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STUDIES ON THE GENUS *APHODIUS* OF THE UNITED STATES
AND CANADA (COLEOPTERA: SCARABAEIDAE): V. AN
EVALUATION OF HORN'S GROUP F

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ABSTRACT—Horn's Group F of the genus *Aphodius* is redefined and restricted to include three species, *Aphodius alternatus* Horn, *A. subaeneus* LeConte, and *A. consociatus* Horn. Four species names are placed in synonymy, and three species are transferred out of Group F. Pertinent morphological details are illustrated and distribution maps are provided.

This is the fifth paper in a series dealing with North American *Aphodius*. See Gordon (1973) for an explanation of the purposes of this series.

Members of group F are small, usually yellow and black species distinguished from other groups of *Aphodius* by the following combination of characters: Apex of hind tibia with short, equal spines; head smooth, not tuberculate; clypeus feebly emarginate apically, not dentate. Species of this group are not uncommon in collections, and the need to identify them arises frequently. It has not previously been possible to do this satisfactorily, so I have studied the group in detail, and the results of the study are presented herein.

Horn (1887) established Group F and placed the following four species in it: *obtusus* LeConte, *consociatus* Horn, *subaeneus* LeConte, and *alternatus* Horn. Fall (1907) described *rotundiceps* and stated that it was closest to members of Group F, so the Leng catalogue (1920) included it in Group F. Schmidt (1913 and 1922) put *consociatus*, *subaeneus* and *alternatus* in the subgenus *Volinus* Mulsant, and *obtusus* in the subgenus *Bodilus* Mulsant. In 1938, Robinson described *utahensis* and indicated it was close to *obtusus* and so a member of Group F. In 1940, Robinson described *inermis*, compared it to *alternatus* and thus indicated that *inermis* belonged in Group F.

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Hatch (1971) described *moclipsi* and *gentneri*, placed the former in the subgenus *Calamosternus* Motschulsky and stated that *gentneri* did not belong in any defined subgenus; but I have found from the types that both are junior synonyms of previously described species in Group F. Gordon (1973) described *perpolitus* to make a total of ten names that have been assigned to Group F from 1887 to the present.

Of the ten names now in Group F, four are herein reduced to junior synonyms of previously described species. *Aphodius obtusus* and *utahensis* are not closely related to *alternatus*, etc., and I tentatively assign them to Group I, series c, near *consentaneus* LeConte. *Aphodius rotundiceps* is completely unlike any other Western Hemisphere species and cannot be assigned to any established group. With these changes, Group F is composed of three closely related species and is considered monophyletic. As previously indicated (Gordon, 1973), I do not use Schmidt's subgeneric assignments because the subgenera are rarely monophyletic and do not readily accommodate North American species.

The species of Group F occur in the western half of the United States and contiguous areas of southern Canada with *alternatus* extending eastward as far as Michigan. Both *consociatus* and *subaeneus* are restricted to the West Coast, *consociatus* in southern California and *subaeneus* extending from southern California to southern British Columbia. They are allopatric and similar, hence probably are sister species.

Species of Group F are not dung feeders and are not associated with rodents but are saprophytic on detritus in the upper soil layer. Hatch (1971) recorded "*consociatus*" (*alternatus*) reared from golf turf at Longbeach, Washington. When not taken flying, specimens are usually collected near margins of ponds and streams, apparently preferring the damp soil in those locations. I have collected *alternatus* in North Dakota while collecting water beetles in prairie sloughs and lakes, the beetles were either up on the bordering vegetation or crawling on the ground. *Aphodius alternatus* is capable of massive flight activity as observed by J. Schuh at Kirk, Klamath Co., Oregon, on October 23, 1966. I observed the same flight behavior in central North Dakota in September 1965.

I am indebted to the following individuals and institutions for the loan of types and other specimens: David Carlson, Department of Entomology, Oregon State University, Corvallis; John Carr, Calgary, Alberta; David Kavanaugh, California Academy of Sciences, San Francisco; John Lawrence, Museum of Comparative Zoology, Harvard University; Sievert Rohwer, Thomas Burke Museum, University of Washington, Seattle; Joe Schuh, Klamath Falls, Oregon.

