500 days (and/or nights) collecting throughout the county. The extensive collecting in the county since 1937 has yielded numerous additional species, raising the county's total to approximately 150 species of scarabaeoid beetles as of 2007.

SAN DIEGO COUNTY GEOGRAPHY AND CLIMATE

San Diego County covers roughly 1.093 million hectares and is located in the southwest corner of California. It is bordered on the north by Riverside and Orange counties, on the east by Imperial County, and on the south by the international border with Baja California, Mexico (Figs. 1, 2). The Pacific Ocean lies to the west.

The county straddles the Peninsular Ranges geologic province of southern California, which consists of a series of coastal mesas, foothills and intervening valleys, and mountains up to 1991 meters in elevation. The Peninsular Ranges include the Santa Margarita, Volcan, Cuyamaca, Agua Tibia, Palomar, and Laguna mountains. To the east of these mountains a steep escarpment drops down to the very dry hot lowlands of the western reaches of the Colorado Desert. Sand dunes resulting from windblown sediments occur in the eastern portion of the desert region. San Diego County contains roughly 44 hectares of active dunes and 380 hectares of stabilized dunes, as well as alkali flats in the beds of the Borrego Sink and Clark Dry Lake.

San Diego County has a varied climate. The majority of the precipitation falls as rain during the winter months (December through March) with the exception of some summer thunderstorms (July through September) and winter snow in the mountains. There is great variation in rainfall from year to year. For instance, rainfall measured at Lindbergh Field (season 1 July–30 June) ranged from 76.5 mm in 2001–2002 to 571.3 mm in 2004–2005. In 2001–2002 precipitation was the lowest recorded since at least 1851 (Unitt 2004), while rainfall in 2004–2005 was the third highest since 1883–1884. Typical annual precipitation ranges from 210 to 300 mm along the coast, 260 to 400 mm in the coastal valleys and 500 to 1100 mm in the mountains. The desert regions receive only 70 to 130 mm per year with half of that falling during summer thunderstorms (Rand Allan, County of San Diego, Department of Public Works, 2005).

Along the coast temperatures are relatively mild and fluctuate within a rather narrow range, averaging about 7°C in winter (December through March) and 26°C in summer (July through September). Temperatures are more extreme in the inland valleys of the coastal lowland and foothill zone where frost may occur during the winter and summer highs average 31–34°C. The mountain zone is the coolest region of the

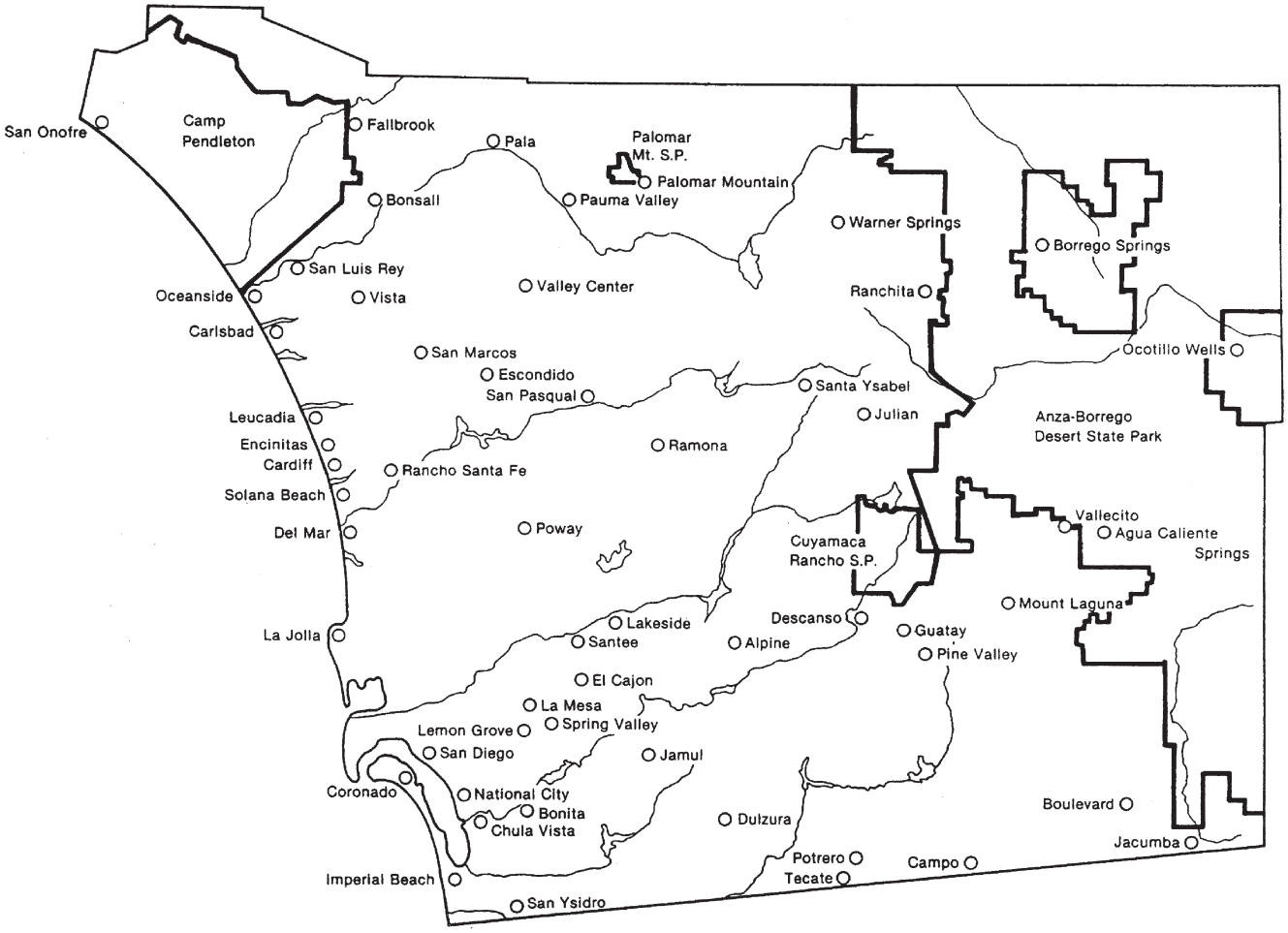


Figure 1. Principal localities named in San Diego County.

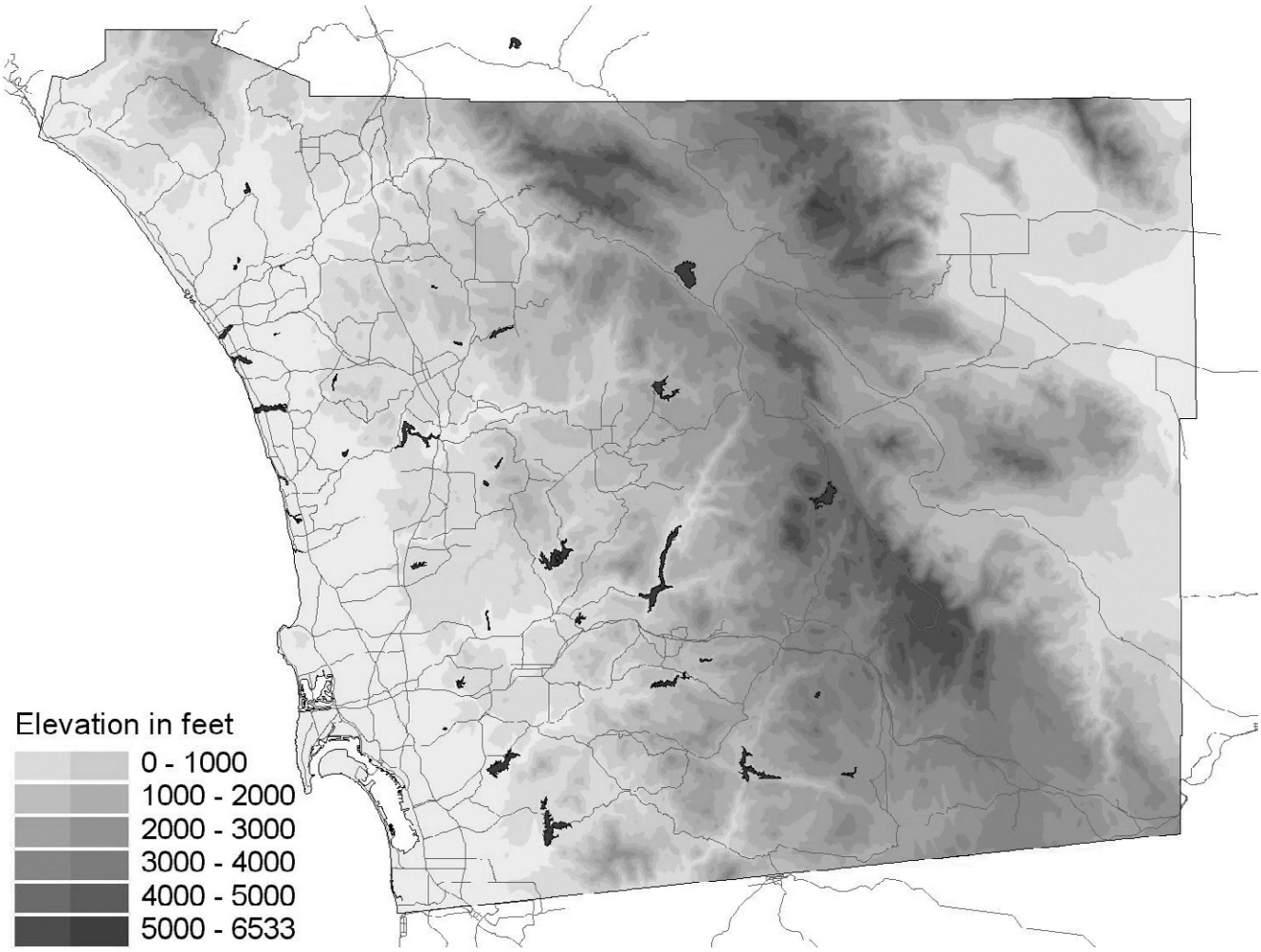


Figure 2. San Diego County topography.

county. During the winter temperatures average –2–0 ºC, in the summer high temperatures average 29–31º C. In the desert summer heat is extreme, with average highs of 41–46º C and a maximum of 50.6º C (National Weather Service website, San Diego Office, 2005).

SAN DIEGO COUNTY VEGETATION COMMUNITIES

Vegetation communities (Fig. 3) in San Diego County are diverse and directly responsible for supporting the county's diversity of scarab beetles. Vegetation patterns are correlated with climatic and geological conditions, including soil type, exposure, and level of precipitation. We discuss beetle distribution with respect to these vegetation communities where an association is important, especially for phytophagous species. The nomenclature for plants follows Hickman (1993).

Urban/Agricultural

Modern development and agriculture in San Diego County, especially in coastal and mesa areas west of the mountains, have eradicated extensive areas of native vegetation. Coastal sage scrub, coastal dunes, and chaparral have been especially affected. Non-native plant species have been introduced widely. The genera of scarab beetles common in urban/agricultural areas include *Aphodius* Illiger, *Parathyce* Hardy, *Serica* MacLeay, *Cotinis* Burmeister, and *Tomarus* Erichson (all of family Scarabaeidae).

Coastal Dunes

Coastal dune habitat (sometimes referred to as coastal strand), mostly disturbed by human activity and development, is now limited to a few locations, as on the southern Silver Strand, in Torrey Pines State Reserve, and at the mouth of Santa Margarita River. *Camissonia cheiranthifolia* (Sprengel) Raim (beach evening primrose), *Ambrosia chamissonis* (Less.) E. Greene (beach-bur), *Astragalus* spp., and *Cakile maritima* Scop. (sea rocket) grow in this community. Typical genera of scarab beetles in this vegetation are *Aegialia* Latreille, *Tesarius* Rakovic, and *Aphodius* (all of family Scarabaeidae).

Coastal Sage Scrub

Much of the coastal sage scrub that formerly covered much of coastal San Diego County has been lost to urban development. The remains of this community are dominated by *Artemisia californica* Less. (California sagebrush), *Eriogonum fasciculatum* Benth. (California buckwheat), and *Malosma laurina* (Nutt.) Abrams (laurel su-

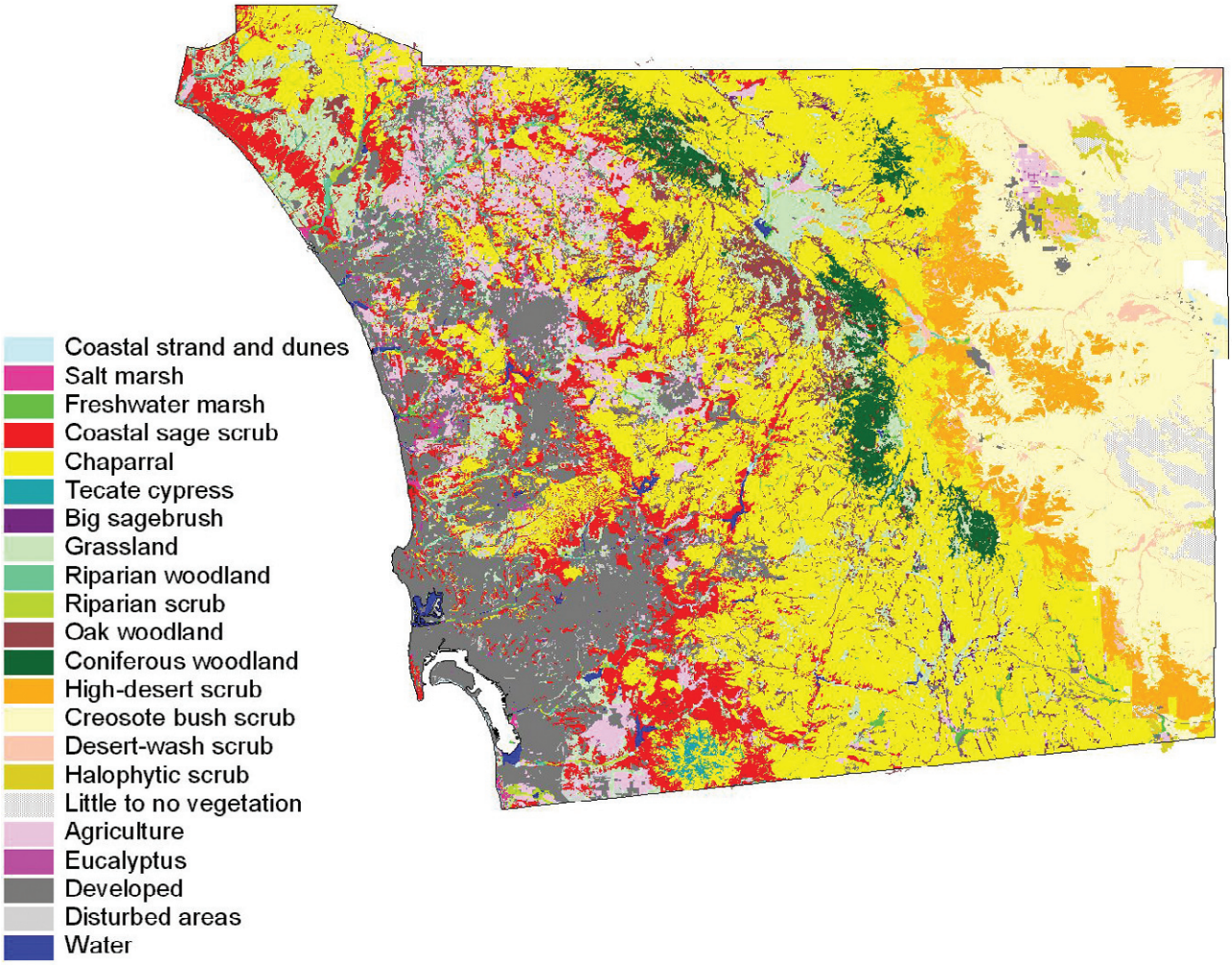


Figure 3. San Diego County vegetation communities.

mac). Along the immediate coast, *Rhus integrifolia* (Nutt.) Brewer & S. Watson (lemonadeberry), *Cylindropuntia prolifera* Engelm. (coast cholla), *Opuntia littoralis* (Engelm.) Cockerell (coast prickly-pear), *Ferocactus viridescens* (Torrey & A. Gray) Britton & Rose (coast barrel cactus), and *Mammillaria dioca* M. K. Brandegee (fish-hook cactus) are sometimes present. Typical genera of scarabs found in coastal sage scrub are *Trox* Fabricius (Trogidae), *Aphodius*, *Cyclocephala* Dejean, *Serica*, and *Tomarus* (Scarabaeidae).

