

Revision of the *Phyllophaga* of Hispaniola (Coleoptera: Scarabaeidae: Melolonthinae)

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ABSTRACT: With this study, the fauna of Hispaniolan *Phyllophaga* is now composed of 48 species, all of which are endemic (precinctive), including 22 new species described herein (4 attributed to Woodruff and Sanderson: *approxima*, *bonfils*, *jimenezi*, *rex*; 18 to Woodruff: *aceitillar*, *alcoa*, *androw*, *baoruco*, *carnegie*, *davidsoni*, *eladio*, *haitiensis*, *jaragua*, *larimar*, *marcano*, *nunezi*, *ortizi*, *pedernales*, *rawlinsi*, *rustica*, *santachloe*, *toni*). Additionally, allotypes are described for 7 species with previously unknown males (*aliada*, *cano*) or females (*esquinada*, *fossoria*, *imprima*, *kenscoffi*, *panicula*), and 6 new country records (Dominican Republic) are provided (*aliada*, *leptospica*, *minutissima*, *panicula*, *permagna*, *recorta*). Of the 48, only 1 male remains unknown (*barrosa*), and 9 females are missing (*aceitillar*, *carnegie*, *costura*, *davidsoni*, *espina*, *garrota*, *probaporra*, *rustica*, *toni*); 32 are recorded only from the Dominican Republic, and 5 are known only from Haiti. The 727 Figures include 50 habitus illustrations for all species, as well as SEM photos of male and female genitalia, and other salient morphological characters. The discovery of “sister species”, on opposite sides of the Enriquillo basin, provides significant data to support the 2 island concept; 15 species are known only from the paleo “south island”, and 23 are restricted to the “north island”.

RESUMEN: De acuerdo con este estudio, la fauna de *Phyllophaga* en la isla Española, en el mar Caribe, está compuesta por 48 especies, todas endémicas (precinctivas), incluyendo a 22 nuevas especies aquí descritas (4 atribuidas a Woodruff y Sanderson: *approxima*, *bonfils*, *jimenezi*, *rex*; 18 a Woodruff: *aceitillar*, *alcoa*, *androw*, *baoruco*, *carnegie*, *davidsoni*, *eladio*, *haitiensis*, *jaragua*, *larimar*, *marcano*, *nunezi*, *ortizi*, *pedernales*, *rawlinsi*, *rustica*, *santachloe*, *toni*). Adicionalmente, se describen los alotipos de 7 especies, de las cuales no se conocían los machos (*aliada*, *cano*) o las hembras (*esquinada*, *fossoria*, *imprima*, *kenscoffi*, *panicula*), y se reportan por primera vez a 6 especies para la República Dominicana (*aliada*, *leptospica*, *minutissima*, *panicula*, *permagna*, *recorta*). De las 48 especies, solo un macho no se conoce (*barrosa*) y 9 hembras aún no se describen (*aceitillar*, *carnegie*, *costura*, *davidsoni*, *espina*, *garrota*, *probaporra*, *rustica*, *toni*); 32 de estas especies se conocen solo de la República Dominicana y solo se conocen 5 de Haití. Las 727 ilustraciones incluyen a 50 figuras completas de todas las especies, al igual que microfotografías electrónicas (SEM) de las genitales de machos y hembras. El hallazgo de “especies hermanas” en lados opuestos la cuenca Enriquillo es un indicador significativo que apoya al concepto de dos islas; 15 especies se conocen solo en la “isla sur”, y 23 están restringidas a la “isla norte”.

Introduction

This study had its beginning over 50 years ago, shortly after the previous revision by Sanderson (1951). He acquired additional records, and new species, especially during a 3 week trip to Haiti and the Dominican Republic in 1959. Health problems prevented him from finishing the work, and it was relegated to Woodruff for completion. Originally Sanderson had recognized 5 new species, 4 of which are described jointly herein. The fifth species was discovered later to be the unknown male of one described earlier from a unique female. The additional 18 new

species described here, are solely attributed to Woodruff.

Over a period of 33 years, Woodruff made 46 trips to the Dominican Republic, and new species were encountered on a regular basis. In each new and remote area, unique and endemic forms were often collected. For that reason, this revision has been long in preparation. We do not believe this is the entire fauna, and we are certain that additional new species remain to be discovered. In the remainder of this treatment, reference to “I” or “me” refers to the senior author and “we” to both authors. The final manuscript was solely prepared by the senior author, and I

take full responsibility for any errors of omission or commission.

Sources of specimens. Although the bulk of the material examined was from the authors' collections, valuable material was generously loaned by the major museums that house Hispaniolan specimens. Although a few were seen from the Museo Nacional de Historia Natural in Santo Domingo, most of their material is on loan to a graduate student, and was unavailable for our studies. No major collections were seen from Haiti. A few private collections and the museum depositories are listed in the text in brackets and their curators are thanked in the acknowledgments section. Abbreviations (codens) follow those in Arnett, et al. (1986):

CMNH: Carnegie Museum of Natural History, Pittsburgh, Pennsylvania.

EGRC: E. G. Riley, Texas A and M University, College Station Texas.

EJMC: E.J. Marcano, Santo Domingo, Dominican Republic (now in FSCA).

FSCA: Florida State Collection of Arthropods, Florida Department of Agriculture, Gainesville, Florida.

INHS: Illinois Natural History Survey, Urbana-Champaign, Illinois.

MCZC: Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts.

MHND: Museo Nacional de Historia Natural, Santo Domingo, Dominican Republic.

NHMB: Naturhistorisches Museum, Basel, Switzerland

RHTC: R.H. Turnbow, Ft. Rucker, Alabama.

TAMU: Texas A and M University, College Station, Texas.

UMMZ: University of Michigan Museum of Zoology, Ann Arbor, Michigan.

USNM: United States National Museum, Washington, D.C. (we used USNM here because many of the holotypes carry that abbreviation, with a number. It currently uses the coden NMNH).

ZMHB: Humboldt -Universität Museum für Naturkunde, Berlin, Germany.

Historical Resumé

For such a large fauna, there is little literature and few authors dealing with Hispaniolan species. The first 2 species (*neglecta* and *hogardi*) were described by Blanchard (1850). Two more species (*major* and *permagna*) were described by Moser (1918). The Haitian species were treated by Wolcott (1928a,b),

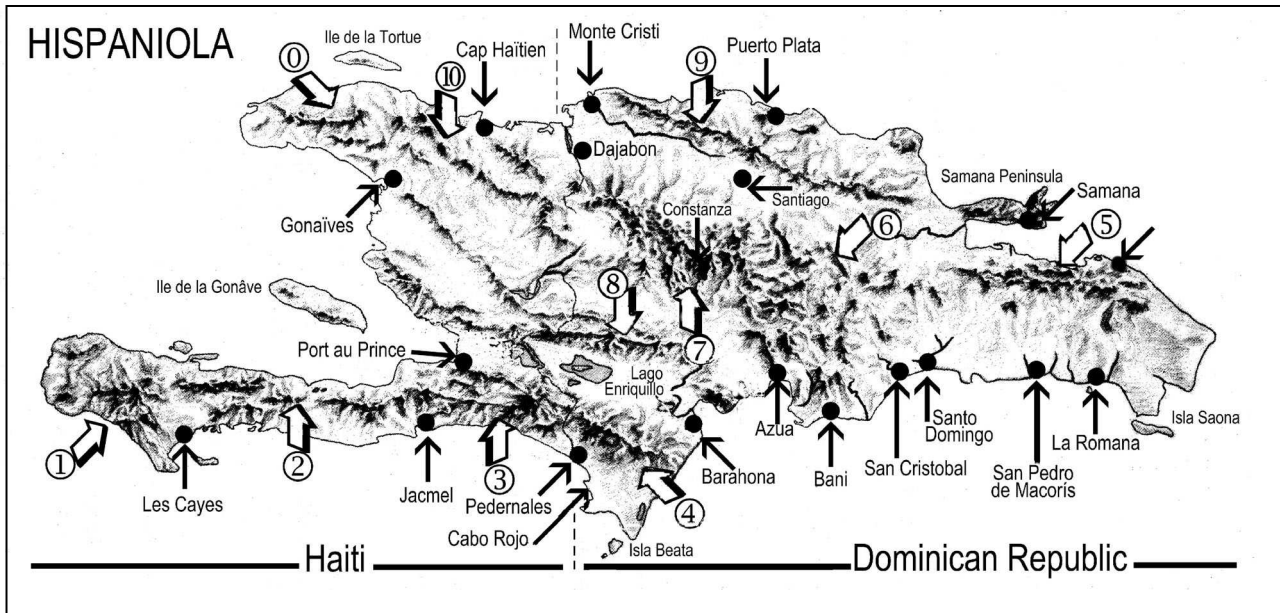
who named 5 additional species (*audanti*, *kenscoffi*, *latiungula*, *mali*, and *minutissima*). Saylor (1940, 1946) described 2 more (*pseudocalcaris* and *romana*). The remaining 15 species (*aliada*, *barrosa*, *canoa*, *cartaba*, *costura*, *espina*, *esquinada*, *fossoria*, *garrota*, *imprima*, *leptospica*, *mella*, *panicula*, *probaporra*, *recorta*) were described by Sanderson (1951).