GROUP F

Head mostly black, at least medially; convex, without frontal tubercles; anterior clypeal margin not dentate, anterolateral angle broadly arcuate. Pronotum mostly black, sexually dimorphic. Male front tibial spur robust, bent downward at apex, laterally flattened (Fig. 1); both middle tibial spurs slender, apically acute, unmodified as in female. Apical fringe of hind tibia composed of moderately long spines nearly equal in length (unless worn down so that some are longer than others). Male genitalia soft, dorsoventrally compressed, somewhat inflated.

KEY TO SPECIES OF GROUP F

- 1. Basal border of pronotum without marginal line medially; 1st, 2nd and 4th elytral intervals dull, rough in most California specimens (Fig. 7); hind tibia with oblique carinae reduced, not well developed *subaeneus* LeConte
- Basal border of pronotum with marginal line medially; all elytral intervals usually smooth, if not, then usually all are rough; hind tibia with oblique carinae well developed 2
- 2. Pronotal punctures fine (Fig. 5), not larger than punctures of elytral intervals; strial punctures on elytron fine, equal to or very slightly larger than punctures on intervals; male anterior tibial spur broad, not hooked inward at apex (Fig. 1) *alternatus* Horn
- Pronotal punctures coarse (Fig. 6), much larger than punctures of elytral intervals; strial punctures on elytron coarse, each 2 × as large as a puncture on interval; male anterior tibial spur slender apically, hooked inward at apex (Fig. 3) *consociatus* Horn

Aphodius subaeneus LeConte

Fig. 2, 4, 7-9, 22

Aphodius subaeneus LeConte, 1857:41; Horn, 1870-71:129; Horn, 1887:21; Hatch, 1971:454.

Aphodius gentneri Hatch, 1971:457. NEW SYNONYMY.

Aphodius perpolitus Gordon, 1973:439. NEW SYNONYMY.

Remarks: The typical form of *subaeneus* is readily recognizable because the first and third elytral intervals are smooth and polished, the second and fourth intervals are dull and rough (Fig. 7) and the elytra are yellow in large part. This form occurs in the coastal areas and Central Valley of California. The pronotal punctures are coarse, separated by one to three times a diameter (Fig. 4). Specimens from the mountainous areas of eastern California, northern Oregon and southern British Columbia have the yellow elytral areas reduced and all elytral intervals smooth and polished. Specimens from extreme northern California and southwestern Oregon present a different appearance from the other two forms in that they are entirely black dorsally, or black with an indistinct pale spot on the apical declivity of each elytron. In addition, the elytral intervals are flatter, the striae