Chaparral

Chaparral is widespread in the county from the coastal mesas to the mountains and upper desert slopes. Chaparral occurs in a variety of forms. In some locations it is dominated by *Adenostoma fasciculatum* Hook &. Arn. (chamise) in nearly pure stands. In other locations chamise is mixed with *Ceanothus* (California-lilac), *Arctostaphylos* (manzanita), and/or *Quercus berberidifolia* Liebm. (scrub oak). Chaparral is the most important habitat for scarab beetles in San Diego County. Scarabs' abundance and diversity are especially high in spring and early summer. The common genera of scarab beetles typically encountered in chaparral include *Trox*, *Bolbelasmus* Boucomont (Geotrupidae), *Pleocoma* LeConte (Pleocomidae), *Aphodius*, *Coenonycha* Horn, *Dichelonyx* Harris, *Serica*, *Parathyce*, *Phobetus* LeConte, *Paracotalpa* Ohaus, and *Tomarus* (Scarabaeidae).

Grassland

In San Diego County grasslands grow along the coast, in valleys among the foothills, and in a few montane areas. These grasslands are now dominated by introduced grasses, especially *Avena* spp. (oats), *Bromus* spp. (brome), *Hordeum* spp. (barley), and by *Brassica* spp. (mustard). Introduced species occur in some areas of the county with *Lasthenia californica* Lindley (goldfields), *Dichelostemma capitatum* Alph. Wood (blue dicks), *Deinandra fasciculata* (DC.) E. Greene, and other native herbs. *Nassella* spp., mixed with native herbs such as *Sidalcea malvaeflora* (DC.) Benth. (checker mallow), *Sanicula* spp., and *Sisirynchium bellum* S. Watson (blue-eyed-grass), occur as a grassland composed of native species in a few locations with heavy clay soils (such as Alpine, Ramona, and Poway). The common genera of scarab beetles typically found in grassland habitats include *Aphodius*, *Ataenius* Harold, *Cyclocephala*, and *Tomarus* (all of family Scarabaeidae). Meadows exist within the montane regions in valleys and terraces where soil texture and moisture inhibit the growth of woody species. Montane meadow vegetation is dominated by herbaceous perennials including grasses such as *Elymus* spp., *Muhlenbergia* spp. (muhly), *Poa* spp. (bluegrass), rushes (*Juncus* spp.), and sedges (*Carex* spp.). Major montane meadows are Crouch and Laguna meadows on Laguna Mountain, around Cuyamaca Lake, and within Dyche, French, Mendenhall and Doane valleys on

Palomar Mountain. The genus of scarab typically found in montane meadows is *Aphodius*.

Riparian Woodland

Riparian woodland grows along stream courses, particularly where water flows or lies near the soil surface. It is extensive in the major coastal valleys and penetrates well into the montane regions in the form of narrow strips. Near the coast, the dominant trees are *Populus fremontii* S. Watson (Fremont cottonwood), *Platanus racemosa* Nutt. (western sycamore) and several species of *Salix*, such as *S. lasiolepis* Benth. (arroyo willow) and *S. lucida* Muhlenb. (shining willow). *Alnus rhombifolia* Nutt. (white alder) is the dominant species in montane riparian woodlands. *Lichnanthe* Burmeister (Glaphyridae), *Aegialia*, *Aphodius*, *Parathyce*, *Serica*, *Cyclocephala*, and *Tomarus* (Scarabaeidae) are the scarabs collected in riparian woodland habitats.

Oak Woodland

Oak woodland grows in major canyons extending from the foothills down nearly to the coast at a few sites and up into the mountainous regions. Most oak woodlands are dominated by *Quercus agrifolia* Nee (coast live oak), but *Q. engelmannii* E. Greene (Engelmann oak) also grows locally in the foothills, especially in the central portion of the county, forming an open woodland of trees with an understory of grass, sage scrub vegetation, or chamise. At some locations in montane regions of the county *Q. kelloggii* Newb. (California black oak) and *Q. chrysolepis* Liebm. (canyon live oak) are dominant. Typical scarab genera encountered in oak woodland are *Pleocoma* (Pleocomidae), *Aphodius*, *Hoplia* Illiger, *Polyphylla* Harris, and *Tomarus* (Scarabaeidae).

Coniferous Woodland

Coniferous woodland typically grows above 1050–1200 m in elevation and is found on Mount Laguna, the Cuyamaca Mountains, Corte Madera Mountain, Pine Valley, Pine Hills, Julian, Pine Mountain, Angel Mountain, Hot Springs and Bucksnort Mountains, the San Ysidro Mountains north of Ranchita, Palomar Mountain, and the Agua Tibia Mountains. The most conspicuous species of conifers in these mountains include *Pinus coulteri* D. Don (Coulter pine), *P. jeffreyi* Grev. & Balf. (Jeffrey pine), *P. ponderosa* Laws. (ponderosa pine), *P. lambertiana* Douglas (sugar pine), *Abies concolor* (Gordon & Glend.) Lindley (white fir), *Calocedrus decurrans* (Torrey) Florin (incense cedar), and *Pseudotsuga macrocarpa* (Vasey) Mayr (bigcone Douglas-fir). Coniferous woodland also includes Torrey Pine woodland (*Pinus torreyana* Carrière) on the bluffs south of Del Mar and Tecate cypress stands (*Cupressus forbesii* Jepson) on Otay Mountain. Common hardwood species in coniferous forests include *Quercus kelloggii*, *Q. agrifolia*, and *Q., chrysolepsis*. The common genera of scarab beetles found in coniferous forests include *Odonteus* Samouelle (Geotrupidae), *Pleocoma* (Pleocomidae), *Dichelonyx*, *Diplotaxis* Kirby, *Polyphylla*, and *Serica* (Scarabaeidae).

Pinyon–Juniper Woodland

Desert mountains, such as Pinyon, parts of the Santa Rosa, and In-Ko-Pah mountains include an open woodland of *Pinus quadrifolia* Parl. (Parry pinyon pine), *Juniperus californica* Carrière (California juniper), *Quercus palmeri* Engelm. (Palmer's oak), and *Purshia tridentata* (Pursh) DC. *glandulosa* (Curran) M. E. Jones (antelope bush). Scarab genera typically found in pinyon–juniper woodland include *Coenonycha*, *Diplotaxis*, *Paracotalpa*, *Cyclocephala*, and *Tomarus* (all of family Scarabaeidae).

Desert Transition Scrub

Desert transition scrub, a form of chaparral, occurs along the eastern slope of the Cuyamaca, Volcan, Hot Springs, and Laguna mountain ranges at elevations of 460–1070 m. Examples of this community can be seen below Banner, in much of San Felipe Valley, on Montezuma Grade, and in In-Ko-Pah County Park. This transition community contains plants from pinyon–juniper woodland at higher elevations and creosote bush scrub at lower elevations. Typical plants in the community are *Prunus fremontii* S. Watson (desert apricot), *Thamnosma montana* Torrey & Fremont (turpentine broom), *Ziziphus parryi* Torrey (lotebush), *Coleogyne ramosissima* Torrey (blackbush), *Acacia greggii* A. Gray (catclaw acacia), and scattered *Quercus cornelius-mulleri* K. Nixon & K. Steele (desert scrub oak) and *Juniperus californica* (California juniper). The common genera of scarab beetles found in desert transition scrub include *Aphodius*, *Coenonycha*, *Serica*, and *Tomarus* (all of family Scarabaeidae).

Creosote Bush–Desert Wash Scrub

Most of the very arid Anza-Borrego Desert is covered with a sparse scrub dominated by *Larrea tridentata* (DC.) Cov. (creosote). The creosote bush community is highly variable, however, and may in some locations include little *Larrea*. Other important plants in the creosote bush scrub community include *Ambrosia dumosa* (A. Gray) Payne (burro-weed), *Fouquieria splendens* Engelm. (ocotillo), *Encelia farinosa* Torrey & A. Gray (brittlebush), *Cylindropuntia bigelovii* (Engelm.) P. M. Knuth (teddy-bear cholla), *Ferocactus cylindraceus* (Engelm.) Orc. (California barrel cactus), and *Agave deserti* Engelm. (desert agave). The common genera of scarab beetles found in creosote bush scrub include *Glaresis* Erichson (Glaresidae), *Bolbocerastes* Cartwright (Geotrupidae), *Phyllophaga* Harris, *Diplotaxis*, *Anomala* Samouelle, *Cyclocephala*, *Oxygrylius* Casey, and *Tomarus* (Scarabaeidae).

Vegetation on sand dunes in the desert consists of a sparse cover of *Larrea tridentata* and a number of herbaceous annual plants that appear in spring after good winter rains, such as *Astragalus* spp., *Oenothera deltoides* Torrey & Fremont (basket evening primrose), and *Abronia villosa* S. Watson (sand verbena), adapted to the shifting substrate. In some locations, sand hills 2 to 4 meters high accumulate around shrubs of *Prosopis glandulosa* Torrey (mesquite). The shrub continues to grow upward as sands accumulate and the mound increases in height. Several interesting scarab genera occur in sandy habitats, including *Xeropsamobaeus* Saylor, *Gymnopyge* Linell, and *Oncerus* LeConte (all of family Scarabaeidae).

Arroyo bottoms and stream courses in the desert are dry most of the time, except after torrential summer thunderstorms or torrential winter rains in the mountains. Dominant trees and shrubs growing along these washes include *Hyptis emoryi* Torrey (desert lavender), *Chilopsis linearis* (Cav.) Sweet (desert "willow"), *Acacia greggii*, *Olneya tesota* A. Gray (ironwood), and *Psorothamnus spinosus* (A. Gray) Barneby (smoketree). *Washingtonia filifera* (L. Linden) H. A. Wendl. (California fan palm) grows in a few oases. A mesquite bosque dominated by *Prosopis glandulosa*, *P. pubescens* Benth. (screwbean), and *Acacia greggii* exists near the Borrego Sink. Scarab genera typically found in desert wash habitats include *Diplotaxis*, *Cyclocephala*, *Megasoma* Kirby, *Oxygrylius*, and *Tomarus* (all of family Scarabaeidae).

Wildfire in San Diego County

The ecology of San Diego County implies a long history of evolving with fire. The brief overview presented here on San Diego County wildfires is based on Unitt (2004). Few places in the county are unburned through recorded history. Wildfires burn in San Diego County each year and vary in intensity, number of fires, and total

area consumed. Fires have been especially extensive in recent years, as a result of prolonged drought and extended periods of wind with low humidity. In 2002, the Gavilan fire north of Fallbrook burned 9.0 square miles and the Pines fire burned 51.4 square miles along the east slope of the mountains from Hot Springs Mountain nearly to Mount Laguna. Fire conditions were much worse during 2003. The fires began during dry windy conditions (Santa Ana winds) in October. The Cedar fire, the largest single fire in California history since the beginning of accurate records in 1910, burned 436.4 square miles of San Diego County from Miramar and Crest east to Julian and Mount Laguna. Three additional fires also burned in the county during October 2003. The Roblar fire burned 76 square miles in Camp Pendleton, the Paradise fire burned 88.1 square miles in northern San Diego County east of Valley Center and Escondido, and the Otay fire burned 69.9 square miles between Otay Mountain and Jamul. In 2007 additional large-scale fires burned a large fraction of the areas unburned in 2002 or 2003 and reburned some areas.

After a fire, native vegetation can grow back quite quickly, depending upon several factors, including the intensity of heat produced by the fire, whether "islands" of unburned vegetation remain after the fire, the type of vegetation community burned, and the amount and pattern of rainfall after the fire. Vegetative cover may be fully recovered in three to five years. Within 10 to 15 years the vegetation structure is similar to but less dense than the structure before the fire. Chaparral usually will not burn again until it is 25 to 30 years old, while coastal sage scrub may burn in a few years before plants become large enough to survive another fire. Coastal sage scrub can be converted to nonnative grassland if burned too frequently. Very hot crown fires in forested areas during 2002 and 2003 resulted from large quantities of dead material from the drought, lack of vegetation-thinning low ground fires over the years, and concomitant growth of dense stands of fire-susceptible trees (Franklin et al. 2006). These crown fires resulted in a major loss of coniferous forest in the Cuyamaca, Laguna, and Volcan mountains.

What does wildfire mean to scarabaeoid beetles in San Diego County? The full effect is not known and will not be known until appropriate studies are done. However, it is to be expected that phytophagous beetles would be affected by the loss of food and loss of habitat. Larvae of many scarab beetles feed on roots (e.g., *Pleocoma* feeds on *Ceanothus*) and would be killed if the fire is hot and host plants are killed. There is some evidence that the fire of October 2003 reduced the population of *Trox gemmulatus* near Poway (see under that species). Only time will tell what impact the record firestorms of 2003 and 2007 will have on San Diego County's scarab beetle fauna.

METHODS AND MATERIALS

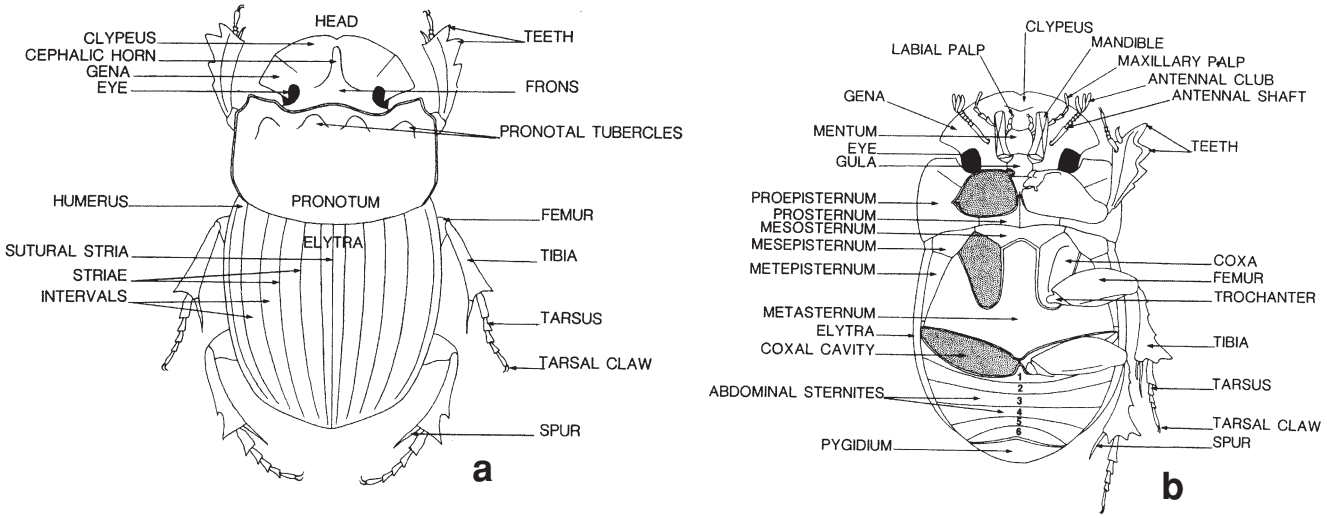
The results of the Part I study are based on examination of 3090 specimens, the majority of which McPeak collected by using blacklights, light traps, and pitfall traps, excavating beetle burrows, sampling dung and carrion, and collecting beetles in flight or on vegetation. Specimens were also examined at the San Diego Natural History Museum (SDNHM), Los Angeles County Museum of Natural History (LACM), University of California, Berkeley (UCB), University of California, Riverside (UCR), University of California, Davis (UCD), University of Idaho (WFBM), California State Collection of Arthropods (CSCA), California Academy of Sciences (CAS), and the private collections of D. C. Carlson (DCC) and D. A. La Rue (DAL). McPeak's collection is housed at his home in Battle Ground, Washington.

Each species-level taxon is introduced with a brief diagnosis followed by information on general distribution, San Diego County locality records, temporal distribution, and remarks. Each diagnosis includes length (tip of clypeus to apex of the elytra), width (measured across humeri), color, and other characters useful for species identification. Figure 4 shows a representative scarab with its body parts labeled. Dichotomous keys are presented for all included taxa.

SCARABAEOID BEETLES OF SAN DIEGO COUNTY. PART I.

Key to the families of the Scarabaeoidea of San Diego County (modified from Ratcliffe and Jameson, 2002)

1. Antennae with 11 segments 2
1′. Antennae with 8–10 segments 3
2. Large hairy beetles. Males 24.5–34.2 mm long; females 34.0–39.5 mm long, more heavy bodied than males. Males with antennal club elongate, 5-segmented (5th segment reduced), and well-developed hind wings; females with antennal club segments short, hind wings reduced to vestigial stubs ..... PLEOCOMIDAE
2′. Smaller, males and females 8.5–19.8 mm. Both sexes with antennal club round, 3-segmented, and with well-developed hind wings ..... GEOTRUPIDAE (Bolboceratinae)
3. Longer mesotibial spur pectinate along edge (Fig. 5). Reddish-brown, yellowish-brown, or bicolored with pale elytra and black pronotum and head. Length 3.9–8.5 mm ..... OCHODAEIDAE



Figures 4. Dorsal (a) and ventral (b) aspects of a scarab beetle. Courtesy B. C. Ratcliffe, University of Nebraska, Lincoln.