Hispaniola: The Island

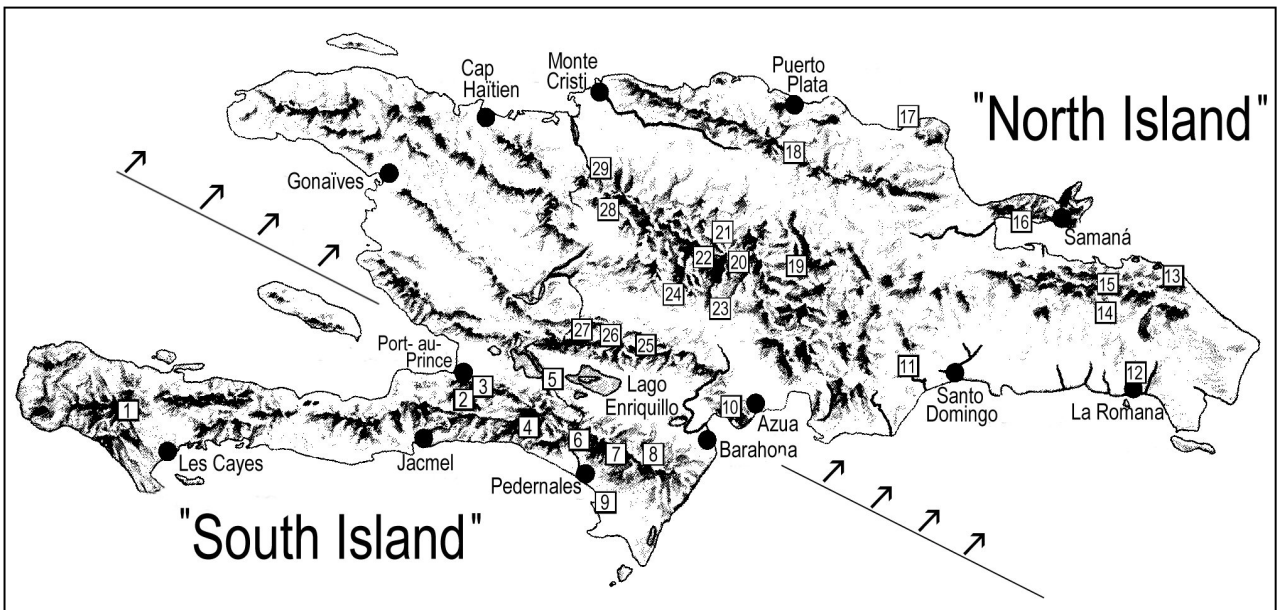
Occupying a central position in the Greater Antilles, Hispaniola is composed of 2 countries: Haiti and the Dominican Republic [DR]. The faunal differences do not coincide with their political boundaries, but are a reflection of the paleogeography (discussed later under Zoogeography). However, the cultural differences between the 2 countries have greatly affected which animals and plants can survive there. In area it is about 77,150 km², with Haiti about one-third and the remainder DR. The island is located between 17°26' and 19°56' N latitude, and 74°26' and 68°30' W longitude. It is 77 km from Cuba (Windward Passage) on the west, 102 km from Puerto Rico (Mona Passage) on the east, and 200 km from Jamaica to the southwest.

It contains several mountain ranges (Map 1) running mostly east-west, with some northwest-southeast directions. The southwestern portion ("south island") is separated from the remainder ("north island") by a depression crossing both countries from above the Barahona peninsula in the DR to Port-au-Prince, Haiti (Map 2). This basin was occupied by the sea during the Pleistocene, and now has a relictual salt lake (Enriquillo) at the lowest point on the island (40 m below sea level!). The "north island" occupies 67,700 km², the "south island" only about 9,450 km². There are 3 high peaks in the north (all higher than any in the eastern U.S.): Pico Duarte (3087 m), La Pelona (3075 m), and Pico del Yaque or La Rucilla (3038 m). The Haitian mountains consist of 3 main ranges: Massif de la Hotte (highest Pic Macaya, 2347m.), Massif de la Selle (highest Pic la Selle, 2574 m), and the Sierra Baoruco, which also extends into the DR. Under a 1989 contract with USAID, this area was investigated and conservation strategies were recommended (Woods and Ottenwalder, 1992; Woods, et al., 1992; Sergile, et al., 1992; Ottenwalder, 1989; Paryski, et al., 1989). Some of our few Haitian *Phyllophaga* were collected by Dr. M.C. Thomas on one of their study trips.

Ecologically it is extremely varied, leading to the title of the most comprehensive book on the DR: "The Dominican Republic, a country between rain forest



Map 1. Mountain ranges (hollow arrows & numbers) and major cities (solid arrows & dots) in Haiti and the Dominican Republic. ①=Montagnes du Nord-Ouest; ②=Massif de la Hotte; ③=Massif de la Selle; ④=Sierra de Baoruco; ⑤=Cordillera Oriental; ⑥=Sierra de Yamasá; ⑦=Cordillera Central; ⑧=Sierra de Neiba; ⑨=Cordillera Septentrional; ⑩=Massif du Nord. [1 inch = approximately 50 miles]. Map modified from Schwartz (1989).



Map 2. Arrows indicate the line marking the division of the paleo "North and South Islands" at the Enriquillo basin, and direction of plate subduction. Major *Phyllophaga* collecting localities (boxes) are as follows (1-4, Haiti; 5-29, Dominican Republic): 1) Ville Formon, Massif de la Hotte; 2) Fury and Kenscoff; 3) Petionville; 4) La Visite, Massif de la Selle; 5) Jimaní; 6) Banano and Agua Negra; 7) Las Abejas and Aceitillar; 8) Larimar Mine, Filipinas; 9) Cabo Rojo, Alcoa Headquarters; 10) Sierra Martin Garcia; 11) Medina and San Cristobal; 12) Casa de Campo, La Romana; 13) Nisibon; 14) Loma de Chivo, 7 km N. Pedro Sanchez; 15) El Seibo; 16) Las Garitas, Samaná; 17) Rio San Juan; 18) La Cumbre; 19) Bonao; 20) Constanza and Valle Nuevo; 21) Jarabacoa; 22) La Cienega, Manabao, Pico del Yaqui; 23) Padre de las Casas; 24) San Juan; 25) Vallejuelo; 26) El Cercado; 27) Hondo Valle; 28) Rio Limpio; 29) Dajabon. The area between 7 and 9 is the Mercedes road on which several new species were collected. Map modified from Schwartz (1989).

and desert" (Bolay, 1997). Because Haiti has been largely devastated by clearing for crops, and we have few specimens from there, our remarks on climate pertain mainly to the DR, and are mostly taken from Lora Salcedo, et al. (1983). In temperature it ranges from a mean annual low of 18°C (Constanza) to 28.3°C (LaDescubierta); the high of 40°C (Bonaó, Samaná, Sánchez) and low of 0°C (Constanza). It should be noted that our new species *rex* occurs at Constanza and larvae may be pests of strawberries there. Rainfall is extremely varied, from over 300 inches recorded at Miches on the north coast, to none some years (average of 4 inches) at Cabo Rojo in the southwest.