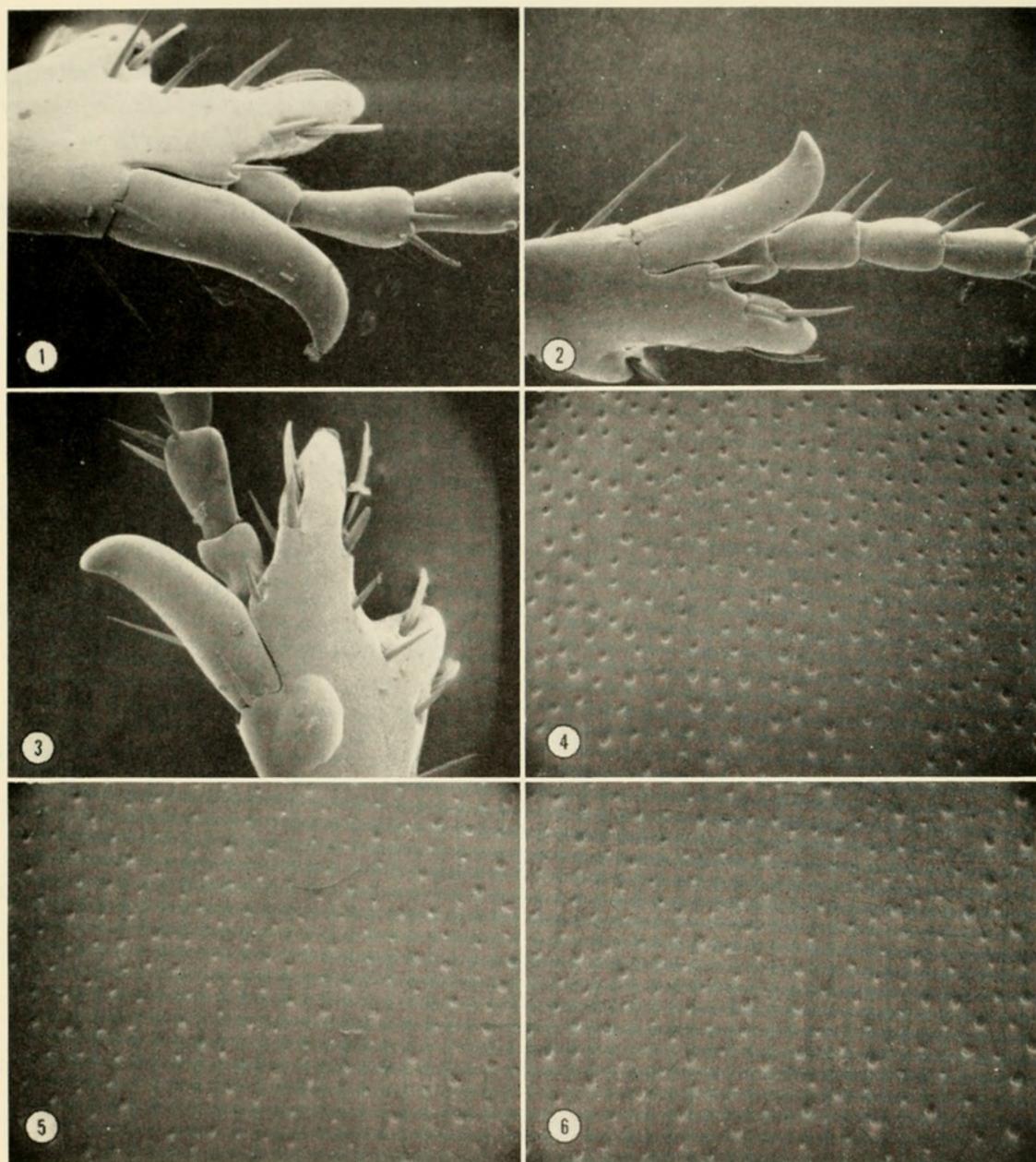


Fig. 1-6. Anterior tarsal spurs and pronotal punctures of discal pronotal area. 1, 5, *Aphodius alternatus*. 2, 4, *Aphodius subaeneus*. 3, 6, *Aphodius consociatus*.

not as deep, the marginal line on the basal border of the pronotum more widely incomplete and the pronotum more densely punctured. The male genitalia (Fig. 8, 9) and anterior tibial spurs (Fig. 2) are identical in all three forms, and I consider these forms to represent a polymorphic species. Two names have been proposed for the dark specimens from southwestern Oregon, *gentneri* Hatch and *perpolitus* Gordon, both of which I place as junior synonyms of *subaeneus*.

It is apparent from LeConte's original description that he had more than one specimen. There are presently three specimens in the LeConte Collection labeled as types; and the first of these, a