3′. Mesotibial spur not pectinate 4
4. The first club antennomere cup-shaped to receive second club antennomere (Fig. 6). Antennal club with 3 antennomeres. General color reddish-brown. Length 4.8–6.9 mm ..... HYBOSORIDAE
4′. First club antennomere not cup-shaped to receive second club antennomere (Fig. 7). Antennal club with 3–7 antennomeres 5
5. Abdomen with five visible ventrites underneath; upper surface of body dull and rough, with warts and ridges or tiny tubercles 6
5′. Abdomen with six visible ventrites underneath; upper surface of body variable 7
6. Eyes not divided by canthus. General color brown to black, with body surface warty or ridged. Abdomen visible, not hidden by expanded leg segments. Length 5.5–14.0 mm ..... TROGIDAE
6′. Eyes divided by canthus. General color reddish-brown. Leg segments enlarged to cover abdomen when retracted. Length 3.5–5.2 mm .....GLARESIDAE
7. Elongate hairy beetles resembling bees. Elytra short and divergent at apex ..... GLAPHYRIDAE
7′. Not elongate and hairy. Elytra longer and not diverging at apex .....SCARABAEIDAE

FAMILY GLARESIDAE Kolbe, 1905
ENIGMATIC SCARAB BEETLES

Glaresids are oblong-oval convex beetles, tan to dark brown; their dorsal surface bears moderately dense short setae. Antennae 10-segmented with 3-segmented opposable club. Eyes divided in half by canthus. Clypeus lacks tubercle or horn. Mandibles toothed and project weakly beyond apex of clypeus. Pronotum short, broad, and convex. Elytra convex with 10 distinct costae. Scutellum exposed. Pygidium concealed by elytra. Hindfemora and hindtibiae enlarged to cover abdomen when retracted.

The family Glaresidae contains one genus (*Glaresis*) with about 50 species worldwide except Australia, where it does not occur. There are 15 species in nearctic North America, distributed in mostly hot and sandy habitats from the western Great Plains to the west coast and from Manitoba, Canada, to Sonora and Baja California Sur, Mexico (Jameson 2002).

Genus *GLARESIS* Erichson, 1848

Glaresis ecostata Fall is the only species of the genus in San Diego County. One specimen of *G. inducta* Horn in the CAS collection was labeled as taken at Coronado. Robert Gordon (pers. comm.) does not believe this species occurs in San Diego County. It is probable that the Coronado specimen was mislabeled, and we do not address *G. inducta* further. Moore (1937) reported the Coronado specimen as *G. mendica* Horn.

Figure 5. Pectinate mesotibial spur of *Ochodaeus mandibularis*. 75× actual size.

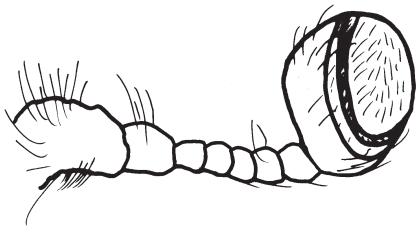


Figure 6. Right antenna of *Pachyplectrus laevis*. Note cup shape of first antennomere of club. 100× actual size.

Glaresis ecostata Fall
(Figs. 8–9)

Diagnosis—Length 3.5–5.2 mm; width 1.4–2.2 mm. Color reddish-brown. Head nearly smooth, tubercles few and small; anterior margin of clypeus nearly straight, reflexed, with angles bluntly pointed (Fig. 8). Mesotibia sinuate on outer margin; six spines present on outer margin from middle nearly to apex. Posterior margin of metatrochanter with two large teeth and one small tooth. Outer margin of metatibia bears a very large projection.

Distribution—*Glaresis ecostata* is recorded from California, Arizona, New Mexico, and Sonora and Baja California, Mexico (Gordon 1970; McPeak, personal observation).

San Diego County Locality Records—165 specimens were examined from the following desert localities (Fig. 9): Borrego Springs, 29–30 Mar 1960 (5 CAS), 2 Apr 1960 (1 CAS), 1 Oct 1961 (2 CAS), 7 Apr 1962 (9 CAS, 2 CSCA); Borrego Springs, 5 mi. SE, 6 Apr 1962 (48 CAS); Borrego Springs, Yaqui Pass Rd. and Borrego Springs Rd., blacklight, 27 Apr 1991 (13 RHM), 11 May 1991 (10 RHM), 22 Mar 1993 (16 RHM); Borrego Sink, blacklight, 11 May 1991 (10 RHM); Borrego Springs, county dump, blacklight, 23 Mar 2001 (4 RHM); Borrego Springs, 1.5 mi. N of county dump, blacklight, 23 Mar 2001 (12 RHM); Font's Point, Anza-Borrego Desert State Park, 21 Apr 1979 (9 CAS, 8 CSCA); Dolomite Mine, Anza-Borrego Desert State Park, blacklight, 13 Mar 1993 (1 RHM); Hawk Canyon, Anza-Borrego Desert State Park, blacklight, 9 Apr 1993 (15 RHM). Moore (1937) reported *Glaresis ecostata* from along the edge of the desert in March.

Temporal Distribution—March (38), April (105), May (20), October (2).

Remarks—The life history and immature stages of this beetle are unknown. *Glaresis ecostata* is readily taken at blacklights in the desert where *Prosopis* and *Larrea* are abundant.

Figure 7. Right antenna of *Trox gemmulatus*. Note lamellate shape of first antennomere of club. 100× actual size.

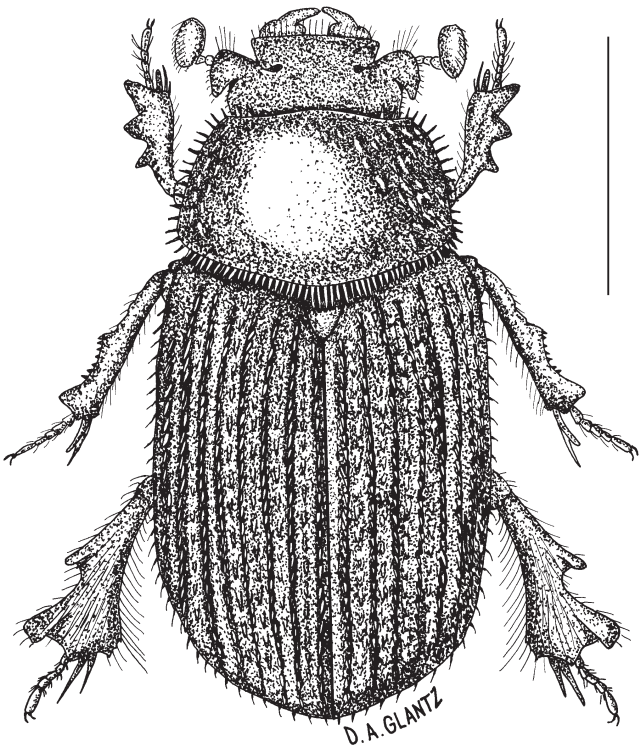


Figure 8. *Glaresis ecostata* Fall. Scale 2 mm.

FAMILY TROGIDAE MacLeay, 1819
HIDE BEETLES

Trogids are recognized by their warty or ridged body surfaces and brown to gray to black coloration. They are frequently encrusted with soil and/or organic debris and may need to be cleaned for viewing and identification. They range in length from 5.5 to 14.0 mm.

Vaurie (1955) provided an excellent revision of the North American trogid species, and Scholtz (1982) produced a world catalog for the family Trogidae. Approximately 300 trogid species are known worldwide, with diversity and abundance increasing in more arid regions (Scholtz 1982). Two genera (*Trox* and *Omorgus*) and 42 species occur in the Nearctic Realm (Smith 2003). *Omorgus suberosus* and three species of *Trox* occur in San Diego County.

These beetles feed on skin, bones, hair, and feathers and are among the last scavengers to visit the dry remains of dead animals. Trogids also feed on organic debris in bird and mammal nests (feathers, fur, feces), as well as on the hair in coyote (*Canus latrans*) scat. Larvae of carrion-feeding species live in short burrows beneath animal carcasses, where they presumably feed on the same remains as the adults (Baker 1968). Adult trogids, when disturbed or frightened, feign death by withdrawing their legs and holding them tightly under the body and remaining motionless. This behavior, coupled with their dirt-covered bodies, makes them cryptic and difficult to see. All stages of their life cycle are found by sifting soil beneath the dried remains of animals in the later stages of decay.

Key to the Trogidae of San Diego County

1. Scutellum hatchet-shaped or hastate, distinctly narrowed at base. Base of pronotum constricted. Size 12.0–14.0 mm ....*Omorgus suberosus* (Fabricius)

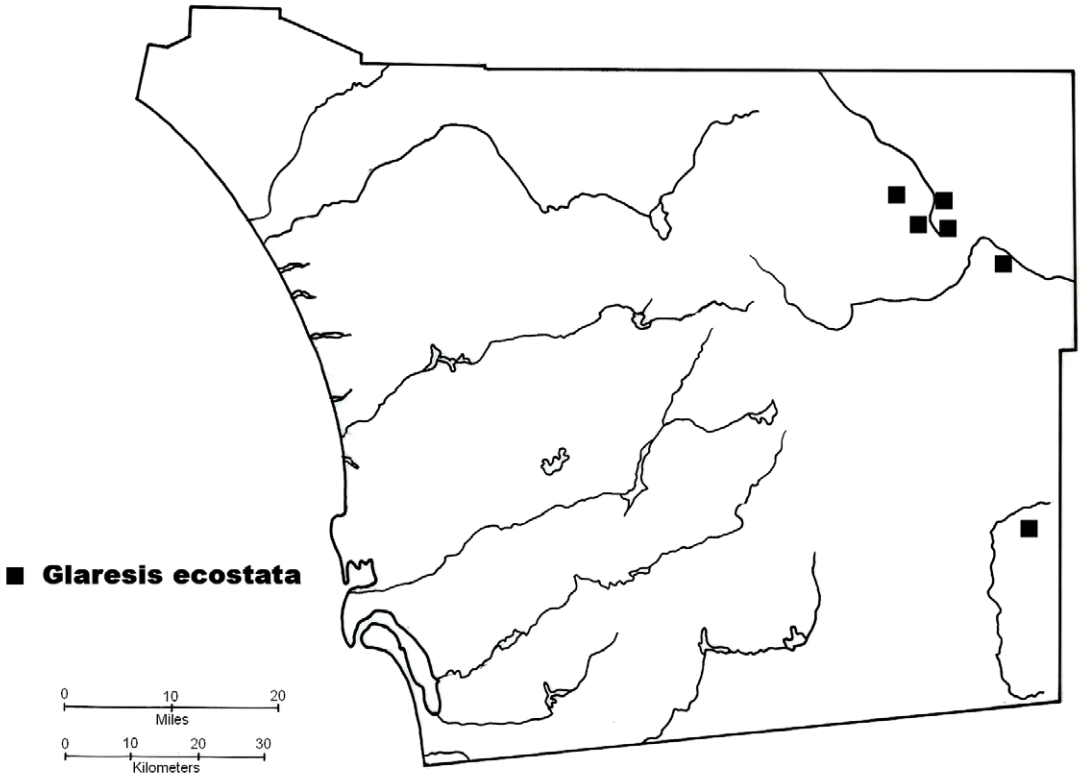


Figure 9. Distribution, *Glaresis ecostata*.

1′. Scutellum oval, not narrowed at base. Base of pronotum not constricted. Size 6.0–11.8 mm: *Trox* Fabricius 2
2. Pronotum virtually glabrous, quite uniformly smooth, without pronounced ridges or depressions; elytra with all intervals about equal in width and elevation 3
2′. Pronotum tomentose, irregularly sculptured with pronounced ridges, tubercles, and depressions; elytra with alternate intervals strongly elevated and sharply ridged ....*Trox gemmulatus* Horn
3. Lateral margins of pronotum with setae as long or longer than the elytral intervals are wide; elytral intervals with a single row of equidistant setae in center .....*Trox atrox* LeConte
3′. Lateral margins of pronotum with short setae; elytral intervals with setae, if visible, in double rows or in isolated patches .....*Trox fascifer* LeConte

Genus *OMORGUS* Erichson, 1847

Omorgus is distributed throughout the drier regions of the world. Vaurie (1955) treated members of this genus as the *suberosus* species group of *Trox*, while Baker (1968) restored *Omorgus* to generic status on the basis of several differences in both larvae and adults. The genus is distinguished from *Trox* by having the pronotum sharply constricted on the side near the base and having a hatchet-shaped or hastate scutellum.

Seventeen species of *Omorgus* occur in the Nearctic Realm (Smith 2003). *Omorgus suberosus* (Fabricius) is the only species in San Diego County.

Omorgus suberosus (Fabricius)
(Figs. 10–11)

Diagnosis—Length 12.0–14.0 mm; width 5.9–7.5 mm. Head with frons bituberculate. Lateral margin of pronotum sharply constricted in its basal fourth with a strong (but lesser) constriction just behind the middle (Fig. 10). Elytra with odd intervals weakly elevated and with small black shining areas alternating with tomentose patches.

Distribution—*Omorgus suberosus* has the broadest distribution of any trogid in the western hemisphere. It ranges from Canada to southern South America and on some Pacific islands (Scholtz 1982). It occurs throughout the United States except New England, the Pacific Northwest, and Alaska (Vaurie 1955; Baker 1968).

San Diego County Locality Records—80 specimens were examined. *Omorgus suberosus* has been collected from the coast to the desert at elevations from near sea level to 1220 m (Fig.11): California/Mexico border, 18 May 1983 (1 UCB, 1 SDNHM); San Diego, 20 Mar 1933 (1 CAS), 28 May 1946 (1 CSCA); Point Loma, no date (2 SDNHM); La Mesa, 7 Jun 1959 (1 UCB); Del Mar, May (1 SDNHM); Carlsbad, 7989 La Brusca Way, blacklight, Jun 1979 (1 RHM), Jun 1986 (1 RHM), May 1990 (1 RHM), 1–11 Aug 1991 (2 RHM); Vista, 7 May 1960 (41 CAS); Spring Valley, blacklight, 7–10 Mar 1970 (1 RHM), 4 Jun 1987 (1 RHM); Jamacha, 21 May 1956 (6 LACM); Barrett School, 30 Jul 1983 (1 SDNHM); Boulevard-Manzanita, 7 Aug 1979 (1 SDNHM); Escondido, Lake Dixon, 4 Jun 1981 (1 SDNHM); El Capitan Dam, May (1 SDNHM); Pine Valley, blacklight, 28 Jun 1986 (1 RHM), 18 Jun 1993 (2 RHM); Jacumba, Sep (1 SDNHM); Jacumba, De Anza Springs Resort, blacklight, 9 Jun 1994 (2 RHM, 3 LACM); Jacumba, 1.5 mi. E, 11 Jun 1981 (1 CAS); Mountain Springs Pass, 24 Jun 1984 (2 SDNHM); Tamarisk Grove, Anza-Borrego Desert State Park, 14 Jun 1961 (1 CAS), and Borrego Springs, 4 Jul 1956 (1 RHM).

Temporal Distribution—March (2), May (53), June (17), July (2), August (3), September (1).

Remarks—Vaurie (1955) reported *Omorgus suberosus* taken under goat carrion, chicken feathers, and cow dung, at malt, and at lights. Adults in North Dakota overwinter and emerge the following spring to feed and mate (Lago et al. 1979).

Figure 10. *Omorgus suberosus* (Fabricius). Jacumba, De Anza Springs Resort, blacklight, 9 Jun 1994. 5× actual size.

Genus *TROX* Fabricius, 1775

Trox is easily distinguished from *Omorgus* by its oval scutellum in combination with an overall warty appearance, brown to black color, and crust of dirt. Twenty-five species of *Trox* occur in the Nearctic Realm, four in San Diego County.

Trox atrox LeConte
(Figs. 11–12)

Diagnosis—Length 6.0–9.0 mm; width 3.1–5.2 mm. Head lacking tubercles or ridges (Fig. 12). Apex of clypeus broadly rounded. Marginal setae of pronotum long. Surface of elytra not tomentose.

Distribution—*Trox atrox* is found in the western United States east to the Mississippi River and in Illinois, Michigan, and Indiana, as well as in Canada and Durango, Mexico (Bousquet 1991; Vaurie 1955).

San Diego County Locality Records—3 specimens were examined (Fig. 11): San Diego County, no date (2 CAS); Carlsbad, La Brusca Way, blacklight, Jun 1986 (1 RHM).

Temporal Distribution—June (1).

Remarks—*Trox atrox* is a member of the *scaber* species group. Adults have been collected in nests of a ground squirrel (species not specified) and a burrowing owl (*Athene cunicularia*), in a gopher hole, at lights, and under a dead cow (Vaurie 1955).

Trox fascifer LeConte
(Figs. 11, 13)

Diagnosis—Length 5.5–7.0 mm; width 3.8–4.0 mm. Pronotum with short marginal setae and rectangular hind angles (Fig. 13). Elytra with all intervals flat, clothed with small round tufts of yellow setae; reflexed elytral sides without setae.

Distribution—Vaurie (1955) reported *Trox fascifer* from the region of San Francisco, California, north to British Columbia, Canada. Here we extend the known distribution of *T. fascifer* southeast to San Diego County, a distance of approximately 640 km.