In the DR, Ottenwalder (1989) indicated that 5,250km² was set aside in 9 National Parks and 5 Scientific Reserves, or about 10% of the country. Several of our new *Phyllophaga* have come from 3 of these: Parque Jaragua (900km²), created in 1983; Parque Armando Bermudez (766km²), created in 1956 and encompassing Pico Duarte; and Bahoruco [or Baoruco] (700km²), created in 1983. In Haiti, Paryski, et al. (1989) listed Parc National la Visite (3,000 ha), established in 1983; Parc National Pic Macaya (5,500 ha), established in 1983; and Parc National Historique la Citadelle, Sans Souci, Ramiers (2,200 ha), established in 1968. The establishment of such parks and their continued preservation depend heavily on government's ability and willingness to enforce laws and protect them. The road from Cabo Rojo to Aceitillar, from which many of our specimens came, is a prime example of encroachment by squatters and agricultural development.

Much destruction is the result of charcoal being the primary energy source. Ottenwalder (1989) estimated that 45% of Dominican households (much higher in Haiti) depend on firewood and charcoal for fuel. At that time, deforestation rates were estimated at 100,000 hectares per year, and the needs have increased. His conservative estimate of 277 species of endangered or threatened plants gives little encouragement for their future survival. Recent floods and landslides are partially the result of deforestation.

There are 4 sizeable islands off Hispaniola, some of which may harbor unique *Phyllophaga*, especially Gonâve in the bay opposite Port-au-Prince. In the DR, 3 other larger islands have had no specimens collected: Saona, Beata, and Catalina. However, a new species is under study from Navassa, a much smaller island off the western tip of the southern peninsula of Haiti.

Methods and Materials

Most of the methods used for this study are those employed previously (Woodruff and Beck, 1989). The greatest modification has been in the improvement of scanning electron microscope (SEM) equipment, which permitted digital photography of uncoated genitalic specimens (JEOL: JSM-5510LV). With digital images recorded on compact discs, we were able to edit these easily (compared to hand painting backgrounds as before) on a computer, using Paint Shop™ Pro® software. Scale lines accompanied each image, but these were often modified in the finished version. Dirt and extraneous material was electronically eliminated. In the plates dealing with morphological characters, this software enabled labeling various parts on the image.

Most genitalia were removed from alcoholic preserved specimens, dried, and mounted traditionally on card points below the specimen. Some earlier material (especially Sanderson types) had the genitalia preserved in glycerin vials pinned in the same fashion. It was discovered early that specimens could be digitally photographed in the SEM directly from alcohol (with surface briefly dried). This was especially advantageous for female genitalia that are often softer, more flexible, and prone to shrinkage or misplacement when thoroughly dried. Some pinned specimens were placed directly in the SEM, and their parts easily photographed. None of our specimens required critical point drying, although some may have been prepared with this technique by other museums.

Specimen preparation. Because of the external similarity of many species, and the diagnostic nature of the genitalia, we extracted these from 99% of the material studied. We recommend that this routinely should be done, or specimens may be misidentified. The technique is simple, easy to learn, and requires minimal time. Material preserved in 70% isopropyl alcohol has proven to be the most satisfactory, even superior in some cases to fresh specimens. As long as they are not overcrowded, specimens stay perfectly preserved in this fashion for more than 50 years. To extract genitalia from dried specimens, they may be relaxed in a moist chamber for 2-3 days; we found the best way (without damaging specimens or genitalia) was to strip data labels (not to get wet) and place the beetle in a glass, fireproof container (a pyrex lab beaker) with about 2 inches of water and a small amount of household ammonia (10%, preferably lemon scented). This was then heated on a hotplate until it came to a rolling boil and the heat turned off; the

process usually took less than 5 minutes. Immediately the specimen was removed and even the oldest, driest specimens were readily dissected. Because *Phyllophaga* have relatively long legs, which are precarious in dried museum specimens, for relaxed specimens we recommend carefully tucking legs near the body to avoid later breakage. Usually overnight drying in position will suffice for both boiled and alcoholically preserved specimens.

Dissection. Although a certain amount of dexterity is assumed, the actual dissection was normally easy. Difficulties arose only with smaller and softer females, or when parts broke from poor relaxation (both the beetle and the dissector); patience is a virtue. The abdomen often was opened at the pygidial apex with forceps, but large tight fitting male specimens often required small cuts in the lateral membrane to allow space for removal of the large genitalia in some species. Gentle pressure on the sternites, and a bent insect pin or forceps were usually used to pull out the genital capsule (males) or genital plates (females). In obstinate cases, the specimen was re-boiled or relaxed again. Female plates were usually extruded, but not removed (except for photographic purposes), whereas the male genitalia are easier to study when mounted on points below the specimen. Clearing in KOH was not necessary, although occasionally done to elucidate various parts; these were subsequently stored in glycerin.

Once the male genital capsule has been dissected, it must be cleaned of membranes and extraneous tissue. Normally the apical structures are well-sclerotized and such material is easily picked off or flushed with alcohol to assist the process; forceps, insect pins, and fine brushes were the only tools needed. A little experience, coupled with attention to the various parts in our illustrations, should make this an easy process. The aedeagi are often sufficiently visible, but occasionally require gentle teasing or pulling to see all relevant portions. The resultant ease with which they can be identified, makes it a rewarding experience. Dawson (1935) provided additional details on dissection.

Collecting. Every child knows how easy it is to collect May or June "Bugs". And every entomologist knows how abundant they can sometimes be, and how readily they are attracted to lights. Some common pest species in coastal areas of Hispaniola (e.g., *romana*, *hogardi*, *mali*) fit this picture. However, many species occurring at higher elevations are very localized, have limited seasons, or are actually rare (several described here are known from 2 or 3 specimens, and some have not been collected for over 50

years). We suspect that some of these are more common than our records show, and the more we learn of their habits and habitats, the greater chance we will have of finding them.

The advent of blacklight traps (Hollingsworth, et al., 1963) revolutionized the surveys for such beetles. Although a few were taken in Malaise traps (some diurnal), probably 95% of all specimens we examined were from UV (blacklight) or Mercury vapor lights (either as traps or attractants). We used mainly 15 watt blacklight [BL] fluorescent tubes, but even an 8 watt blacklight can attract hundreds on a given night. Specimens were usually preserved in 70% isopropyl alcohol (even overproof rum works) in the field, and later dissected, mounted, or conserved in the same fluid (often changed from field samples). It was especially useful for our SEM studies to have access to alcoholically preserved specimens. They were cleaner (or more easily cleaned), could be manipulated with little fear of breakage, and the female plates retained their original shape and position. I highly recommend storing samples of each species in 70% isopropyl alcohol, where even large collections occupy much less museum drawer space than when pinned. Who knows, additional information may be discovered in alcohol preserved specimens that is unusable in those dried. When properly preserved as described, specimens have been adequate for DNA studies.

Habitus illustrations (Fig. 62-111). Most of our habitus photographs were made from digital images produced on an Auto-Montage Pro©, and later edited as were the genitalia photographs. A few, especially large species, were photographed with a digital camera (Nikon Coolpix®). Because most beetles are shiny, a diffuser provided better images (this consisted of either frosted paper or a translucent mixing bowl, surrounding the specimen). In a few cases, where beetles were too large to be entirely photographed in one image on the automontage (e.g., *toni*), 2 separate photos were made and digitally merged. All specimens were photographed as pinned specimens, but the pins were removed digitally in Paint Shop Pro.