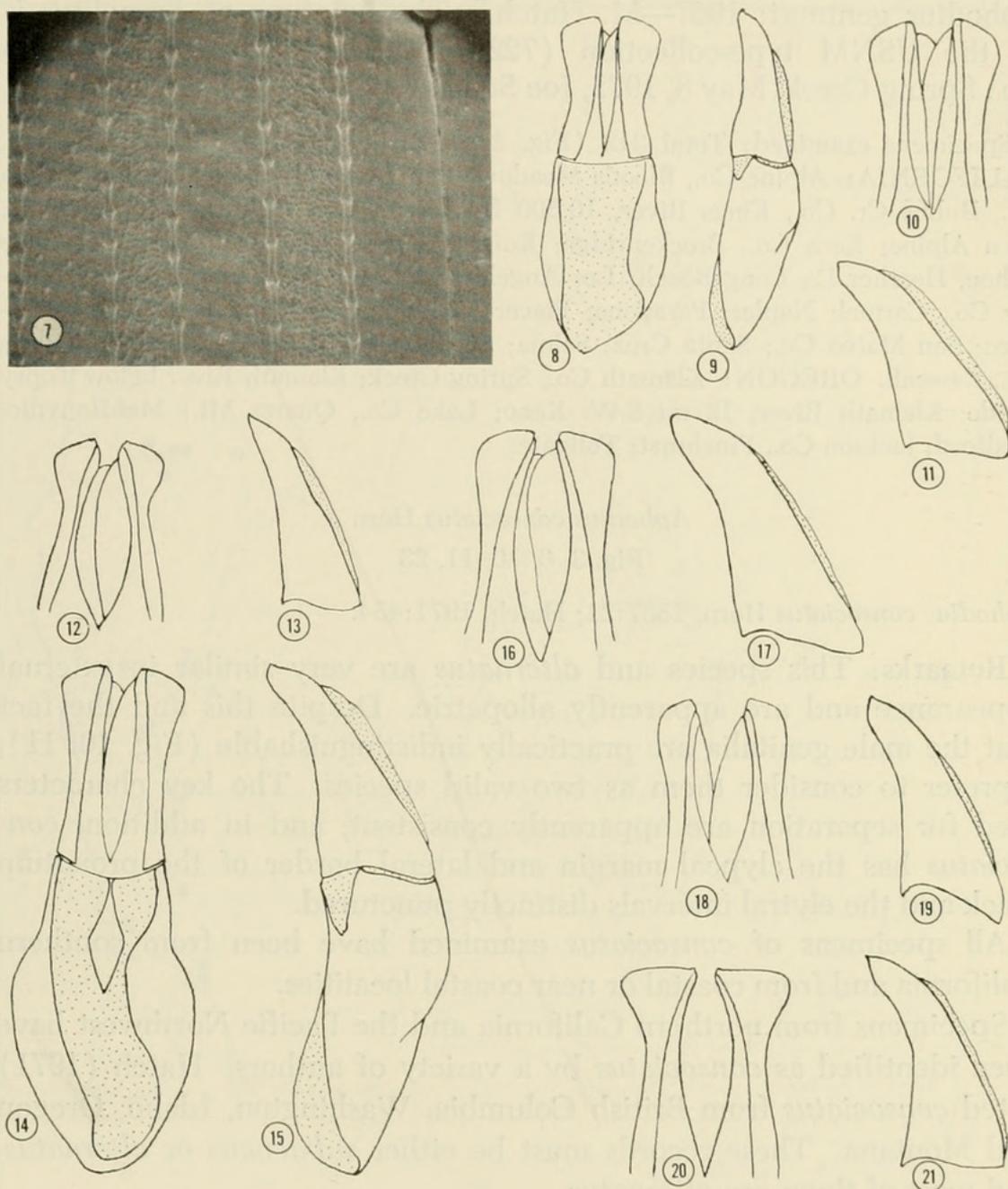


Fig. 7. First 5 elytral intervals, *Aphodius subaeneus*. Fig. 8-21. Male genitalia. 8, 9, *Aphodius subaeneus*. 10, 11, *Aphodius consociatus*. 12-21, *Aphodius alternatus*.

male, bearing the following labels, is here designated and labeled lectotype: "(gold disc)/Type 3352 (red paper)/*A. subaeneus* LeC., S. Fr." LeConte (1857:42) specifically gave San Francisco as the type-locality. The remaining two type-specimens (females) bear identical data, except the "S. Fr." is lacking, and they are designated and labeled paralectotypes. The holotype of *gentneri* in the Oregon State University collection has been examined and is a male labeled "Pinehurst, Jackson Co., Ore., V-19-60/L. G. Gentner, sweeping/Type,

Aphodius gentneri: 1967—M. Hatch." The holotype of *Perpolitus* is in the USNM type-collection (72287) labeled "Oregon, Klamath Co., Spring Creek, May 8, 1971, Joe Schuh."

Specimens examined: Total 312 (Fig. 22). BRITISH COLUMBIA: Vernon. CALIFORNIA: Alpine Co., Bloods Meadow; Ben Lomond; Cisco; Fresno; Fresno Co., Bubbs Cr. Cn., Kings River, 10,500 ft; Fresno Co., Bullfrog L., 10,600 ft; Glen Alpine; Kern Co., Breckenridge; Knights Ferry; Lake Co., Hopville; Lake Tahoe, Heather L.; Long Beach; Los Angeles; Modesto; Mokelumne Hill; Monterey Co., Carmel; Naples; Pasadena; Placer Co., Summit; Sacramento; San Francisco; San Mateo Co.; Santa Cruz; Selma; Siskiyou Co., 6 mi S. Macdoel; Tulare Co., Kaweah. OREGON: Klamath Co., Spring Creek; Klamath River below Topsy Grade; Klamath River, 12 mi S.W. Keno; Lake Co., Quartz Mt.; McMinnville; Medford; Jackson Co., Pinehurst; Tollgate.