San Diego County Locality Records—5 specimens were examined (Fig. 11): Lake Hodges, 16 May 1978, at blacklight (1 SDNHM);

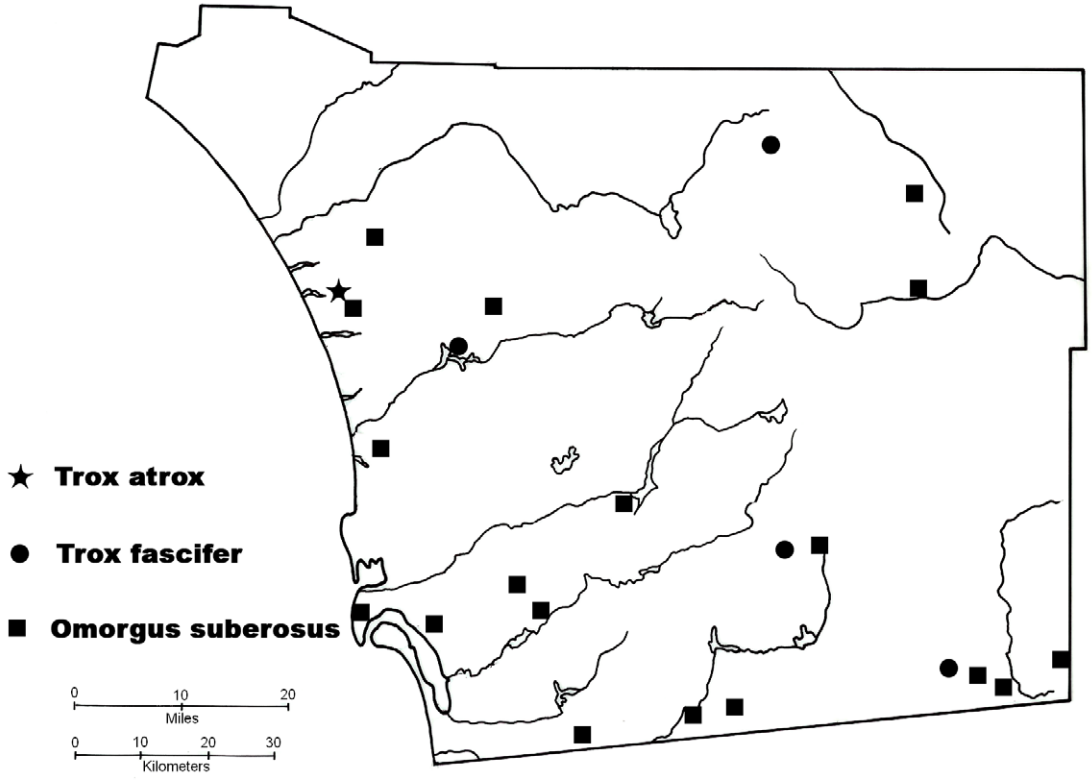


Figure 11. Distribution, *Omorgus suberosus*, *Trox atrox*, and *T. fascifer*.

Figure 12. *Trox atrox* LeConte. Carlsbad, 7989 La Brusca Way, blacklight, June 1986. 10× actual size.

Boulevard, 16 May 1994, at light (1 LACM); Hot Springs Mountain, 1835 m, 8 Jul 1991, at blacklight (1 RHM), 6 Jul 2002 (1 RHM); Pine Valley, Nobel Canyon Trailhead, 1220 m, 18 Jun 1993, at blacklight (1 RHM).

Temporal Distribution—May (2), June (2), July (1).

Remarks—*Trox fascifer* is only rarely collected in San Diego County. Its habits may be similar to those of other members of the *scaber* species group of *Trox* that live in bird nests and mammal burrows where they feed on feathers, fur, and other organic material (Vaurie 1955).

Trox gemmulatus Horn
(Figs. 14–15)

Diagnosis—Length 9.2–11.8 mm; width 4.5–6.0 mm. Head not tuberculate. Pronotum with two prominent median longitudinal ridges from base to apex, often ridged transversely at middle (Fig. 14). Pronotum deeply sinuate near the hind angles. Four odd intervals of each elytron sharply elevated and cristiform. Tubercles on seventh interval at base usually very prominent on humeral umbone. Elytral margin strongly crenulate.

Distribution—California and northern Baja California, Mexico. Vaurie (1955) also recorded specimens from Arizona, New Mexico, South Dakota, but these records are highly suspect.

San Diego County Locality Records—1745 specimens examined. Most were collected in chaparral or coastal sage scrub west of the mountains (Fig. 15): San Diego County, no date (6 CAS), 19 Apr 1891 (3 CAS); San Diego, no date (2 CAS, 1 SDNHM), 13 Jan 1912 (22 CAS), 22 Mar 1913 (1 SDNHM), 20 Feb 1946 (2 UCB); Chula Vista, pitfall trap, 5 Apr 1997 (1 RHM); 0.5 mi. S. of Sweetwater Reservoir, pitfall trap, 5 Apr 1997 (3 RHM); Spring Valley, Edgewater Estates, on dead cats, 7–13 Mar 1970 (38 RHM); Spring Valley, Jamacha Rd., on

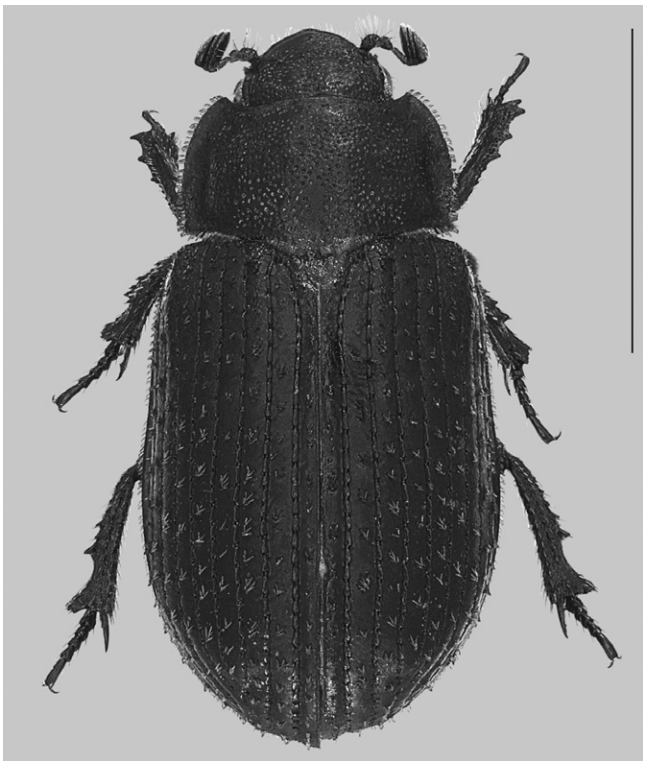


Figure 13. *Trox fascifer* LeConte. Pine Valley, Nobel Canyon Trailhead, blacklight, 18 Jun 1993. Photo courtesy Steve Valley, Oregon Department of Agriculture. Scale 3 mm.

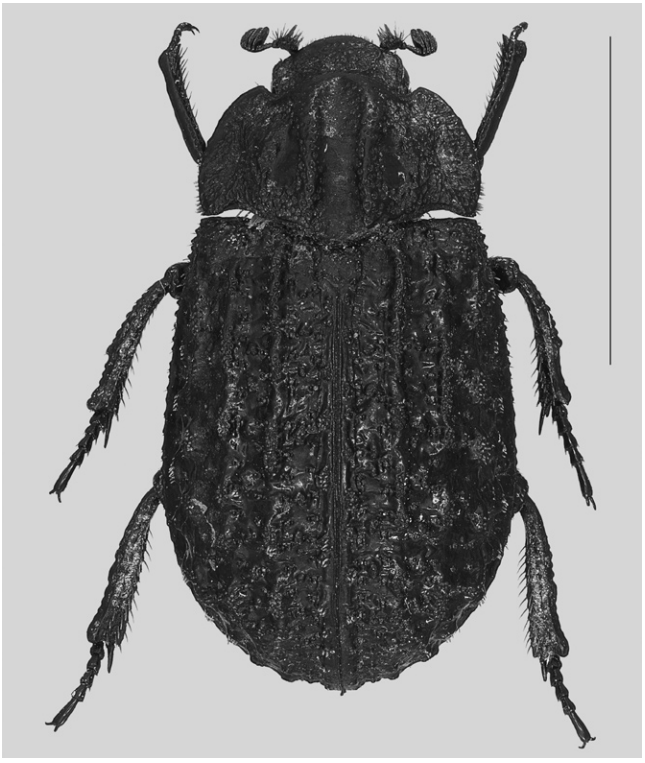


Figure 14. *Trox gemmulatus* Horn. Poway, near Blue Sky Reserve, on coyote scat, 2 Jan 2002. Photo courtesy Steve Valley, Oregon Department of Agriculture. Scale 5 mm.

dead cat, 22–27 Jan 1971 (21 RHM); Spring Valley, Dictionary Hill, 11 Feb 1977 (1 SDNHM); Jamul, 9 Jan 1983 (1 SDNHM), 1 Mar 1987 (3 SDNHM); 8 km NE of Lakeside, Silverwood Wildlife Sanctuary, 21 Mar 1978 (1 SDNHM); Mission Valley, 17 Jan 1930 (6 CAS), 24 Dec 1932 (1 UCB, 2 SDNHM); 22 Feb 1933 (1 UCB, 7 SDNHM), 3 Feb 1940 (8 SDNHM); Mission Valley, "eating hair-filled dung," 23 Jan 1979 (5 SDNHM); Mission Gorge, 23 Jan 1979 (1 SDNHM), 24 Feb 1979 (3 SDNHM), 24 Mar 1979 (3 SDNHM), 22 Oct 1979 (2 SDNHM); E. end, USIU campus, pitfall trap, Apr 1997 (1 RHM); Del Mar, McHenry Ranch, 19 May 1979 (1 SDNHM); Torrey Pines, pitfall trap, 19 Feb 1997 (5 RHM); Little Cedar Canyon (ridge above), pitfall trap, 20–25 Feb 1997 (3 RHM); Miramar, 22 Jan 1988 (7 UCB), 19 Feb 1988 (3 UCB), 10 Mar 1987 (5 UCB); Scripps Ranch, USIU (currently Alliant International University) campus, 24 Jan 1973 (7 SDNHM), 12–26 Feb 1973 (7 SDNHM), 3–28 Nov 1973 (29 SDNHM), 5–19 Dec 1973 (16 SDNHM), 3 Jan 1974 (14 SDNHM), 10 Jan 1974 (5 SDNHM), 24 Jan 1974 (7 SDNHM), 31 Jan 1974 (14 SDNHM), 7 Feb 1974 (3 SDNHM), 14 Feb 1974 (3 SDNHM), 21 Feb 1974 (12 SDNHM), 26 Feb 1974 (2 SDNHM), 29 Feb 1974 (4 SDNHM), 8 Mar 1974 (4 SDNHM), 29 Mar 1974 (2 SDNHM), 6–23 Apr 1974 (15 SDNHM), 28 Apr 1974 (2 SDNHM), 6 May 1974 (1 SDNHM), 28 Jun 1974 (1 SDNHM), 27 Oct 1974 (2 SDNHM), 17 Dec 1974 (4 SDNHM), 19 Dec 1974 (2 SDNHM), 26 Dec 1974 (11 SDNHM), 24 May 1979 (1 SDNHM), 26 May 1979 (1 SDNHM); Poway, no date (2 CAS), 14 Oct 1972 (1 CAS); Poway, near Blue Sky Reserve, on coyote scat, Jan 2002 (14 RHM); Poway, Lake Poway, on coyote scat, 26 Jan 2005 (21 RHM); Vista, 12 May 1937 (1 CAS); Carlsbad, 0.5 mi. NE El Camino Real and Olivenhain Road, on coyote scat, 5 Feb 1989 (157 RHM), 15 Dec 1991 (58 RHM); Carlsbad, 0.5 mi. NE El Camino Real and Olivenhain Road, on dog dung, 5 Feb 1989 (32 RHM); Carlsbad, near city dump, on coyote scat, 5 Feb 1989 (5 RHM); Carlsbad, El Camino Real and Olivenhain Road, on horse hide, 16–22 Feb 1987 (30 RHM), 8 Mar 1987 (16 RHM), 14–29 Mar 1987 (18 RHM); Carlsbad, El Camino Real and Olivenhain Road, on coyote scat, 3–8 Jan 1989 (98 RHM), 14–15 Jan 1989 (20 RHM), 4 Feb 1989 (15 RHM), 5 Mar 1989 (2 RHM), 15 Mar 1989 (3 RHM), 22–26 Nov 1990 (88 RHM), 2 Dec 1990 (2 RHM), 31 Mar 1991 (15 RHM), 17 Nov 1991 (2 RHM), 1 Jan 1992 (38 RHM), 16 Feb 1992 (15 RHM), 28 Mar 1992 (6 RHM), 6 Dec 1992 (52 RHM), 29 Dec 1992 (45 RHM), 28 Jan 1993 (44 RHM), 11–12 Dec 1993 (22 RHM), 25 Jan 1994 (18 RHM), 31 Jan 1994 (50 RHM), 17 Nov 1995 (7 RHM), 19–20 Nov 1995 (47 RHM), 13–14 Dec 1995 (114 RHM); Carlsbad, El Camino Real and Olivenhain Road, on dog dung, 25 Jan 1994 (1 RHM); Carlsbad, Questhaven and Rancho Santa Fe Drive, on coyote scat, 1 Jan 1993 (59 RHM); Carlsbad, El Camino Real and Cassia Drive, on coyote scat, 14 Dec 1995 (90 RHM), 17 Jan 1997 (64 RHM); Carlsbad, 1.0 mi. N of La Costa on El Camino Real, coyote scat, 27 Jan 2005 (42 RHM); Camp Pendleton, San Onofre Canyon, on coyote scat, 21 Feb 1992 (15 RHM); Ramona Springs, 11 Feb 1940 (17 UCB); Japatul Valley, 21 Dec 1992 (9 RHM); Pine Creek Wilderness, on coyote scat, 17 Jan 1995 (50 RHM); La Puerta; 11 Jul (1 SDNHM).

Temporal Distribution—January (629), February (350), March (117), April (25), May (5), June (1), July (1), October (5), November (173), December (428).

Remarks—*Trox gemmulatus* LeConte is a late fall or winter species in California and common in San Diego County. Summer in the county is dry, and *T. gemmulatus* usually emerges with the onset of rains in the fall or winter. Vaurie (1955) recorded a single specimen taken under coyote dung, the only previous record of ecological associations for the species. In San Diego County *T. gemmulatus* is most often found on coyote scat or crawling on the ground near the scat from November through February. The beetles feed on hair and other debris in scat. We have collected as many as 51 individuals on and under a single scat. None of the other three species of trogid in San Diego County were taken on scat.

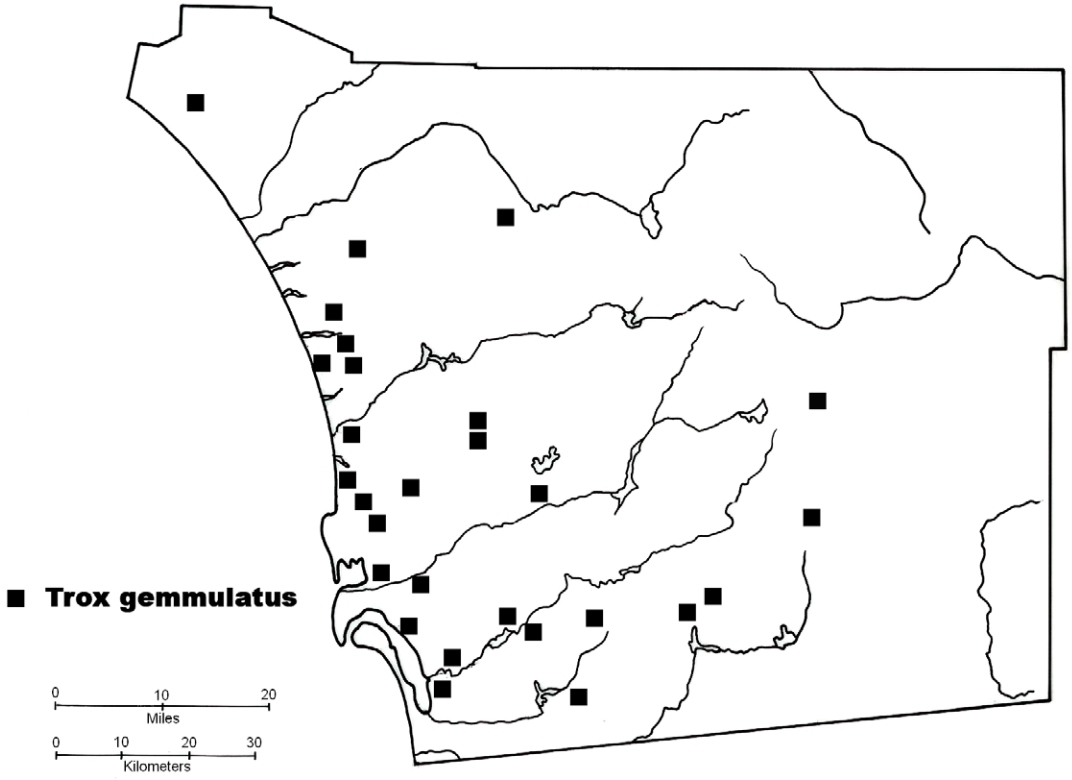


Figure 15. Distribution, *Trox gemmulatus*.