Format. To save space, and because the paper deals only with the genus *Phyllophaga*, the species names are used mostly without the genus or its abbreviation (*P.*). Most morphological characters are illustrated with labeled SEM photographs prior to the species descriptions. Keys are presented to the 48 species known, with emphasis on genitalic structures. Species treatments and associated figures are arranged alphabetically. Full technical descriptions

and genitalic illustrations are provided for each of the 22 new species treated. Because of space restrictions, for all previously described species, reference is provided to Sanderson's (1951) treatment; here, only a brief description, new records and notes, and genitalic illustrations are presented. One new species (near *fossoria*) is illustrated for identification purposes, but its description and naming are reserved for a Dominican graduate student.

Because we treat only adults and to conserve space, any statements (other than those in the larval discussion) refer to that stage only. We have given relative size terms (within the genus), and we believe that it is understood and shorter to say "large species" with accompanying measurements, rather than the cumbersome "individuals of this species are large". We have used length (L., the style manual indicates that lower and upper case have both been used for liter, and the confusion with the numeral 1) and width (W.) measurements to nearest half millimeters (to avoid redundancy we use "mm" only after the last numeral). Specimens were measured from tip of head to tip of elytra, but exact measurements are not possible because of variable positioning of parts (head or abdomen distention, etc.). We have listed them thusly: 10-12.5, avoiding the decimal after whole numbers, as a result of the inexact nature of the measurements (to 0.5 mm only). We have used numerical label data as it appeared, without risk of converting all to metric.

Names. Of the 22 new species, names for the 4 jointly described species were chosen by Sanderson; the remaining 18 by Woodruff. Most were chosen to recognize places (e.g., *pedernales*), beetle features (*rustica*), institutions (*alcoa*), or people (*marcano*). In all cases where names were not Latinized (e.g., *eladio*) they are treated as nouns in apposition, for the sake of euphony.

Types. Holotypes (males) and allotypes (females) are designated for all new species described herein; females remain unknown for 10 species, and 1 male is unknown (see Table 1). In 7 cases the opposite sex of a known species is described for the first time, and allotypes are here designated. Because the genitalia are diagnostic in both sexes, it is important to designate both holotypes and allotypes, which are of equal significance. In this study we have associated male specimens for 2 of the 3 species described by Sanderson (1951) from unique females. Although the holotype females were described more than 50 years ago, we believe that describing allotype males now is both useful and relevant for nomenclatural stability. Fernald (1939: 691-692) defined the term "allotype" as

originally coined: "A specimen of opposite sex to holotype, chosen later, either by the author or by any subsequent student, not necessarily from the original type series. Muttkowski, 1910." For 7 previously described species, by this definition we establish the allotype males for *aliada* and *canoas* Sanderson (1951), as well as female allotypes for *esquinada*, *fossoria*, *imprima*, and *panicula* Sanderson (1951), and *ken-scoffi* Wolcott (1928a).

Maps. The major mountain ranges, the Enriquillo basin, and major cities are shown on Map 1; some of the major collecting sites are shown in Map 2. Specific distribution maps were planned for each species, and full data were recorded for each specimen. However, space restrictions prevented including them here. They should form the basis for future detailed zoogeographic studies, when all records can be plotted. Many of the Carnegie specimens had GPS readings on the labels; much more exact localities than are generally recorded with label data.

Specimens examined. In specimen data recorded here, new country records are indicated in boldface. The total number of specimens examined was recorded first, followed by country, province, number of specimens in parentheses, precise locality, date (month in Roman), and other label data, followed by the depository in brackets (used throughout the text). The listing of depositories is provisional at this writing; with cooperation among institutions, attempts will be made to distribute as many species as possible to each lending museum, especially the Museo Nacional de Historia Natural (Santo Domingo).

The individual species treatments are followed by sections on Questionable and Erroneous records, Acknowledgments, and References.

Morphological Characters

The terminology used here is that traditionally used in *Phyllophaga* (Böving, 1942b; Sanderson, 1951; Morón, 1986; Woodruff and Beck, 1989). Because of the external similarities in habitus (Fig. 62-114), greater reliance is placed on the diagnostic features of the male and female genitalia. However, the latter are often so radically different, and homologies have not been established for various parts, that they defy description. For this reason, emphasis has been placed on illustrating these features, rather than detailed descriptions. All new species have been described in more detail, with less detail for previously described species; all include citations to Sanderson's previous descriptions, and references to his and our illustrations. The characters and their character

PLATE 1: *Phyllophaga* Morphological Characters: Head

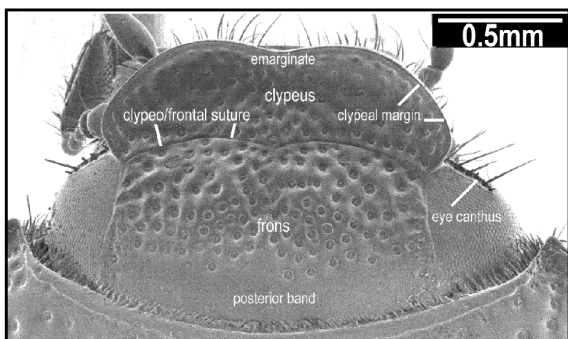


Fig. 1. *panicula* Sanderson. Head (dorsal) with parts labeled. Note clypeus shorter than frons, emarginate, coarsely punctured (non-setigerous), posterior angles converging to frontal suture, which is deeply impressed, emarginate, and coarsely punctate (denser in 2 center spots), posterior band impunctate.

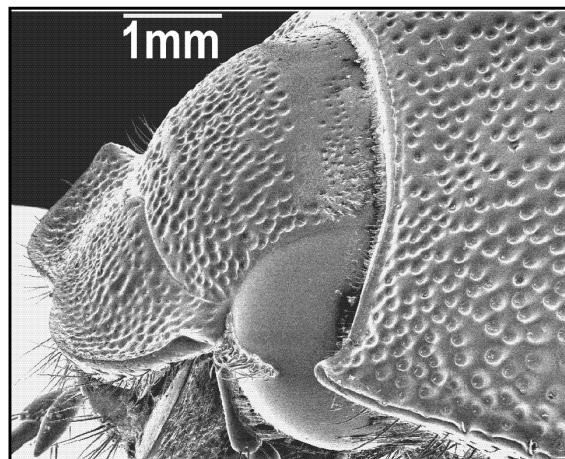


Fig. 2. *marcana* Woodruff. Head (lateral), showing reflexed (upturned) clypeal margin, sharp posterior angles, dense, coarse punctation of clypeus, frons, pronotum, and punctures in posterior band of head.

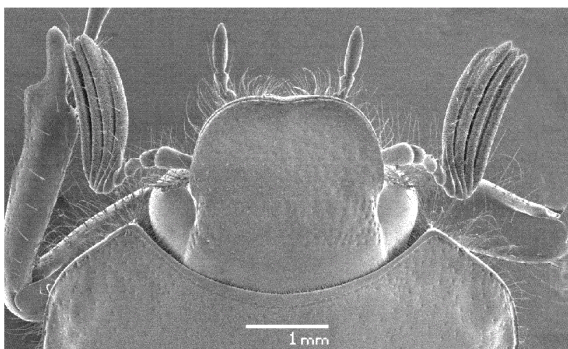


Fig. 3. *garrota* Sanderson. Head (dorsal); note 4 lamellae in antennal club. Clypeus rounded on sides, barely emarginate in middle, weakly reflexed; clypeus and frons nearly equal in length, suture weakly impressed, surface evenly and shallowly punctate, non-setigerous.