Aphodius consociatus Horn

Fig. 3, 6, 10, 11, 23

Aphodius consociatus Horn, 1887:21; Hatch, 1971:454.

Remarks: This species and *alternatus* are very similar in external appearance and are apparently allopatric. Despite this and the fact that the male genitalia are practically indistinguishable (Fig. 10, 11), I prefer to consider them as two valid species. The key characters used for separation are apparently consistent, and in addition, *consociatus* has the clypeal margin and lateral border of the pronotum black and the elytral intervals distinctly punctured.

All specimens of *consociatus* examined have been from southern California and from coastal or near coastal localities.

Specimens from northern California and the Pacific Northwest have been identified as *consociatus* by a variety of authors. Hatch (1971) listed *consociatus* from British Columbia, Washington, Idaho, Oregon and Montana. These records must be either *subaeneus* or *alternatus*, and most of them are *alternatus*.

It is apparent from Horn's original description that he had more than one specimen. There are four specimens labeled as types presently in the Horn Collection and the first of these, a female labeled "Cal/ Type No. 3577 *Aphodius consociatus* G. H. Horn (red paper)/A. consociatus Horn" is designated lectotype and is so labeled. The remaining three specimens (two females, one male) bearing the following labels are designated paralectotypes and are so labeled; "Cal/ G. H. Horn A. consociatus Paratype 3577/Horn Coll. H10193."

Specimens examined: Total 28 (Fig. 23). CALIFORNIA: Anaheim; Long Beach; Los Angeles; Poway; Redondo; Riverside Co., Keen Camp; San Diego; San Jacinto; San Pedro; Santa Monica; Smith's Springs, 3300 ft.