There is some evidence that populations of *Trox gemmulatus* in San Diego County have been affected by wildfire. On 29 January 2005 we compared the number of live beetles on coyote scats at two sites near Poway, one burned during October 2003 and the other unburned. Both sites were in coastal sage scrub. One *T. gemmulatus* was observed on approximately 25 fresh scats at the burned site. We were surprised to find so few individuals on "perfect" scats under ideal conditions during recent rains and decided to sample the unburned site. Nineteen individuals were found on 15 scats at the unburned site. The intense heat of the October 2003 fire probably killed adult beetles that were beneath the surface at the burned site.

The population of *Trox gemmulatus* in San Diego County has been reduced by construction and development. The chaparral at most of the sites where McPeak collected *T. gemmulatus* in Carlsbad in the 1990s no longer exists.

FAMILY PLEOCOMIDAE LeConte, 1861
RAIN BEETLES

The family Pleocomidae contains the single genus *Pleocoma* LeConte. Adult beetles have nonfunctional mandibles and do not feed. Males have a well-developed horn on the vertex, a strongly emarginate clypeus, and color that varies from reddish-brown to piceous black (Figs. 16–17). Females are generally much larger than males, have a poorly developed horn on the vertex, a less emarginate clypeus, and are almost always reddish-brown (Fig. 18). Both sexes are clothed in dense setae underneath the body and on the appendages.

Adults of *Pleocoma* are called rain beetles because they usually fly during or immediately after fall and early winter rains. Larvae of *Pleocoma* feed externally on roots and are often found deep within the soil beneath their host plants. For most species the duration of the larval stage is not known, but some species are known to have nine or more instars and require up to 13 years to reach adulthood (Ellertson and Ritcher 1959). Pupation occurs in late summer. Both sexes dig to the surface and emerge, usually during or immediately after precipitation. Males are fully winged and capable of flight, but females have greatly reduced hind wings and are unable to fly. Females release pheromones that attract flying males, and mating occurs on the surface of the ground or inside the female's larval burrow. Some flights of males are enormous, with several hundred beetles coming to light in an evening. In San Diego County rain beetles are active in the fall or early winter.

Genus *PLEOCOMA* LeConte, 1856

There are 26 species and 6 subspecies of *Pleocoma*, confined to western North America from northern Baja California north through California and Oregon to southern Washington (Hovore 2002). Two species occur in San Diego County.

Key to the Pleocomidae (males) of San Diego County

1. Clothed in reddish-yellow hair .....*Pleocoma australis* Fall
1′. Clothed in black or rusty-black hair .....
.....*Pleocoma puncticollis* Rivers

Females of both species are similar in appearance, being robust, ovate, castaneous, and larger and more heavy-bodied than males (Fig. 18). Females are difficult to identify to species without males from the population (Frank Hovore, pers. comm.).

Pleocoma australis Fall
(Figs. 16, 19)

Diagnosis—Male's length 25.8–29.8 mm; width 12.7–15.5 mm. Black above. Body beneath castaneous and clothed with reddish-

yellow hair (Fig. 16). Male's head horn on vertex with sides that converge toward the apex. The female much larger than the male, robust, ovate, and castaneous in color. The single female examined measures 34.0 mm long, 15.8 mm wide. Greatest width of female across elytra at about 2/3 distance from base 19.2 mm.

Distribution—*Pleocoma australis* occurs in Los Angeles, San Bernardino, Riverside, and San Diego counties, California, and likely in Baja California, Mexico, also.

San Diego County Locality Records—1 female and 49 male specimens were examined from San Diego County from the following locations (Fig. 19): Palomar Mountain Ranger Station, 11 Nov 1972 (1 SDNHM); Palomar Mountain Maintenance Station, 20745 State Park Road, 1590 m, 29–30 Nov 1991 (1 SDNHM, 1 RHM), 23–30 Oct 1992 (9 RHM), 22–24 Nov 1992 (3 RHM), 6–12 Dec 1992 (5 RHM); road to Palomar Mountain Observatory, 30 Oct 1998 (1 SDNHM); Cuyamaca, no date (1 CAS); Cuyamaca Mountain, 1400 m, 1 Nov 1990 (1 SDNHM); Hot Springs Mountain, during first snow, 17 Nov 1935 (2 SDNHM, 1 CAS); Julian, base of Volcan Mountain, 2.0 mi. N of Wynola Road on Farmer Road, 1280 m, 22 Nov 1992 (1 RHM), 3–4 Dec 1992 (2 RHM); Wynola, 1070 m, 30 Oct 1992 (2 RHM), 22 Nov 1992 (1 RHM); Laguna Mountains, taken in forest from hole dug 0.75 m, 29 Oct 1968 (1 ♀, SDNHM); Julian, 30 Dec 1964 (1 CAS); Indian Flats, 977 m, 26 Oct 1957 (16 SDNHM); Oak Grove, 832 m, near the Riverside County line (A. V. Evans, pers. comm.).

Temporal Distribution—October (29), November (12), December (8).

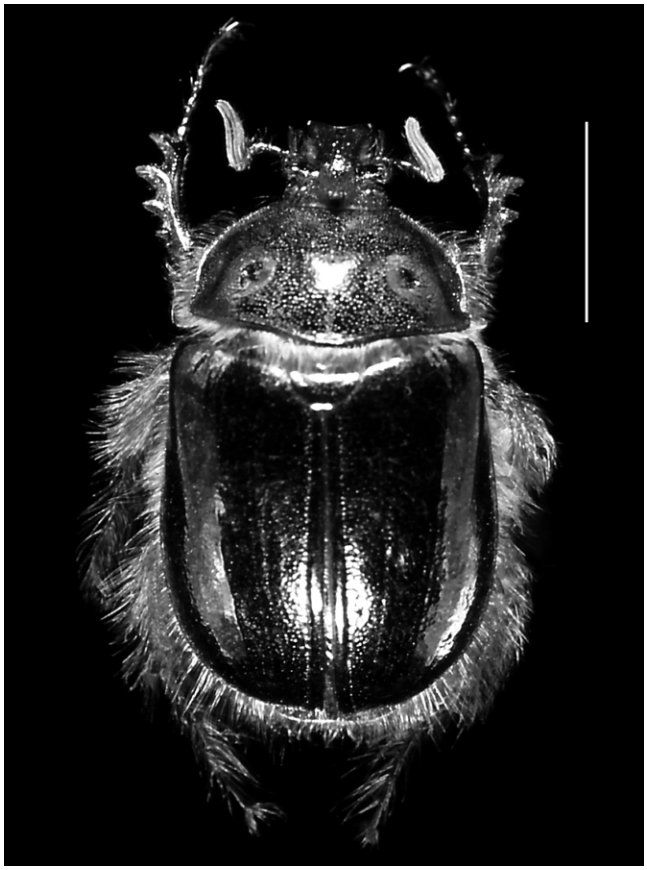


Figure 16. Male *Pleocoma australis* Fall. Palomar Mountain, Palomar Mountain Maintenance Station, 20745 State Park Road, in light trap, 23-30 Oct 1992. Scale 10 mm.

Remarks—*Pleocoma australis* occurs primarily at higher elevations, usually above 1000 m in San Diego County. Peak activity occurs in October before the onset of freezing temperatures. Males are usually taken at night in foggy, misty, and rainy conditions but only occasionally in snow flurries. On Palomar, Cuyamaca, Volcan, Laguna, and Hot Springs mountains the species occurs in coniferous forest dominated by species of *Pinus* and *Quercus*, as well as *Abies concolor, Pseudotsuga macrocarpa*, and *Calocedrus decurrens*. At Oak Grove and Indian Flats it occurs at elevations lower than 1000 m in chaparral dominated by *Adenostoma*, *Arctostaphylus*, *Ceanothus*, and *Quercus*. Larvae, pupae, and adults of both sexes have been dug from beneath *Quercus chrysolepis*, *Quercus* sp., *Pinus ponderosa*, *Arctostaphylus* sp., *Ceanothus* sp., and in an area with grasses and forbs a considerable distance away from any woody shrubs or trees (D. A. La Rue, pers. comm.).

Males of *Pleocoma australis* can be distinguished from those of *P. puncticollis* by their reddish-yellow hair, smaller average size (length 27 mm; width 13.5 mm), earlier activity period, and occurrence primarily at elevations above 1000 m in coniferous forest.

Pleocoma puncticollis Rivers
(Figs. 17–19)

Diagnosis—Male's length 24.5–34.2 mm; width 12.5–17.0 mm. Body shining black. Underside of body and legs clothed with black, slate-black, or rusty-black hair (Fig. 17). Horn of vertex with sides almost parallel and with a very slight emargination at the apex. The female is much larger than the male, robust, ovate, and castaneous in color (Fig. 18). Female's length 37.0–39.5 mm; width 18.1–20.2 mm. Greatest width of female across elytra at about 2/3 distance from base 22.8–25.1 mm.

Distribution—*Pleocoma puncticollis* occurs in Los Angeles, Orange, and San Diego counties, California, and Baja California, Mexico.

San Diego County Locality Records—893 male and 13 female *Pleocoma puncticollis* were examined from the following locations (Fig. 19): Naval (now Marine Corps) Air Station Miramar, 27 Jan 1996 (2 RHM); Torrey Pines Grade, Feb 1927 (1 CAS); Torrey Pines Park, 8 Jan 1950 (1 UCB); Del Mar, no date (1 ♀ SDNHM, 3 CAS); Del Mar, Feb 1925 (1 CAS), 11 Dec 1926 (1 ♀ CAS, 13 CAS, 1 UCD), 11–12 Dec 1926 (19 SDNHM, 1 UCB), 11 Nov 1927 (1 CAS), 11 Dec 1927 (1 UCD), Feb 1932 (2 CAS, 3 SDNHM), 27 Oct 1941 (1 LACM), 9–10 Jan 1943 (2 LACM), 5 Nov 1944 (25 LACM, 7 UCB, 1 ♀ UCB), 8 Nov 1944 (2 UCD), 25 Nov 1944 (1 LACM), 28 Oct 1948 (12 LACM), 26 Dec 1948 (5 UCB), 22 Nov 1949 (3 UCR), 23 Dec 1949 (9 UCB), 30 Jan 1950 (1 ♀ UCB), 16 Nov 1950 (3 ♀ LACM), 11 Nov 1954 (1 LACM), 6 Jul 1955 (1 LACM), 28 Oct 1957 (1 SDNHM), 15 Nov 1969 (3 CAS), 15–16 Nov 1969 (56 RHM), 17 Dec 1970 (1 RHM), 29 Sep 1971 (1 RHM), 3–4 Dec 1971 (2 CAS, 4 RHM), 13 Dec 1971 (4 RHM), 21 Dec 1971 (1 UCD), 13 Nov 1978 (4 SDNHM), Oct 1985 (1 RHM), 26 Nov 1990 (1 RHM); Del Mar, flying in fog, 23 Nov 1949 (3 CAS); Del Mar, flying in light drizzle, 28 Oct 1948 (3 UCB); Encinitas, Oakcrest Park, 7–8 Dec 1992 (4 RHM), 17–18 Dec 1992 (1 RHM); Encinitas, 0.25 mi. N of Oakcrest Park, 17–18 Dec 1992 (1 RHM); Encinitas, 13 Nov 1978 (2 SDNHM); Leucadia, from road cut, 12 Nov 1966 (1 ♀ SDNHM); Leucadia, 15 Nov 1966 (1 SDNHM); Tenaja, 732 m, dug from base of *Ceanothus crassifolius*, 11 Dec 1992 (1 ♀ RHM); Escondido, 9 Dec 1973 (1 UCR); Escondido, 9407 Canyon Country Lane, above Lawrence Welk Country Club Village, 490 m, light trap, 17 Dec 1990 (10 RHM), 2–11 Nov 1991 (18 RHM), 17–18 Nov 1991 (40 RHM), 29–30 Nov 1991 (30 RHM), 9 Dec 1991 (2 RHM), 14 Dec 1991 (6 RHM), 17–19 Dec 1991 (18 RHM), 27–30 Dec 1991 (101 RHM), 2–7 Jan 1992 (37 RHM); Escondido, Welk View and Welk Highland Drive, dug, 16 Nov 1991 (1 ♀, 1 DAL); Escondido, near 9407 Canyon Country Lane, dug

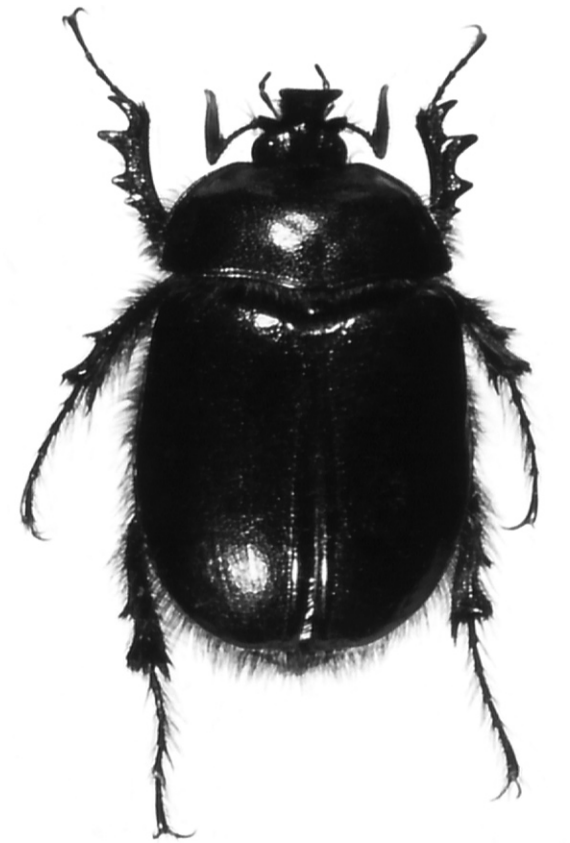


Figure 17. Male *Pleocoma puncticollis* Rivers. Escondido, 9407 Canyon Country Road, in light trap, 29-30 Nov 1991. Scale 10 mm.

Figure 18. Female *Pleocoma puncticollis* Rivers. Ramona, Dos Picos County Park, dug from beneath *Ceanothus crassifolius*, 27-X1-1992. Scale 10 mm.

from 50-cm hole, 16 Nov 1991 (1 ♀ RHM); Escondido, Meadow Mesa Lane and Meadow Mesa Drive, dug from near *Ceanothus tomentosus*, 29 Nov 1991 (1 ♀ RHM); Valley Center, no date (1 SDNHM), spring 1928 (1 SDNHM); Ramona, 1935 (1 CAS), spring 1935 (2 SDNHM); Ramona, Dos Picos County Park, 490 m, light trap, 29 Nov 1991 (2 RHM), 17 Dec 1991 (8 RHM), 5 Jan 1992 (4 RHM), 22 Nov 1992 (252 RHM), 3 Dec 1992 (25 RHM), 18 Dec 1992 (4 RHM); Ramona, Dos Picos County Park, at light, 17 Nov 1994 (1 RHM), 26 Nov 1994 (1 RHM), 25–26 Nov 1994 (8 RHM); Ramona, Dos Picos County Park, 490 m, dug from base of *Ceanothus crassifolius*, 27 Nov 1992 (1 ♀ RHM); 8 km NE of Lakeside, Silverwood Wildlife Sanctuary, 13003 Wildcat Canyon Road, 20 Oct 1976 (1 SDNHM), 8 Dec 1991 (1 SDNHM); Alpine, 562 m, 12 Nov 1989 (1 SDNHM), 22 Nov 1992 (10 SDNHM); Descanso, 1047 m, 22 Oct 1978 (1 SDNHM); Lake San Vicente, 200 m, 31 Oct 1987 (44 D. A. La Rue, pers. comm.); Lake Morena, 900 m, 5 Dec 1992 (2 RHM); Mt. Laguna, 9 Nov 1940 (1 CAS); Boulevard-Manzanita, 1160 m, 3–4 Nov 1979 (10 SDNHM), 6 Dec 1979 (1 SDNHM), 19 Nov 1982 (2 SDNHM); Boulevard, 21 Nov 1978 (18 SDNHM), 20 Nov 1982 (12 SDNHM).

Temporal Distribution—January (47), February (7), July (1), September (1), October (64), November (526), December (251).

*Remarks***—** *Pleocoma puncticollis* is primarily a species of lower elevations, generally occurring below 1000 m in chaparral dominated by *Adenostoma* and *Ceanothus*. It is most active during rains in November and December. Hazeltine (1952) speculated that the host plant for the Del Mar population was *Ceanothus* sp. Hovore (1971) collected larvae and adult males and females from beneath *Ceanothus* sp. in Los Angeles County. We collected females from beneath *Ceanothus tomentosus* C. Parry above Lawrence Welk Country Club in Escondido and from beneath *C. crassifolius* Torrey at Dos Picos County Park, Ramona, and in northwestern San Diego County near Tenaja. Although we did not collect males of the Tenaja population, we believe the single female collected at the site is *P. puncticollis* because it was associated with chaparral at low elevation well west of the mountains.