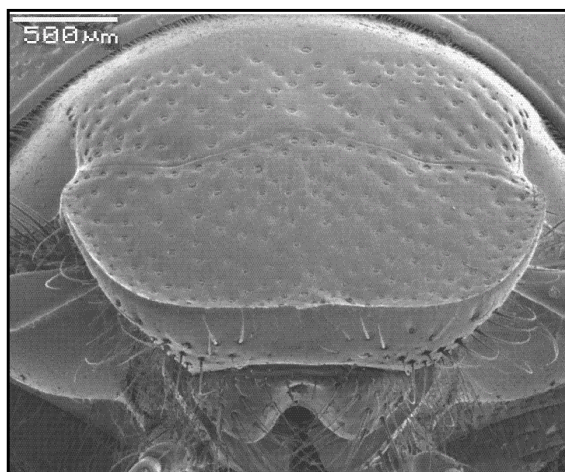


Fig. 4. *garrota* Sanderson. Head (frontal), showing clypeal margin barely reflexed, emargination minimal, punctures shallow and widely separated; clypeo/frontal suture barely impressed, indicated by wavy line.

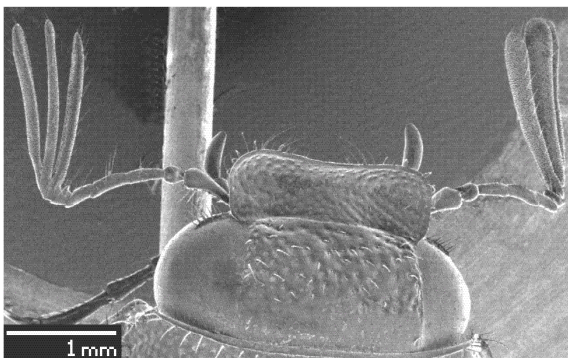


Fig. 5. *fossoria* Sanderson. Dorsal view of head; note 3 lamellae in antennal club. Clypeus nearly quadrate, sides converging abruptly at frontal suture, evenly emarginate in middle, noticeably reflexed; clypeus shorter than frons, suture strongly impressed, nearly straight, surface coarsely punctate, frons with some setigerous punctures.

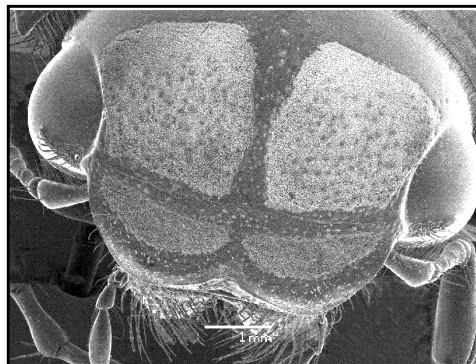


Fig. 6. *rex* Woodruff and Sanderson. Head (dorsal), showing velvety spots, clypeus deeply emarginate, clypeo/frontal suture indicated by dark curved line.

PLATE 2: *Phyllophaga* Morphological Characters: Antennae

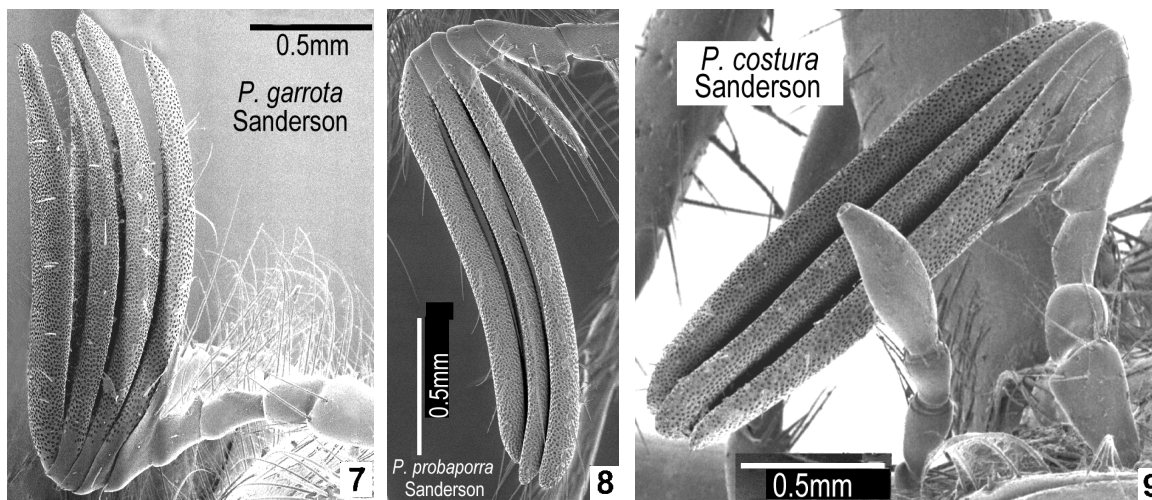


Fig. 7-9. These 3 species have noticeable receptors (indicated by dots) at 20X, and all appear to be diurnal: 7) club with 4 lamellae (unique); 8) partial 4th lamella, about one-third length of others; 9) partial 4th lamella, about one-fourth length of others. Enlargements below:

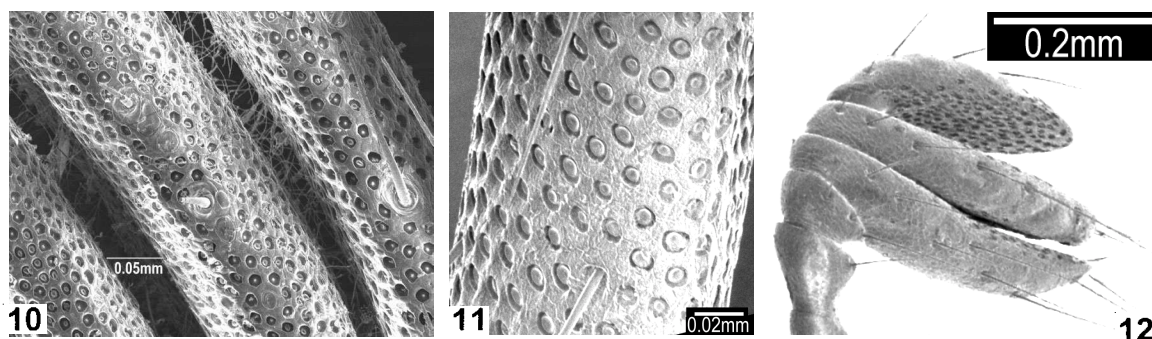


Fig. 10-12. Antennal receptors: 10) *garrota* Sanderson, male; 11) *fossoria* Sanderson, male; 12) *panicula* Sanderson, female (note receptors beneath terminal lamella and margins of lower two).

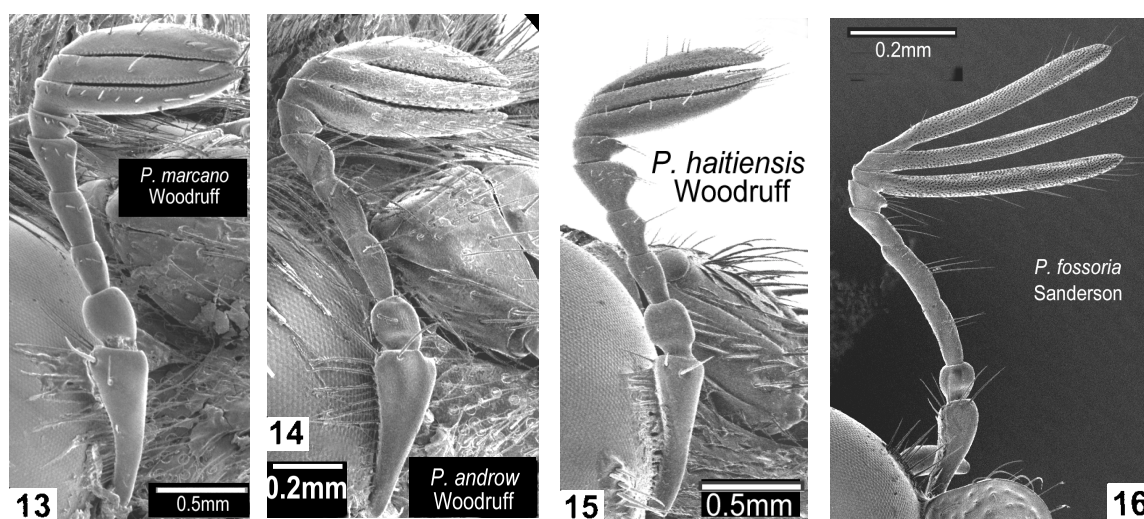


Fig. 13-16. Shapes of antennal segments (antennomeres): 13) male, club ovate, antennomeres 3-5 subequal; 14) female, club ovate, antennomeres 3-4 elongate, cylindrical, division not deeply impressed; 15) male, club ovate, but elongate, antennomeres 3-5 different lengths, fifth with external projection; 16) male, club elongate (longer than 5 preceding antennomeres), lamellae flattened, antennomeres 3-5 cylindrical, weakly divided.