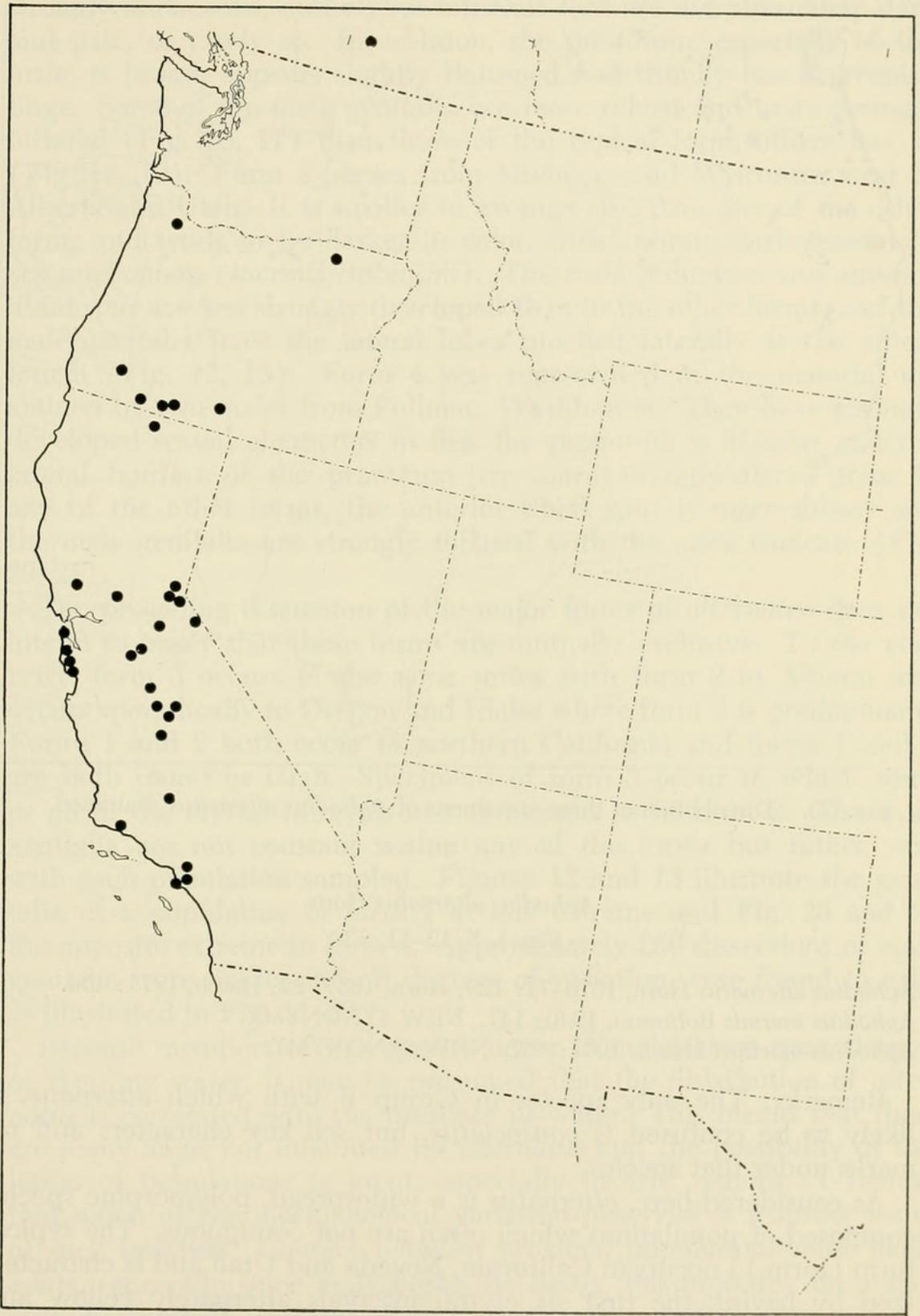


Fig. 22. Distribution of those specimens of *Aphodius subaeneus* examined.