Coastal populations of *Pleocoma puncticollis* have been significantly fragmented in recent years by development and destruction of chaparral in San Diego County. Historically, *P. puncticollis* probably existed all along the coast in chaparral from La Jolla and Air Station Miramar to Oceanside. The Del Mar population still persists in a small patch of chaparral off Del Mar Heights Road, west of Interstate 5. Similar fragmented populations exist in Encinitas at Oakcrest Park and at Air Station Miramar.

The easternmost and highest (1160 m) population of *Pleocoma puncticollis*, known only from collected males, inhabits chaparral near Boulevard-Manzanita. This chaparral is very extensive and has not been fragmented to the extent seen in coastal areas. The larvae probably feed on *Ceanothus cuneatus* (Hook.) Nutt. and *C. greggii* A. Gray ssp. *perplexans* (Trel.), species common in the Boulevard-Manzanita area. Additional sampling in chaparral over a wider area of southeastern San Diego would probably yield additional specimens and increase our knowledge of this species' range.

Davis (1935) reported the type locality for this species as "Cuyamaca Mountains, 8 miles from Julian, Calif." Moore (1937) reported *Pleocoma puncticollis* from Oceanside and Valley Center.

Males of *Pleocoma puncticollis* can be distinguished from those of *P. australis* by their black, slate black, or rusty-black hair, larger average size (length 30 mm; width 16 mm), later activity period, and occurrence primarily in chaparral habitats below 1000 m.

FAMILY GEOTRUPIDAE Latreille, 1802
EARTH-BORING DUNG BEETLES

Geotrupids are oval or round beetles, colored reddish-brown or black in San Diego County. Antennae 11-segmented with a 3-segmented opposable tomentose club. Eyes completely or partially divided

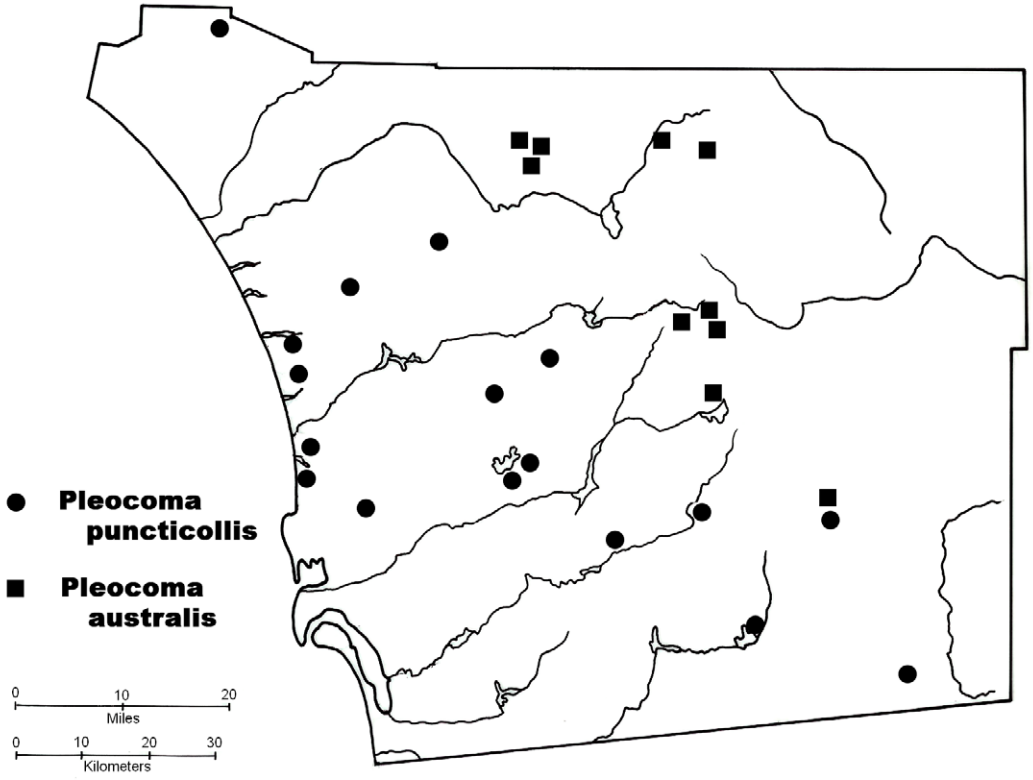


Figure 19. Distribution, *Pleocoma australis* and *P. puncticollis*.

by canthus. Clypeus often with tubercle or horn. Mandibles prominent, produced beyond apex of labrum. Pronotum convex with base wider than or subequal to elytral base and with or without tubercles, ridges, horns, or sulci. Pygidium concealed by elytra. The family Geotrupidae includes 68 genera and about 620 species worldwide (Scholtz and Browne 1996) divided into the subfamilies Geotrupinae and Bolboceratinae. Five species of Bolboceratinae occur in San Diego County.

The life histories of geotrupids are diverse. Adults of most species are secretive, living most of their lives in burrows. Many adult geotrupids are nocturnal and are attracted to lights. The biology and behavior of many species, such as the Bolboceratinae in this region, are poorly known.

Subfamily Bolboceratinae

The subfamily Bolboceratinae is best represented in Africa, Australia, and South America. Tribes Bolboceratini and Athyreini occur in the New World. The Bolboceratini are distributed from Canada to Central America, while the Athyreini are distributed from Mexico to South America.

Tribe Bolboceratini

The Bolboceratini are distinguished by the large antennal club that is rounded and convex on both sides (Howden 1955). The club is about as long as the basal eight segments. Cartwright (1953) and Howden (1955, 1964) provided synoptic reviews of the North and Central American species of Bolboceratini.

Key to the Bolboceratini of San Diego County

1. Eyes entirely divided by canthus; male usually with long cephalic horn; species measuring 9.0–10.9 mm and restricted to montane habitats ..... *Odonteus obesus* LeConte

1′. Eyes not completely divided by canthus 2

2. Pronotum with postapical carina extending almost to side margins; species measuring 8.5–13.0 mm and usually found in desert or desert-transition habitats .... *Bolborhombus parvulus* Cartwright

2′. Pronotum lacking postapical carina 3

3. Middle coxae subcontiguous; metasternum linear between the coxae; smaller species (9.8–11.7 mm) restricted to chaparral ..... *Bolbelasmus hornii* (Rivers)

3′. Middle coxae separated by the anterior lobe of the metasternal plate, which is never linear between the coxae; larger species (11.4–19.8 mm) restricted to the desert: *Bolbocerastes* Cartwright 4

4. Anterior clypeal horn of male narrowly truncate or rounded; in female anterior horn narrower than median horn, back of median horn punctate .... *Bolbocerastes imperialis imperialis* Cartwright

4′. Anterior clypeal horn of male widely truncate; anterior and median horns of female usually equal in width, back of median horn smooth ..... *Bolbocerastes regalis* Cartwright

Genus *BOLBELASMUS* Boucomont, 1911

Howden (1964) characterized the genus *Bolbelasmus* as follows: clypeus arcuate, often with a small tubercle on each side above mandibular insertion; frons with conical horn in males and with a transverse carina in females; eyes not completely divided by canthus; inner segment of antennal club with large denuded area; scutellum as long as wide or wider; elytra with 7 striae between suture and humeral umbone; middle coxae contiguous or very slightly separated by linear metasternum.

Six species of *Bolbelasmus* occur in North and Central America, but only *Bolbelasmus hornii* reaches in San Diego County.

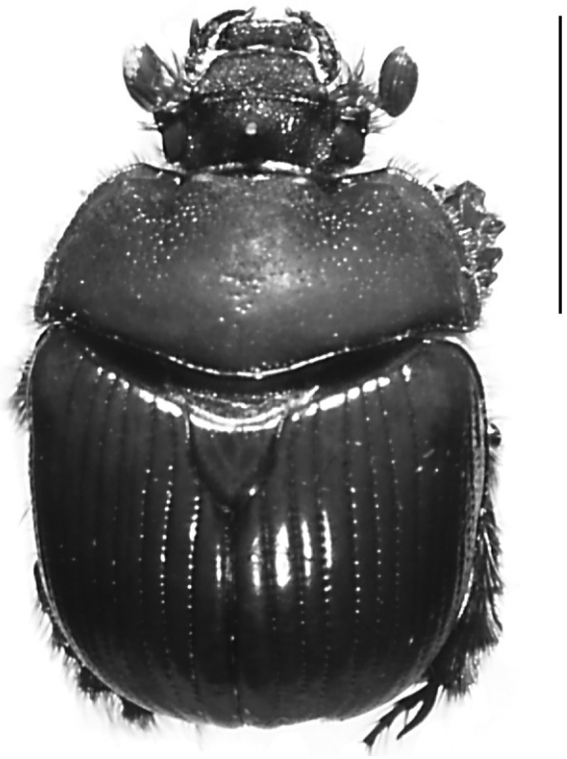


Figure 20. Male *Bolbelasmus hornii* (Rivers). Escondido, 9407 Canyon Country Road, in light trap, 5 Mar 1992. Scale 5 mm.

Bolbelasmus hornii Rivers
(Figs. 20–21)

Diagnosis—Length 9.8–11.7 mm; width 6.9–7.2 mm. Color light to dark reddish-brown. Clypeal margin unevenly arcuate, often almost truncate anteriorly, with a distinct tubercle on each side near eye canthus in male; tubercle often vague in female (Fig. 20). Frons and vertex of male usually with a large vertical, central, cylindrical horn, occasionally reduced to a conical tubercle in male minor. Frontal horn reduced to a nontuberculate transverse carina in female. Pronotum of male quadrituberculate; two inner tubercles more anterior in position than lateral ones. In female lateral pronotal tubercles reduced in size and rounded; the two median pronotal tubercles replaced by an anteriorly arcuate carina.

Distribution—*Bolbelasmus hornii* has been recorded primarily from northern and central California and Baja California Norte, Mexico (Howden 1964). Howden suggested that the single specimen from Hamilton Ranch in Baja California represented a disjunct population of *B. hornii* or possibly an undescribed species. This species is also known to occur in the Transverse and Peninsular ranges, however, and is reasonably common in chaparral in San Diego County. It probably exists in Baja California in good numbers as well.

San Diego County Locality Records—46 specimens were examined from the following localities (Fig. 21): Escondido, 9407 Canyon Country Lane, above Lawrence Welk Country Club Village, 490 m, light trap, 1 Feb 1992 (1 RHM), 6–7 Feb 1992 (1 RHM), 20–22 Feb 1992 (2 RHM), 22–29 Feb 1992 (2 RHM), 5 Mar 1992 (1 RHM); Portrero, Yerba Santa Road and Round Portrero Road, 825 m, light trap, 7–15 Feb 1993 (6 RHM), 16–20 Feb 1993 (4 RHM), 21–27 Feb 1993 (4 RHM), 1–13 Mar 1993 (12 RHM), 14–27 Mar 1993 (5 RHM), 1–25 Apr 1993 (3 RHM); Valley Center, 16122 Fruitvale Road, light trap, 20–28 Feb 1993 (1 RHM); Ramona, Dos Picos County Park, light trap, 13 Feb 1993 (2 RHM); Alpine, Loveland Reservoir, 18–26 Mar 1993 (2 RHM). Moore (1937) reported the species as "*Bolboceras horni*" and taken at San Diego in March.

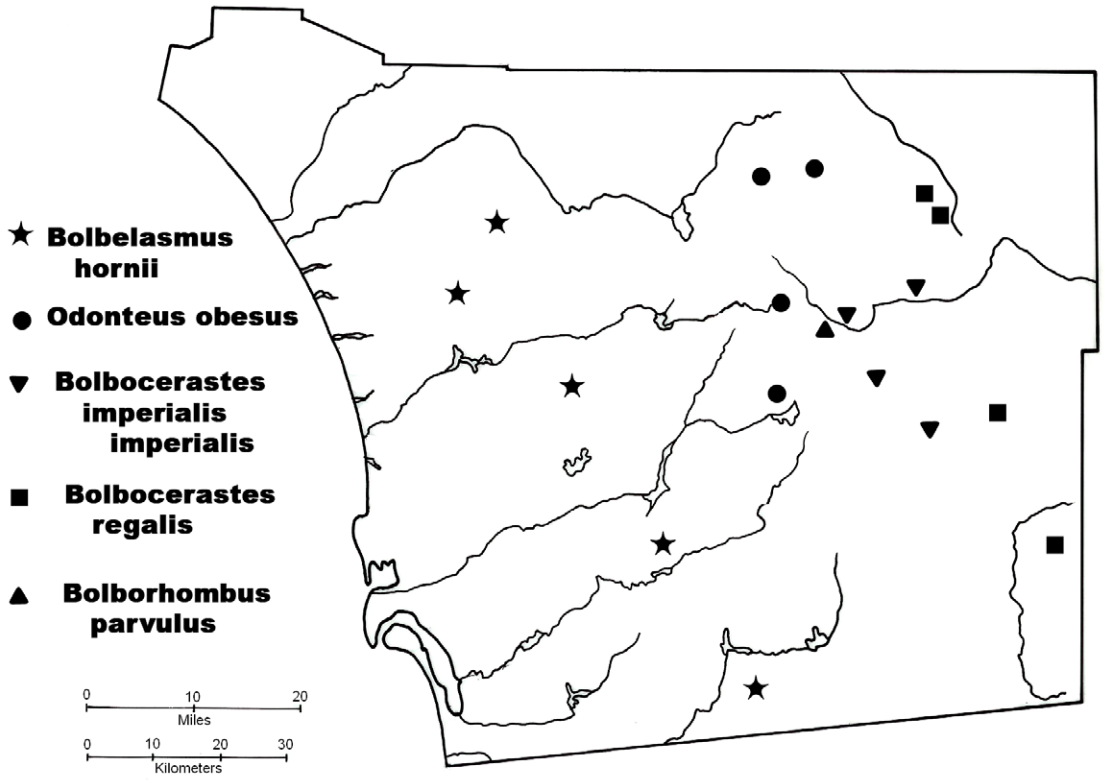


Figure 21. Distribution, *Bolbelasmus hornii*, *Bolbocerastes imperialis imperialis*, *Bolbocerastes regalis*, *Bolborhombus parvulus*, and *Odonteus obesus*.

Temporal Distribution—February (23), March (20), April (3).

Remarks—Bolbelasmus hornii is collected in blacklight traps during late winter in chaparral habitats below 850 meters. These habitats are dominated by *Adenostoma fasciculatum* and *Ceanothus* spp. Nothing has been published on the biology of this species.

Genus *ODONTEUS* Samouelle, 1818

The genus contains ten species that mostly occur in the eastern United States, with one species in Europe and two in Asia. *Odonteus obesus* LeConte is a western species that occurs in San Diego County. The complete division of the eye by the canthus distinguishes *Odonteus* from other San Diego County Bolboceratini.

Odonteus obesus LeConte
(Figs. 21–22)

Diagnosis—Length 9.0–10.9 mm; width 5.8–7.0 mm. Color dark reddish-brown to black, shining. Ventral surface, legs, margins of head and pronotum with long golden pubescence. The male has a long, slender, caudally curved head horn that sometimes extends almost to the scutellum and a pronotum with a longitudinal ridge on each side and a median raised U-shaped protuberance (Fig. 22). The female has a low transverse carina on the head and lacks the head horn. The pronotum of the female has three low tumidities in an antemedian transverse series and a median subbasal tumidity.

Distribution—Odonteus obesus is found in western North America from British Columbia, Canada, through Washington, Oregon, and California and east to Colorado.

San Diego County Locality Records—7 specimens were collected at the following localities (Fig. 21): Hot Springs Mountain, 1832–1863 m, blacklight, 18 Jul 1992 (1 RHM), 31 May 2003 (2 RHM); Volcan Mountain, 1557–1588 m, 8 May 1993 (1 RHM), 31 May 1993 (1 RHM); Cuyamaca, 12 Jul 1928 (1 SDNHM); Warner Springs, 7 Jun 1921 (1 SDNHM). Moore (1937) listed the species as "*Odontaeus obesus*" and recorded it from Warner Springs.

Temporal Distribution—May (4), June (1), July (2).

Remarks—Little is known about the biology of this species. Specimens from Hot Springs Mountain (3) and Volcan Mountain (2) came to blacklight in coniferous woodland habitat at elevations of 1557–1863 m. Linsley and Michener (1943) dug several hundred pupae and a few larvae of this species from sandy soil of an old roadbed, near Mt. Lassen, California.. Two pairs of adults and a third female were taken from winding burrows beneath "pushups" in a wooded area near Trail, Oregon (Ritcher 1966).

Genus *BOLBOCERASTES* Cartwright, 1953

Howden (1964) characterized *Bolbocerastes* as follows: mandibles sharply arcuate anteriorly, median tumosity of pronotum rounded, lateral tumosities carinate, base of elytra margined, only first elytral stria terminates near apex of scutellum, prosternal spine behind anterior coxae transverse, spine doubly pointed and remote from acutely angled intercoxal piece, apices of tibiae of middle and hind legs obliquely truncate. Females can be distinguished from males by their well-developed median horn, which males lack.