PLATE 3: *Phyllophaga* Morphological Characters: Tibiae

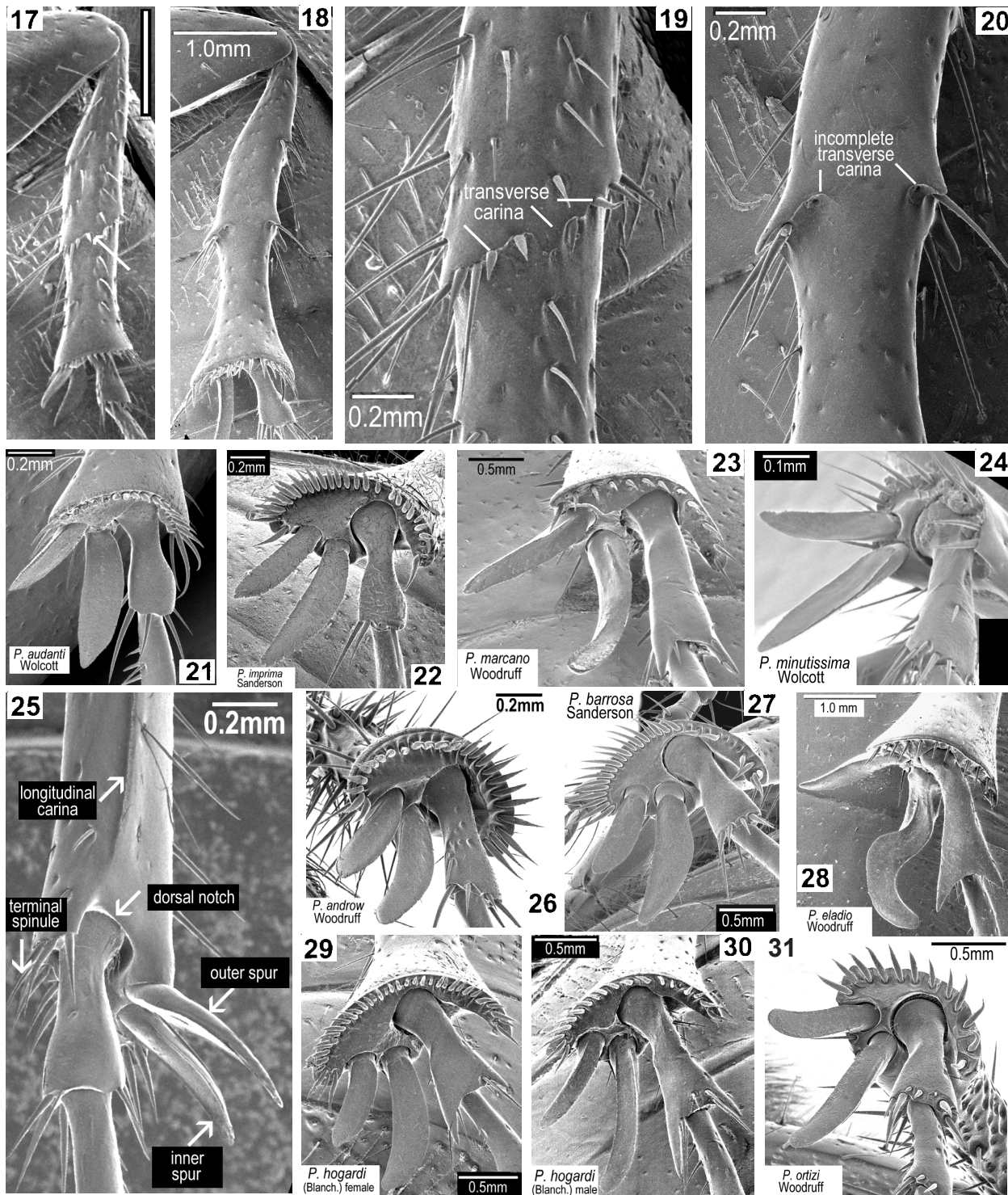


Fig. 17-31. Metatibial character states: 17) *androw* Woodruff, entire, ventral, line =1mm; 18) *rawlinsi* Woodruff, same; 19) *androw*, enlargement of transverse carina; 20) *rawlinsi*, enlargement of incomplete carina; 21-31 tibial apices, number of spines in apical fringe in brackets: 21) *audanti* Wolcott, female [20]; 22) *imprima* Sanderson, female [29]; 23) *marcano* Woodruff, male [13]; 24) *minutissima* Wolcott, male [13]; 25) *imprima* Sanderson, dorsal view with parts labeled; 26) *androw* Woodruff, female [25]; 27) *barrosa* Sanderson, female [28], notice 3 spines missing; 28) *eladio* Woodruff, male, note unique S-shaped long spur [13]; 29-30) *hogardi* (Blanchard), note sexual dimorphism: 29) female [35]; 30) male [19]; 31) *ortizi* Woodruff, female [12].

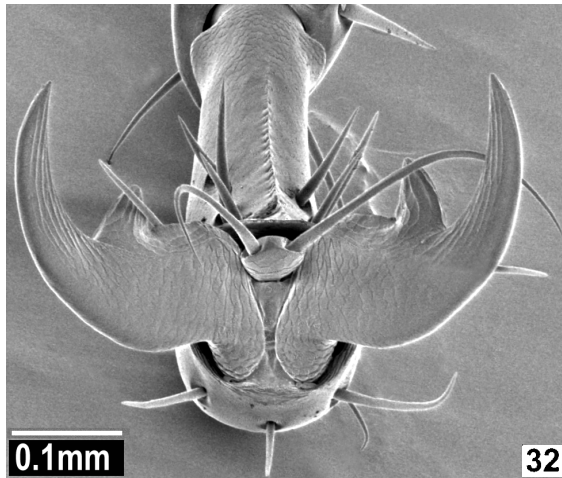
PLATE 4: *Phyllophaga* Morphological Characters: Tarsi

Fig. 32. *audanti* Wolcott (female). Metatarsal claws, with pulvillus between. Note ridges on teeth and scale-like pattern on claw body. Some species have more extensive ridges. Note also the saw tooth carina on venter of fifth tarsal segment and lobes on each side at base.

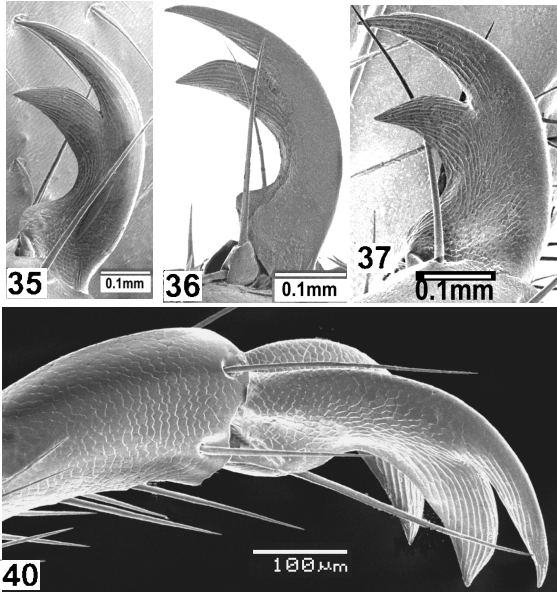


Fig. 35-37,40. Examples of "cleft" tarsal claws (lateral): 35) *fossoria* Sanderson, 36) *aliada* Sanderson, 37) *androw* Woodruff, 40) *nunezi* Woodruff.