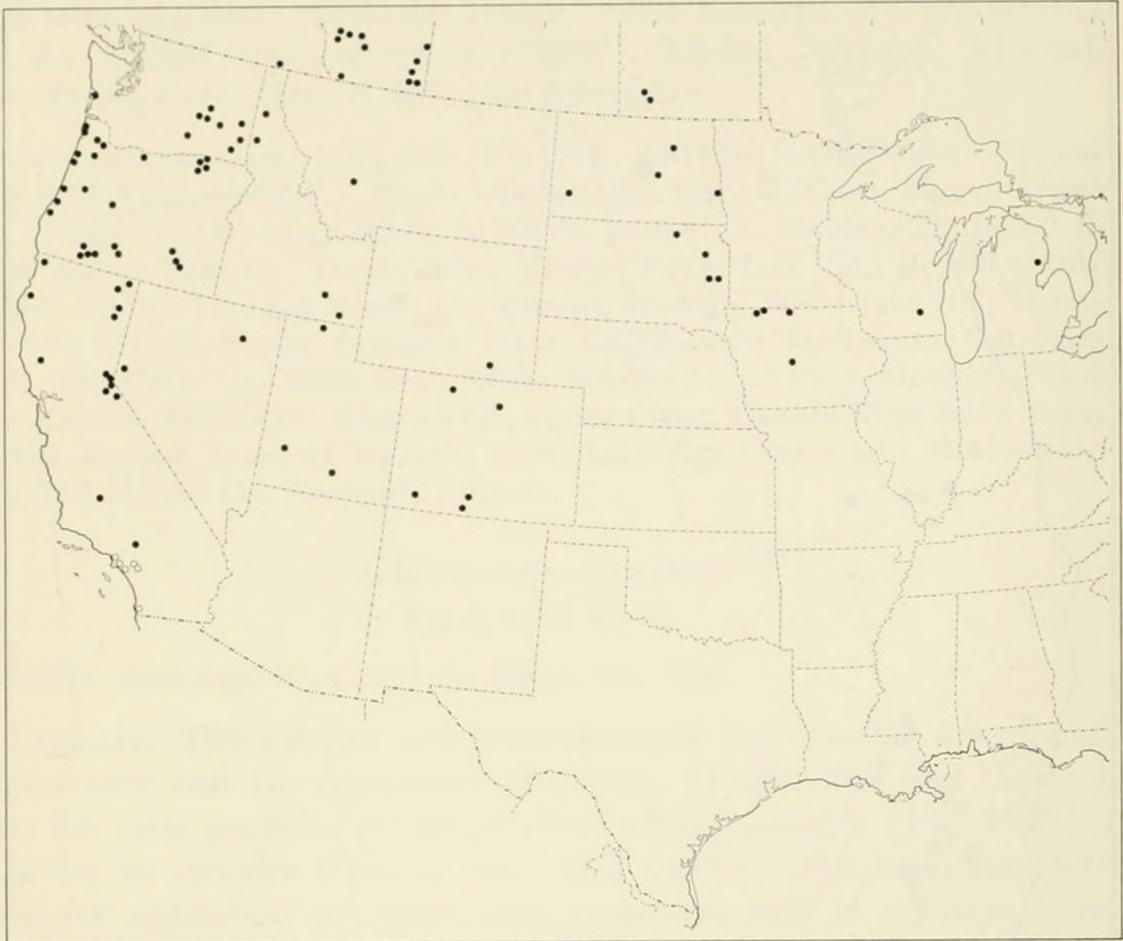


Fig. 23. Distribution of those specimens of *Aphodius alternatus* examined.

Aphodius alternatus Horn

Fig. 1, 5, 12-21, 23

Aphodius alternatus Horn, 1870-71: 129; Horn, 1887: 22; Hatch, 1971: 454.

Aphodius inermis Robinson, 1940: 147. NEW SYNONYMY.

Aphodius moclippsi Hatch, 1971: 457. NEW SYNONYMY.

Remarks: The only species in Group F with which *alternatus* is likely to be confused is *consociatus*, but see key characters and remarks under that species.

As considered here, *alternatus* is a widespread, polymorphic species composed of populations which often are not contiguous. The typical form (form 1) occurs in California, Nevada and Utah and is characterized by having the first six elytral intervals alternately yellow and dark brown, hence the specific name. In addition, the elytral intervals are smooth, and shiny, and the pronotum is shaped as in *consociatus* and is black with no greenish tinge. The male genitalia are as in Fig. 14, 15. Form 2 is present in Oregon, Washington, Idaho and Alberta. This is the most striking of all the morphs because it has

strongly alutaceous, dull elytral intervals that are not alternately dark and pale, or rarely so. In addition, the pronotum, especially of the male, is broad, appears slightly flattened and usually has a greenish tinge. Some of the male genitalia are more robust and more strongly inflated (Fig. 16, 17) than those of the typical form, others less so (Fig. 18, 19). Form 3 occurs from Michigan and Wisconsin west to Alberta and Utah. It is smaller in average size than any of the other forms and tends to be darker in color, with entirely dark specimens not uncommon (*inermis* Robinson). The male pronotum and anterior tibial spur are less strongly developed than in the other forms, and the male genitalia have the lateral lobes pinched laterally at the apical fourth (Fig. 12, 13). Form 4 was represented in the material examined by two males from Pullman, Washington. They have strongly developed sexual characters in that the pronotum is broader and the lateral borders of the pronotum are more strongly flared than in any of the other forms, the anterior tibial spur is more robust and the male genitalia are strongly inflated with the apex truncate (Fig. 20, 21).

The preceding discussion of the major forms of *alternatus* does not intend to imply that these forms are mutually exclusive. To the contrary, form 3 occurs in the same series with form 2 in Alberta and occurs sporadically in Oregon and Idaho where form 2 is predominant. Forms 1 and 2 both occur in northern California and forms 1 and 3 are both found in Utah. Specimens of form 3 occur in which some or all of the elytral intervals are alutaceous as in form 2. The male genitalia are not constant within any of the forms but rather vary with each population sampled. Figures 12 and 13 illustrate the genitalia of a population of form 1 at one extreme and Fig. 20 and 21 the opposite extreme in form 4. Approximately 250 dissections of male genitalia were made, and all degrees of variation were found to exist as illustrated in Fig. 11-20.

Because members of this species occur in moist areas near streams or standing water, it may be presumed that the distribution of *alternatus* is correlated with the presence of water. This means that there are many areas not inhabited by *alternatus* and the possibility of isolation of populations is great, especially in arid regions. I believe that much of the morphological variation observed is a direct result of such isolation. Contact between proximal populations most likely exists, especially since mass flights do occur, but probably on a sporadic basis which does not allow a continuous gene flow.