The genus occurs in the southwestern United States and northern Mexico, including both states of Baja California. Four species of *Bolbocerastes* have been described; two occur in San Diego County.

Bolbocerastes imperialis imperialis Cartwright
(Figs. 21, 23–24)

Diagnosis—Length 11.4–16.4 mm; width 6.5–9.1 mm. Pronotum with or without traces of a doubly carinate margin laterally, the serrations appearing as thickenings of a single sharp edge; color dark brown to yellow-brown, less strongly shining; fully developed male with tip of clypeal horn narrowly truncate and well forward from lateral horns (Fig. 23); female median cephalic horn often very high, usually higher than clypeal horn (Fig. 24).

Figure 22. Male *Odonteus obesus* LeConte. Hot Springs Mountain, just below Lookout Mountain, blacklight, 31 May 2003. Scale 5 mm.

Distribution—Bolbocerastes imperialis imperialis occurs in California, Arizona, New Mexico, and Texas and in Baja California and Sonora, Mexico (Cartwright 1953, Howden 1964).

San Diego County Locality Records—Nine specimens were examined from the following localities (Fig. 21): Vallecito, 15 Sep 1945 (1 LACM); Scissors Crossing, blacklight, 25 Aug 1984 (2 SDNHM); Tamarisk Grove, Anza-Borrego Desert State Park, 1 Sep 1993 (1 RHM), 31 Aug 1993 (2 RHM); and Blair Valley, Anza-Borrego Desert State Park, 24 Aug 1984 (3 SDNHM).

Temporal Distribution—August (7), September (2).

Remarks—Well-developed males of *Bolbocerastes imperialis imperialis* are distinguished from other species of *Bolbocerastes* by the anterior clypeal horn, which is farther forward of the lateral horns than in the other species. The apex of the clypeal horn is distinctly narrower than in *B. regalis*.

Little is known about the biology of this species. Adults come to light. Howden (1964) collected a specimen of *Bolbocerastes imperialis imperialis* in Imperial County, California, 38 cm deep in

Figure 23. Male *Bolbocerastes imperialis imperialis* Cartwright. Anza-Borrego Desert State Park, Tamarisk Grove, blacklight, 31 Aug 1994. 4× actual size.

Figure 24. Female *Bolbocerastes imperialis imperialis* Cartwright. Anza-Borrego Desert State Park, Tamarisk Grove, blacklight, 31 Aug 1994. 4× actual size.

Figure 25. Male *Bolbocerastes regalis* Cartwright. Anza-Borrego Desert State Park, Dolomite Mine, pushups in road, 13 Mar 1993. 4× actual size.

a burrow in sandy soil under the same mesquite thicket in which he also collected *B. regalis*.

Bolbocerastes regalis Cartwright
(Figs. 21, 25)

Diagnosis—Length 13.3–19.8 mm; width 7.5–12.0 mm. Color reddish-brown or light brown. Anterior clypeal horn of male wider than one-half the width of the clypeus, apex truncate or slightly emarginate; inner pronotal carina on either side of median tumosity biangulate in well-developed specimens (Fig. 25). In females the anterior face of clypeus is elevated but lacks a distinct horn; on either side a carina extends from anterior angle to side of elevation then posteriorly to a sharp tubercle above the insertion of the mandibles; vertex with a wide truncate horn approximately twice the height of anterior face of clypeus; pronotum with lateral carinae much less developed than in males.

Distribution—*Bolbocerastes regalis* is recorded from California, Nevada, Arizona, and Sonora, Mexico (Cartwright 1953; Howden 1964). It also occurs in Baja California, Mexico (McPeak, personal observation).

San Diego County Locality Records—60 specimens were examined from the following localities (Fig. 21): Borrego Springs, 7 Apr 1965 (2 CAS); Borrego Springs, street lights, 11 Apr 1970 (1 RHM), 27 Apr 1991 (5 RHM), 11 May 1991 (1 RHM); Borrego Springs, near county dump, Palm Canyon Road and Pegleg Road, blacklight, 23 Mar 2001 (8 RHM); Borrego Springs, 1.5 mi. N of Palm Canyon Road on Pegleg Road, blacklight, 23 Mar 2001, (21 RHM); Dolomite Mine, Anza-Borrego Desert State Park, pushups in road, 5 Mar 1993 (8 LACM, 5 RHM); Dolomite Mine, blacklight, 13 Mar 1993 (8 RHM); and Fish Creek Wash, Anza-Borrego Desert State Park, lantern, 13 Mar 1993 (1 RHM). Cartwright (1953) reported three specimens from "Murrays Dam, San Diego County." We suspect these specimens are mislabeled since Lake Murray Dam is near the coast in chaparral habitat, not in the desert habitat where the species occurs.

Temporal Distribution—March (51), April (8), May (1). Cartwright (1953) reports that throughout its range this "species has been collected in every month from March through September, being more frequently seen in the spring."

Remarks—Males of *Bolbocerastes regalis* can easily be distinguished from other species in the genus by the high, wide, truncate clypeal horn and doubly angulate inner pronotal carina that is always higher in the middle. The truncated tops of the clypeal and median horns are about equal in width in females, and the whole anterior part of the head, including the clypeal and cephalic horns, appears higher than the posterior part of the head, like an elevated snout.

Little is known about the biology of this species. Adults fly to lights and blacklights at night. Howden (1964) collected adults of *Bolbocerastes regalis* from vertical burrows 46 cm deep in damp sand beneath a large mesquite thicket in Imperial County, California, 5–6 Jun 1961. A. V. Evans and McPeak collected 13 by digging beneath pushups, approximately 3.7 cm in diameter, in a dirt road near Dolomite Mine, Anza-Borrego Desert State Park, 3 Mar 1993. The emergence holes were the same diameter as that of the beetles, and the maximum depth of burrows was 10 cm.

Genus *BOLBORHOMBUS* Cartwright, 1953

Mandibles arcuate externally. In both male and female the head lacks a median frontal horn. Pronotal apex with a carina that parallels the anterior margin, the space between the margin and carina interrupted behind each eye by a distinct rather deep foveola; base margined. Elytra not margined at base; seven discal striae, the first two interrupted by the scutellum, the second sometimes indistinctly forked opposite the apex of the scutellum.

Bolborhombus parvulus Cartwright
(Fig. 21, 26)

Diagnosis—Length 8.5–13.0 mm; width 6.0–7.5 mm. Dorsally shining, dark reddish-brown. Pronotum with sharp postapical carina and distinct lateral carina on each side (Fig. 26). Male and female are distinguished as follows: Male's clypeus extends anteriorly and obliquely upward to a slightly binodose transverse carina or horn; female's clypeus with anterior edge abruptly and transversely carinate. Posterior edge of female's clypeus on each side with distinct tubercle.

Distribution—Previously known only from Baja California Sur, Mexico (Cartwright 1953; Howden 1955, 1964), *Bolborhombus parvulus* was recently reported from San Diego County (McPeak 2005).

San Diego County Locality Records—1 specimen was examined (Fig. 21), collected by Scott Haskins at Scissors Crossing 25 Aug 1984, at a blacklight.

Temporal Distribution—August (1).

Remarks—Nothing is known about the biology of *Bolborhombus parvulus*. The four specimens mentioned by Cartwright (1953) in his original description were collected in August and October. We located 19 additional specimens in collections (CAS, CSCA, SDNHM, WFBM), taken from August through October from Loreto south to Cabo San Lucas.

FAMILY OCHODAEIDAE Mulsant and Rey, 1871
SAND-LOVING SCARAB BEETLES

Ochodaeids are convex beetles colored yellowish, reddish-brown, brown, black, or infrequently bicolored. Antennae 9- or 10-segmented with a 3-segmented, opposable club (all antennomeres tomentose). Eyes not divided by canthus. Clypeus simple or with tubercle(s) on its anterior margin. Labrum produced beyond apex of clypeus, often prominent, bilobed, and emarginated. Prominent mandibles project beyond apex of clypeus. Pronotum convex and subquadrate, punctate and setose in most species, without horns, tubercles, ridges, or sulci. Elytra convex , with or without striae, often punctate or granulate and setose, smooth in some species. Scutellum exposed and triangular. Pygidium exposed or concealed by elytra. Protibial apex with one spur; meso- and metabibia with two apical spurs; one mesotibial spur pectinate/crenulate. Abdomen with six visible sternites; stridulatory pegs present in some species (after Carlson 2002a).

The family Ochodaeidae is nearly worldwide in distribution, with ten extant genera and about 80 species found on all continents except Australia and Antarctica. There are four genera and 22 species in nearctic North America (Smith 2003). Three species occur in San Diego County.

Key to the Ochodaeidae of San Diego County

1. Sutural angle of elytra dentiform (Fig. 27); propygidium with pair of tubercles at midline that interlock with dentiform elytral apices ..... *Parochodaeus peninsularis* (Horn)
1′. Sutural angle of elytra not dentiform; propygidium lacks tubercles at midline 2

2. Eyes small, approximately 1/7th distance between eyes; head and thorax black; elytra dull brownish-yellow .... *Ochodaeus californicus* Horn
2′. Eyes large, approximately 1/3rd to 1/4th distance between eyes; head, thorax, and elytra light yellowish ....*Ochodaeus mandibularis* Linell

Figure 26. Male *Bolborhombus parvulus* Cartwright. Scissors Crossing, blacklight, 25 Aug 1984. 6× actual size.

Genus *OCHODAEUS* Dejean, 1821

Members of the genus *Ochodaeus* have a propygidium with the distal margin modified into a transverse ridge that interlocks with the distal margin of the elytra (Nikolayev 1995).

Ochodaeus californicus Horn
(Figs. 28–29)

Diagnosis—Length 3.9–6.5 mm; width 2.1–3.5 mm. Bicolored; head and thorax black, elytra dull brownish-yellow, undersurface and legs piceous (Fig. 28).

Distribution—*Ochodaeus californicus* is very rare and has been recorded only in Los Angeles and San Diego counties in southern California.

San Diego County Locality Records—Seven specimens were examined from the following localities (Fig. 29): San Diego, no date (1 held by DCC from USNM, 1 held by DCC from CAS); San Diego, 10 Jun 1921 (1 CAS); Vista, taken on mustard, 5 Mar 1936 (1 held by DCC from AMNH); Vista, taken during the day in chaparral, 18 Apr 1982 (1 LACM); Pala, Stewart Mine, collected by Robert Turnbow by "taking a swipe" at something flying, 27 Mar 1971 (1 DCC); Margarita Peak area, behind Camp Pendleton, late April (A. V. Evans, pers. comm.).

Temporal Distribution—March (2), April (2), June (1).

Remarks—*Ochodaeus californicus* has been taken "flying low over country roads" in southern California (Fall 1909). This unique diurnal species has the eyes smaller than in *Ochodaeus mandibularis* and *Parochodaeus peninsularis*, the two nocturnal ochodaeids in San Diego County.

Ochodaeus mandibularis Linell
(Figs. 29–30)

Diagnosis—Length 4.8–8.5 mm; width 2.7–4.2 mm. Color light yellowish-brown. Surface of head densely and setigerously punctate; setae moderately long, straw colored. Frons lacks a transverse carina. Clypeus short, its apex rounded, and its surface bears a small tubercle or small horn (Fig. 30). Mandibles large, visible beyond labrum, lateral edges subangulate to distinctly angulate. Pronotum densely punctate, punctations large and setigerous.

Distribution—*Ochodaeus mandibularis* occurs in Nebraska, Colorado, New Mexico, Arizona, and California (Ratcliffe 1991).

San Diego County Locality Records—Two specimens were examined (Fig. 29): Borrego Springs, 1 Nov 1961 (1 CAS); Borrego

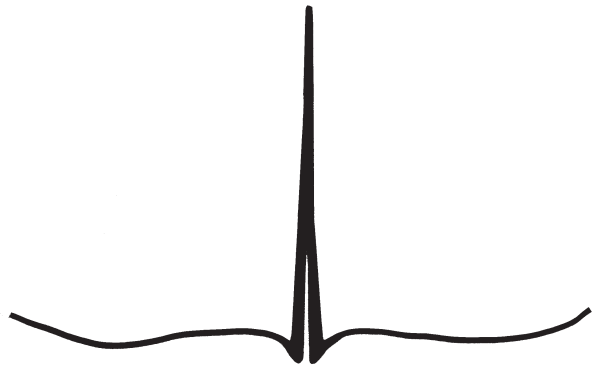


Figure 27. Dentiform elytral apices of *Parochodaeus peninsularis*. 40× actual size.

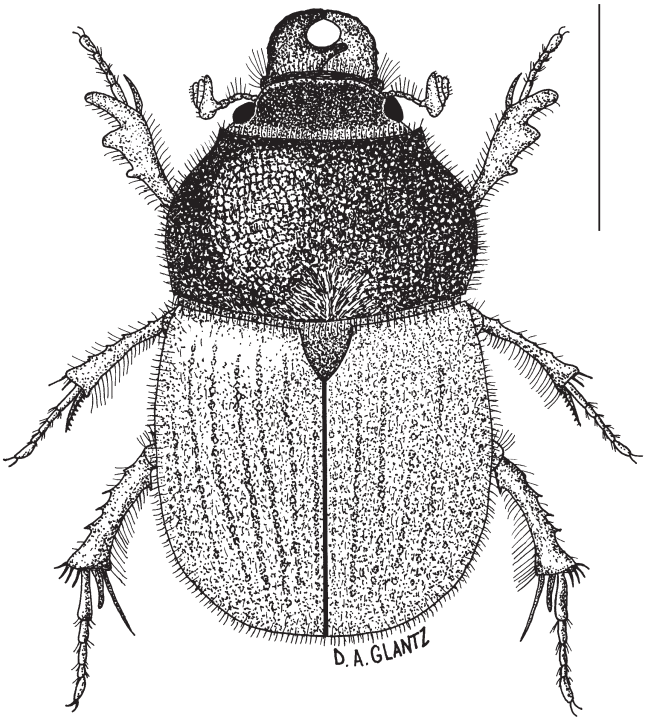


Figure 28. *Ochodaeus californicus* Horn. Scale 2 mm.

Springs, Yaqui Pass Rd. and Borrego Springs Rd., blacklight, 27 Apr 1991 (1 RHM).

Temporal Distribution—April (1), November (1).

Remarks—*Ochodaeus mandibularis* has also been taken at blacklights in the Algodones Dunes, Imperial County, California, during September (Andrews et al. 1979). Additional collecting at different times of the year in dunes near Borrego Springs would probably yield more specimens from San Diego County.

Genus *PAROCHODAEUS* Nikolayev, 1995

The dentiform apices of the elytra distinguish this genus from all other ochodaeid genera (Fig. 27). Seven species occur in the southwestern and midwestern United States and Mexico (Nikolayev 1995; Carlson 2002a; Smith 2003).

Parochodaeus peninsularis (Horn)
(Figs. 27, 29, 31)

Diagnosis—Length 5.6 mm; width 2.8 mm. Oval, slightly oblong. Head very coarsely punctate; clypeus oval at middle; frons not tuberculate (Fig. 31). Elytra with flat intervals.

Distribution—Horn (1895) described *Parochodaeus peninsularis* on the basis of six specimens collected in Baja California Sur, Mexico. The species is relatively common in that state. We collected *P. peninsularis* at a blacklight in the Sierra de la Laguna at 1985 m and examined more than 120 specimens in the CSCA collection taken from the lowlands near and south of La Paz. A single specimen has been reported from California (McPeak 2005).

San Diego County Locality Records—McPeak took the specimen of *Parochodaeus peninsularis* at a blacklight at Tamarisk Grove, Anza-Borrego Desert State Park, 1 Sep 1993 (1 RHM) (Fig. 29).

Temporal Distribution—September (1).