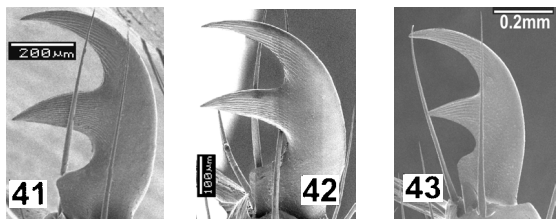


Fig. 41-43. Tarsal claws: examples of middle tooth central, first 2 are nearly length of terminal tooth: 41) *haitiensis* Woodruff, 42) *recorta* Sanderson, 43) *alcoa* Woodruff.

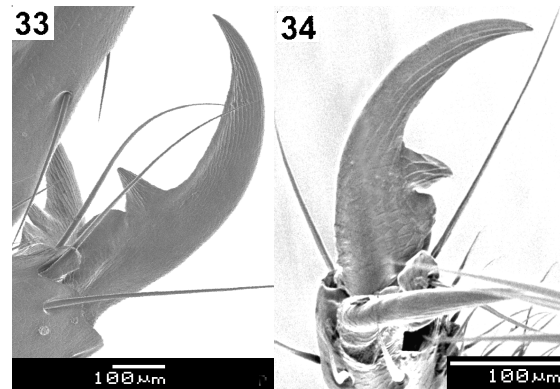


Fig.33-34. Tarsal claws: examples of middle tooth nearer base than tip of long tooth: 33) *probaporra* Sanderson, middle tooth short, triangular, with small notch at base; ridges of terminal tooth not parallel to inner curve; 34) *minutissima* Wolcott, middle tooth heavily ridged, distinct notch behind, base very broad; terminal tooth long, narrow, with ridges curved with curve of tooth.

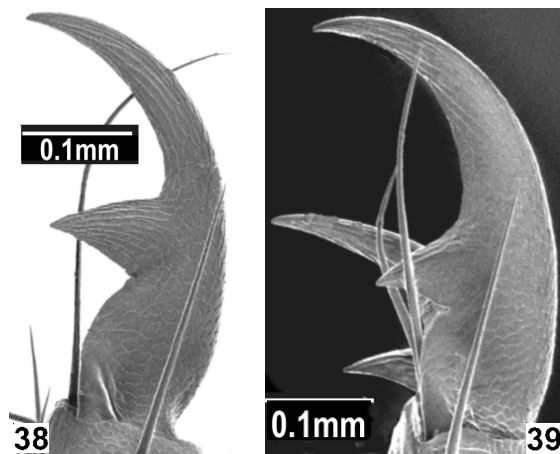


Fig. 38-39. Tarsal claws: examples of middle tooth central, but short, triangular, with the base rounded, and not forming a distinct notch as above: 38) *esquinada* Sanderson, 39) *audanti* Wolcott



Fig. 44. Anterior tarsus of *minutissima* Wolcott. Note first 4 segments about equal in length, with the fifth more elongate. All segments have brush-like setae on their inner surface. Note tarsal claws are elongate, the middle tooth barely visible. This species is the smallest known from Hispaniola (Fig. 95), but its anterior tarsi are proportionately longer than any other species.

PLATE 5: *Phyllophaga* Male Genital Characters

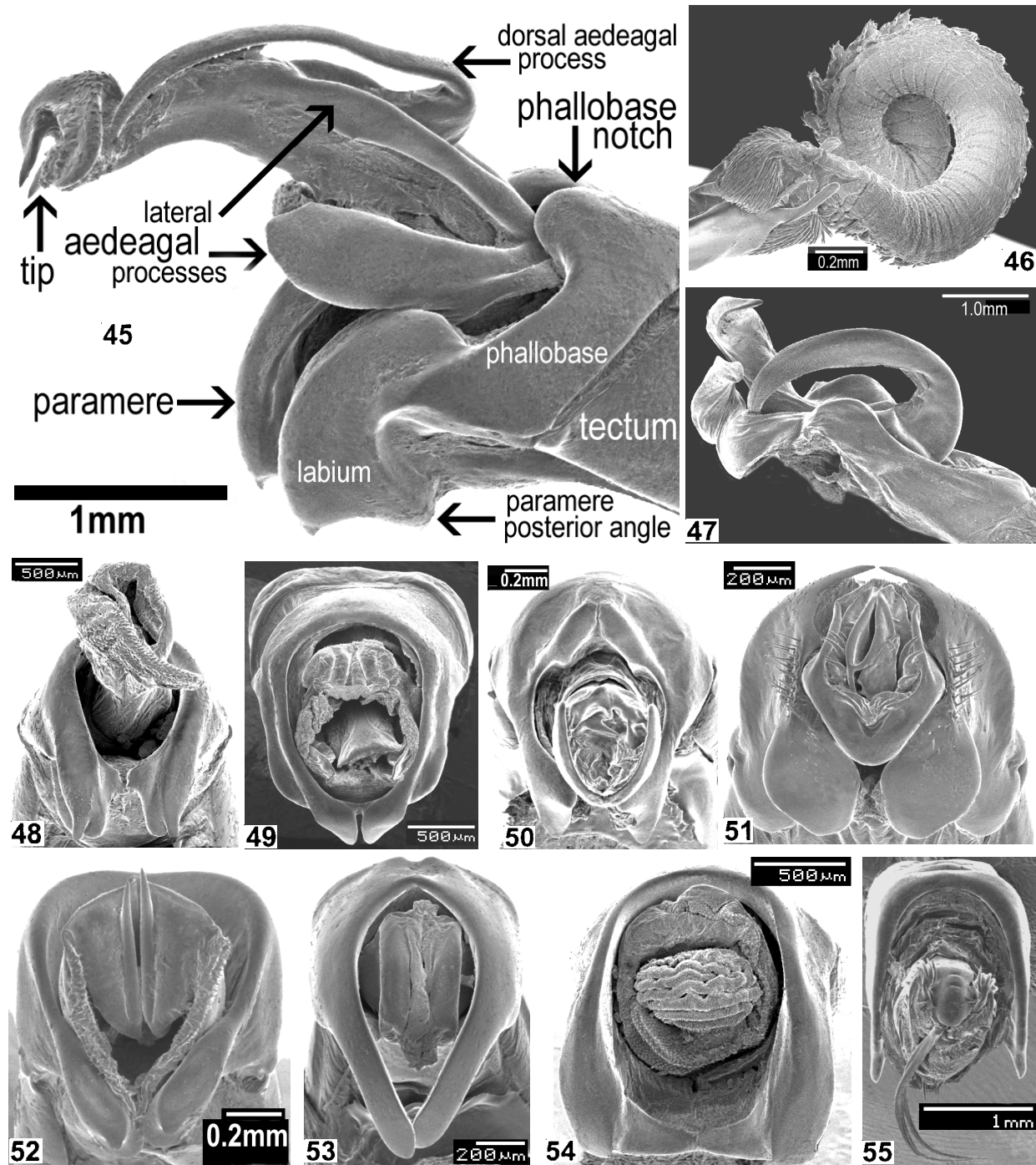


Fig. 45-55. Genitalia: 45) lateral, *mali*, with parts labeled; 46-47) bizarre asymmetrical aedeagi: 46) *rawlinsi* Woodruff, left lateral; 47) *bonfils* Woodruff and Sanderson, right lateral; 48-55) caudal views: 48) *baoruco* Woodruff; 49) *aliada* Sanderson; 50) *acetillar* Woodruff; 51) *fossoria* Sanderson; 52) *imprima* Sanderson; 53) *ortizi* Woodruff; 54) *hogardi* (Blanchard); 55) *espina* Sanderson.