Horn (1870-71) stated that he had several specimens from "Bitter Root Valley" (Montana) and "one from an unknown region of California." A single specimen remains in the Horn Collection, a female labeled "Cal/Type No. 3578 *Aphodius alternatus* G. H. Horn (red

paper)/*A. alternatus* Horn." I presume that this is the specimen from California, and I here designate it as lectotype and have so labeled it. From the appearance of the specimen, I judge it to be from somewhere in northern California, probably the Lake Tahoe region. In 1887, Horn said that *alternatus* occurred from "Fort Yuma, California, eastward through Arizona, north to Colorado and the Bitter Root Valley of Montana." None is now in his collection unless the one from "Cal" designated as lectotype is actually from Fort Yuma, which I consider unlikely. I have not seen any specimens of *alternatus* from Arizona. Robinson (1940) described the entirely dark form of *alternatus* as *inermis* based on a single female now in the USNM collection labeled "Utah/Holotype, Aphodius inermis Mark Robinson/Property Mark Robinson/M. Robinson collection 1959/Type 65601 USNM." Hatch (1971) described *moclipsi* from a specimen of *alternatus* with mostly dark elytra. The holotype of *moclipsi* is a male in the Burke Museum collection, University of Washington, labeled "Moclips, Wash. April 6, 1913/Type Aphodius (Calamosternus) moclipsi 1962—M. Hatch/Aphodius sp. near granarius L. M. H. Hatch 1933." I consider both *inermis* and *moclipsi* to be junior synonyms of *alternatus*.

Specimens examined: Total 730 (Fig. 23). ALBERTA: Calgary; Cypress Hills; Empress; Ghost Dam; Medicine Hat; Twp. 7, Rge. 2, W. 5, Mer.; Twp. 14, Rge. 3, W. 4, Mer.; Twp. 21, Rge. 19, W. 4, Mer.; Twp. 24, Rge. 24, W. 4, Mer.; Waiparous; Waterton. BRITISH COLUMBIA: Creston. CALIFORNIA: Alpine Co., Bloods Meadow, 7000 ft; Cedarville; Del Norte Co., Eldorado Co., Pyramid Pk. 8000 ft; Eldorado Co., Whitehall; Hackamore; Humboldt Co.; Lake Co., Warner; Lake of Woods, 7700 ft; Lake Tahoe; Lake Tahoe, Fallen Leaf Lake; Lassen Co., Facht; Lassen Co., Martins Springs; Modoc Co.; Nevada Co., Shotgun L.; San Bernadino Co., Big Bear Lake; Tallac. COLORADO: Alamosa; Antonito; Boulder; La Plata, San Juan Mts.; Steamboat Springs. IDAHO: Coeur d'Alene; Moscow, Cedar Mt.; Pocatello; Wasatch Mts., Bloomington Lake, 8200 ft. IOWA: Ames; Lake Okoboji; Spirit Lake; Thompson. MANITOBA: Aweme; Brandon. MICHIGAN: Iosco Co. MONTANA: Assiniboine; Helena. NEVADA: Elko; Franktown; Reno. NORTH DAKOTA: Billings Co.; Devils Lake; Fargo; Wells Co. OREGON: Bear Springs; Blue Mountains; Coos Co., Fossil Point; Cornelius; Corvallis; Deschutes Co., 10 mi N. of Sisters; Florence, 7 mi S., Siltcoos Beach; Forest Grove; Klamath Co., Gearhart Mt., 10 mi NE Blye, 7000 ft; Klamath Co., Horse Glades near Blye; Klamath Co., Kirk; Klamath Co., Klamath Falls; Klamath Co., Merritt Crk.; Klamath Co., Meryl Cr.; Klamath Co., Sprague R., 12 mi E. of Chiloquin; Klamath Falls, Algoma; Klamath Falls, Geary Canal; Klamath Falls, Old Fort Road; Lake Co., Drew Reservoir; Lake Co., Summer Lake; Lane Co., Siltcoos Outlet; Lane Co., Winchester Bay; Malheur Lake; Manzanita; McMinnville; Meacham; Neotsu; Seaside; Steens Mountain, Fish Lake, 7500 ft; Tillamook Co., Woods; Tollgate; Trout Creek, Alvord Basin; Upper Klamath Lake; Waldport; Wasco Co., 5.5 mi S. The Dalles; Wasco Co., 7 mi S. Wapinitia. SOUTH DAKOTA: Brookings; Waubay, Blue Dog Lake; Leola;

Volga. UTAH: Boulder, Wilcat Ranger Sta.; Milford; Riverside. WASHINGTON: Cheney; Coulee; Garfield Co., Pomeroy; Grand Coulee; Pullman; Smyrna; Sprague; Stratford; Westport. WISCONSIN: Columbus. WYOMING: Laramie.

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