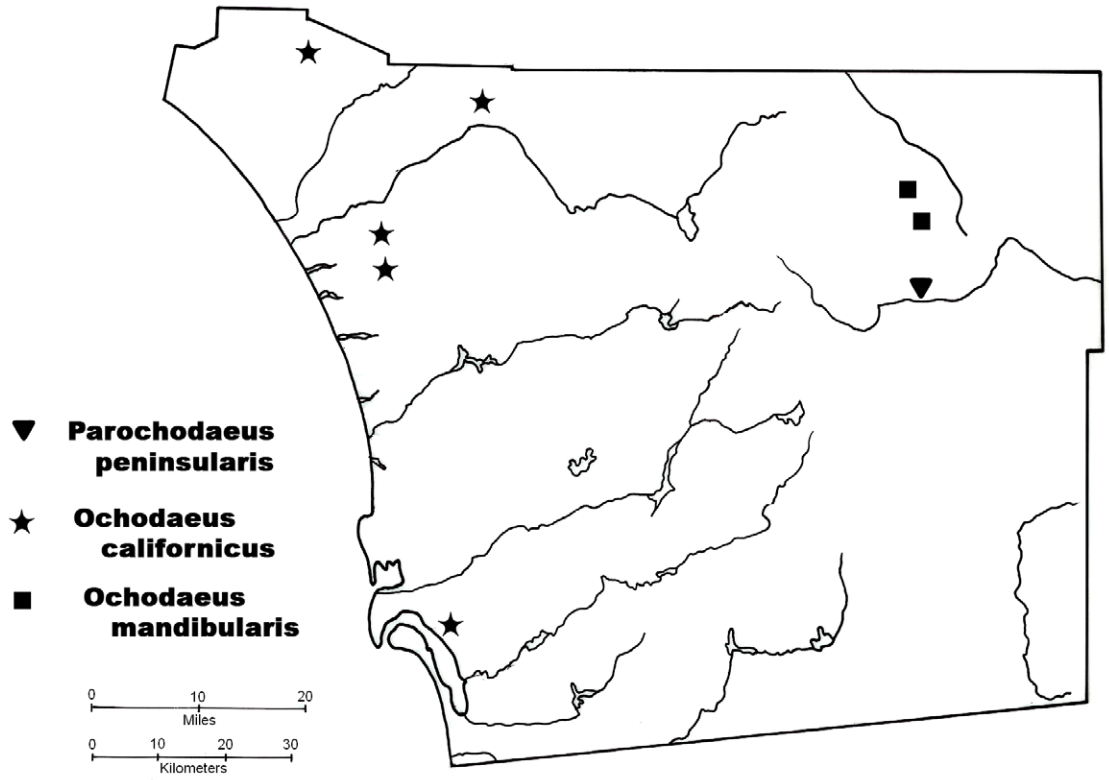


Figure 29. Distribution, *Ochodaeus californicus*, *O. mandibularis*, and *Parochodaeus peninsularis*.

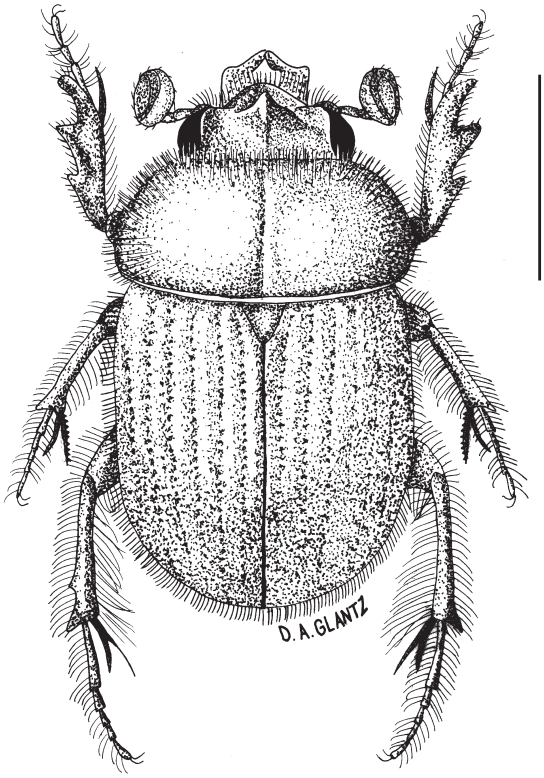


Figure 30. *Ochodaeus mandibularis* Linell. Scale 2 mm.

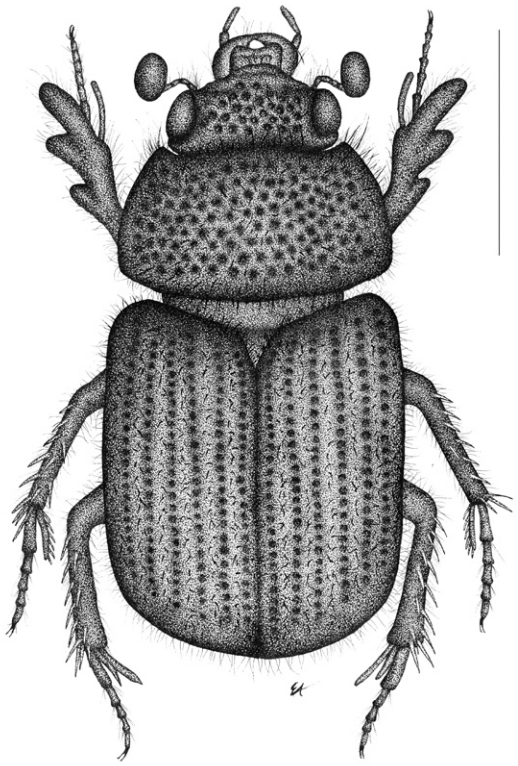


Figure 31. *Parochodaeus peninsularis* (Horn). Scale 2 mm.

Remarks—Nothing is known about the biology of *Parochodaeus peninsularis*.

HYBOSORIDAE Erichson, 1847
SCAVENGER SCARAB BEETLES

Hybosorids are oval beetles with a convex glossy dorsal surface, colored light brown to black. The diagnostic characters are the prominent mandibles and labrum and 9- or 10-segmented antennae with a 3-segmented opposable club. First segment of club hollowed to receive segments 2 and 3. Eyes divided by reduced canthus. Pronotum convex, its base wider than the base of the elytra. Elytra convex, surface polished and glabrous. Pygidium concealed by elytra (after Ocampo 2002). The family Hybosoridae contains 35 genera and more than 220 described species worldwide (Ocampo 2006a). There are two genera and two species in the Nearctic Region. The life history of most hybosorids is poorly known.

Subfamily Pachyplectrinae

The subfamily Pachyplectrinae includes two genera and three species distributed in dry, sandy areas of the Nearctic and Palearctic regions (Ocampo 2006b). *Pachyplectrus laevis* LeConte is the only species that occurs in San Diego County.

Genus *PACHYPLECTRUS* LeConte, 1874

Pachyplectrus is a monotypic genus endemic to the southwest United States. It has the mandibles wide with the outer edge angular; frontoclypeal suture has a medial pyramidal tubercle. Labrum lacks teeth.

Pachyplectrus laevis LeConte
(Figs. 6, 32–33)

Diagnosis— Length 4.8–6.9 mm; width 2.2–3.5 mm. Color testaceous or reddish-brown, shining. Mandibles large, about 1.2 times longer than the clypeus. Frontoclypeal suture with pyramidal tubercle (Fig. 32). Antennae 10-segmented; club 3-segmented, with basal segment cupuliform and receiving segments 2 and 3 (Fig. 6). Meso- and metatibiae with well-developed transverse ridge; transverse ridge and apical margin with series of short, thick, round-tipped setae arising from medial surface.

Distribution—Arizona and Imperial, Riverside, San Bernardino, and San Diego counties in southern California.

San Diego County Locality Records— Locality records are based on specimens reported by Hardy (1977) and Saylor (1939) (Fig. 33): Borrego, 31 Mar 1953 (5), 30 Apr 1954 (1); Mason Valley, 27 Mar 1928 (1). Saylor (1939) noted two specimens taken March 27 at Mason Valley, and Ocampo (2002) listed *P. laevis* from Borrego and San Diego. The "San Diego" specimen(s) were probably from the desert region.

Temporal Distribution—March (8), April (1).

Remarks—*Pachyplectrus laevis* occurs in dry sandy areas and has been collected under carrion and owl pellets and on the soil surface at night (Ocampo 2002). Adults have been taken at lights and on the crests of sand dunes in early spring (Hardy 1977). The larvae of this rare species are unknown.

GLAPHYRIDAE MacLeay, 1819
BUMBLE BEE SCARAB BEETLES

Glaphyrids are elongate, hairy beetles that resemble bees and bumble bees and fly strongly. Color testaceous to black, often with

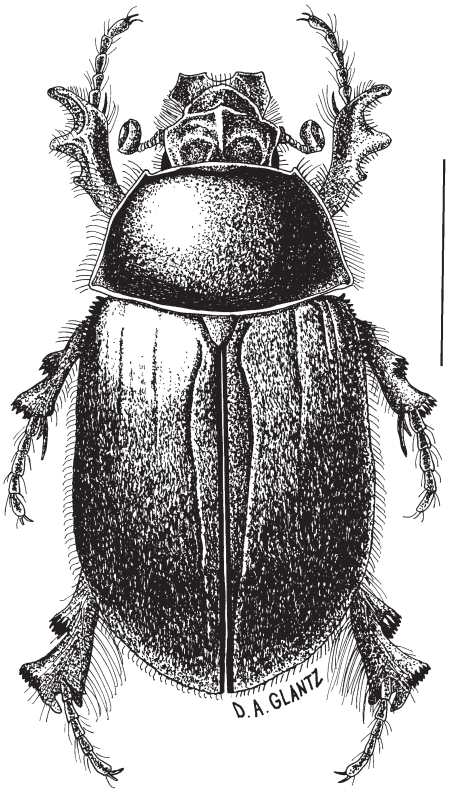


Figure 32. *Pachyplectrus laevis* LeConte. Scale 2 mm.

metallic reflections. Setae dense, moderately long, and variably colored. Antennae 9- or 10-segmented with a 3-segmented opposable club (all antennomeres tomentose). Mandibles prominent, produced beyond apex of labrum. Elytra elongate, often thin and dehiscent at apex, and often setose. Pygidium visible beyond elytra in most species. Abdomen with 6 free sternites (after Carlson 2002b). The family Glaphyridae contains eight genera and about 80 species worldwide (Carlson 2002b). One genus (*Lichnanthe* Burmeister) and eight species of glaphyrids occur in Canada, the United States, and nearctic Mexico. *Lichnanthe apina* Carlson and *L. rathvoni* (LeConte) occur in San Diego County.

Genus *LICHNANTHE* Burmeister, 1844

Body elongate and convex. Dorsal and ventral surfaces densely setose, except on elytra. Elytra clothed with short, fine, closely appressed setae. Head strongly deflexed, mandibles exposed apically and laterally. Labrum prominent, projecting well beyond clypeus, emarginated anteriorly. Clypeus quadrate, deflexed, disc coarsely punctate. Antennae 10-segmented; lamellae free, as long as or longer than funicle (smaller in females). Pronotum subquadrate. Scutellum U-shaped. Elytra thin, translucent to transparent, often dehiscent apically (after Carlson 1980).

Key to *Lichnanthe* of San Diego County

1. Pronotum and ventral surfaces bright metallic green; elytra gradually dehiscent ..... *Lichnanthe apina* Carlson
1′. Pronotum and ventral surfaces lack bright metallic coloration; elytra sharply and acutely dehiscent ....*Lichnanthe rathvoni* (LeConte)

Lichnanthe apina Carlson
(Figs. 33–34)

Diagnosis—Length 9.7–14.5 mm; width 3.9–5.5 mm. Three color morphs differ primarily in color of body setation, which is orange-yellow, black, or white (Fig. 34). Color of integument varies considerably but is usually bright green, green-gold, red-gold, or blue-green. Elytra light to dark red-brown, contiguous along median suture for 2/3 of distance from scutellum to apices of elytra, gradually dehiscent apically. (The San Diego County specimen measures 10.2 mm by 4.5 mm; it is orange-yellow with a metallic green underside, green-blue head, blue-green pronotum, and brown elytra).

Distribution—Central Valley and Coast Ranges of California from Humboldt County south to San Diego County.

San Diego County Locality Records—The single male specimen taken in Oceanside, 27 May 1952, is in the UCR collection (Fig. 33).

Temporal Distribution—May (1).

Remarks—*Lichnanthe apina* usually occurs in riparian habitats around sandy areas with tall grass and dense stands of willow. Adults are very strong fliers and in flight are indistinguishable from medium-sized metallic-colored sweat bees (Halictidae) (Carlson 1980).

Lichnanthe rathvoni (LeConte)
(Figs. 33, 35)

Diagnosis—Length 10.6–16.6 mm; width 4.4–7.3 mm. The species has three color morphs: orange, yellow, and black. Integument usually has a dark metallic green luster except on antennae, legs, abdominal sternites 5–7, and pygidium, which lack luster. Elytra brown, with light setal patches in some specimens, acutely dehiscent. The two San Diego County specimens measured 11.9 mm by 6.0 mm and were of the yellow morph with light setal patches on the elytra (Fig. 35).

Distribution—Arizona, Idaho, Utah, Nevada, California, Oregon, and Washington; British Columbia, Canada; Baja California, Mexico.

San Diego County Locality Records—Two specimens examined (Fig. 33): Poway, 14 Oct 1972 (1 CAS); Palomar, 24 Jun 1928 (1 SDNHM).

Temporal Distribution—June (1), October (1).

Remarks—The habitat of *Lichnanthe rathvoni* appears to be riparian, characterized by areas of sandy soil subject to seasonal flooding (Carlson 1980). In flight, the beetles resemble medium to large bumblebees. No specific habitat data for the San Diego County specimens are available.

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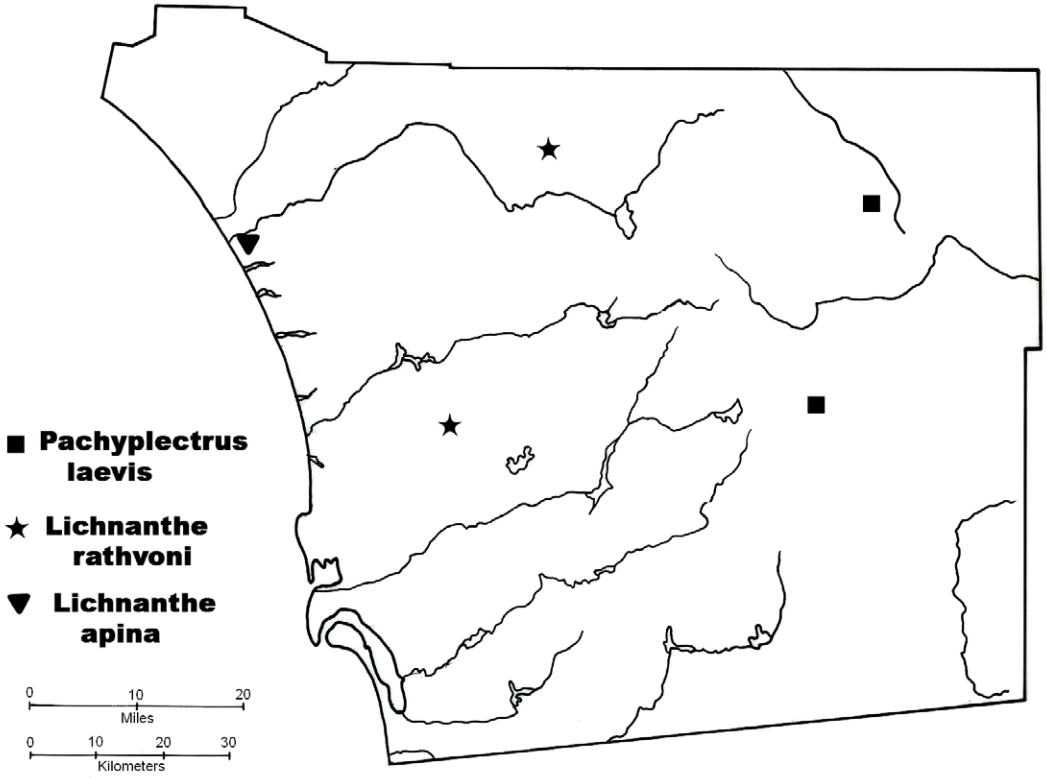

Figure 33. Distribution, *Pachyplectrus laevis*, *Lichnanthe apina*, and *L. rathvoni*.

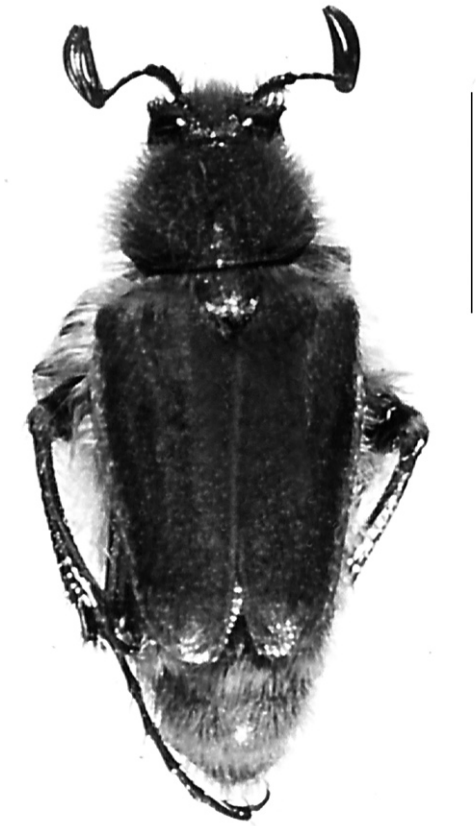

Figure 34. *Lichnanthe apina* Carlson. Specimen collected in California, Pedley, Riverside County, 17 Jun 1979. Scale 4 mm.

Figure 35. *Lichnanthe rathvoni* (LeConte). Oregon, Multnomah Co., Dabney State Park, on willow, 14 Jul 2004. Scale 4 mm.

Academy of Sciences), and D. C. Carlson made available specimens of ochodaeids in his collection. We also wish to thank Larry Buck, Robert Johnson, Gene Kira, Clark Mahrdt, Dick Rhoades, and Nancy Sumerel for allowing us to run light traps on their property. Dave Van Cleve of the Anza-Borrego Desert State Park also allowed us to sample and run light traps in the state park.

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