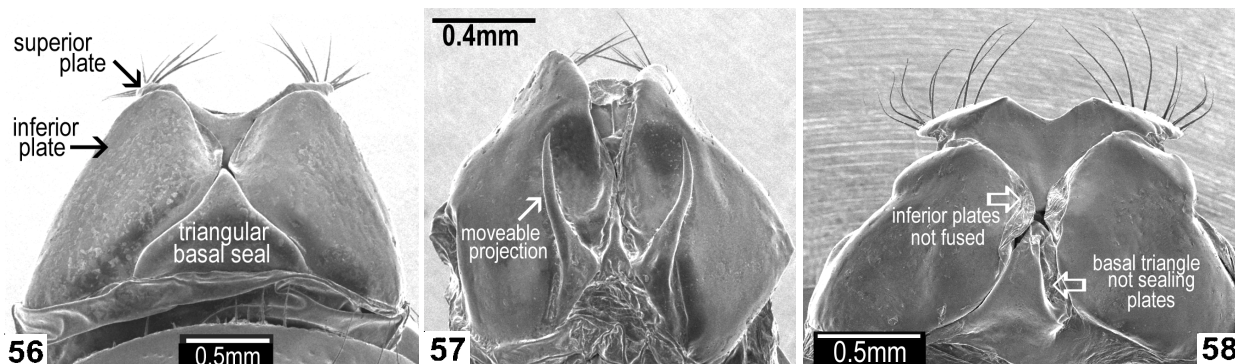
PLATE 6: *Phyllophaga* Female Genital Characters

Fig. 56-57. Ventral views with parts labeled: 56) *recorta* Sanderson, few species have this triangular basal seal; 57) *mella* Sanderson, the moveable projections are unique to this species (see species plates for further views); 58) *jaragua* Woodruff, prominent superior plate, basal triangle present but not sealing plates.

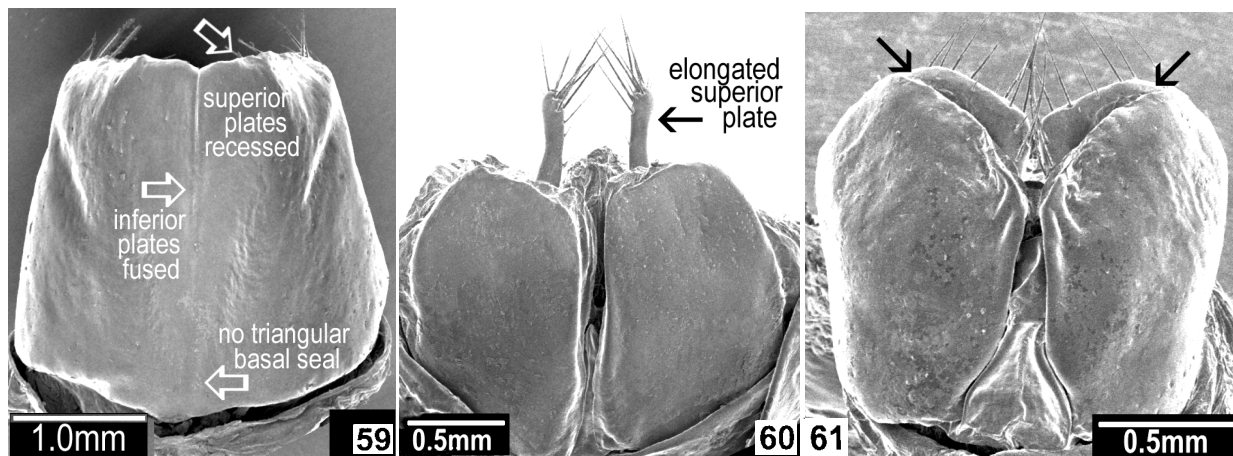


Fig. 59-61. Ventral views with parts labeled: 59) *santachloe* Woodruff, inferior plates completely fused in center; 60) *canoa* Sanderson, inferior plates separated most of their length and superior plates (pubic process?) elongate, separated; 61) *fossoria* Sanderson, inferior and superior plates fused at apex (arrows).

states, which are used for description herein, are explained below (illustrated in Fig. 1-61).

Head (Fig. 1-6). The head often contains diagnostic features on the clypeus, especially the shape, punctation, and margin. The clypeus may be strongly (Fig. 2, 6) or weakly (Fig. 3, 5) emarginate (medial area indented) or not; the anterior angles may be rounded (Fig. 1, 6) or quadrate (Fig. 5); the sides may converge toward the frontal suture at various angles (Fig. 1-5). The margin may be reflexed or raised (Fig. 2) or barely elevated (Fig. 4). The suture between the clypeus and frons is referred to as the frontal suture (=clypeal/frontal) and may be deeply (Fig. 1, 2, 5) or shallowly impressed (Fig. 3, 4), or raised in one species, *costura* (Fig. 253-254), and its outline may vary. The main features of the frons are the extent of punctation and its length in relation to the clypeus.

The posterior band (Fig. 1, 482) is the area behind the frons and is usually impunctate, except for punctures above the eyes and portions often covered by the head in repose. The eye has a canthus (Fig. 1) which varies in length, in convexity (in *imprima* it is depressed, Fig. 379-380), and in the number, size, and color of setae. Mouthparts were not examined in detail, but in the related genus *Diploptaxis*, and some continental *Phyllophaga*, diagnostic characters are present (McCleve, in litt.).

Antennae. Although a part of the head, the antennae are especially noted because of significant character states. A separate plate (Fig. 7-16) is devoted to these. Important features involve number of segments (9 in all species here, but 8-10 elsewhere); the number of lamellae in the club (4 in *garrota*, Fig. 7; 3+ in *costura*, Fig. 8, and *probaporra*, Fig. 9; only

3 in all others, Fig. 13-16); shape of the club, from flattened lamellate (Fig. 7-9, 16) to oval (Fig. 13-15) and sometimes differing between sexes; receptors are present on entire lamellae (Fig. 7-10), on a portion (Fig. 12, 147), or not noticeable at 20X (Fig. 361, 669). The lengths and shapes of the 6 antennomeres (=segments) and their relative lengths to the club are often useful (especially 3-6).

Pronotum (Fig. 62-111). The shape, size, vestiture, punctuation, anterior and posterior angles, and margins are all useful characters. Often the punctuation and/or vestiture differ between pronotum and elytra. The lateral pronotal margin can be smooth, with few setae or it may have large setae, whose bases give the margin a crenulate appearance. The marginal setae may or may not continue around the posterior margin, which may be obsolete (especially medially) or entire. The lateral margin and anterior margin may be variously reflexed.

Scutellum. Although a small structure, normally V- or U-shaped, it can sometimes be used to separate closely related species (Fig. 474, *marcano* punctate; Fig. 77-78, *eladio* impunctate). It may be shiny, smooth, hirsute, velvety (Fig. 670-671), convex or flat.

Elytra. As can be seen in the habitus illustrations (Fig. 62-114), the elytra vary from hirsute to glabrous, pruinose to shiny, convex to flattened, rugose to smooth, coarsely to finely punctate, spinose sutural apex to smoothly rounded, and with costae obscure or noticeably convex.

Pygidium. Character states include surface shiny, pruinose (in *imprima* and relatives it is both, Fig. 374-375) glabrous, hirsute [partially or totally, with setae long (Fig. 531-532), curved, or short, stubby (Fig. 546)], apically truncate or rounded, but invariably with a marginal fringe of very long, curved setae. The shape is roughly triangular, but varies in width/length proportions. In *kenscoffi* (Fig. 414-415) and lesser so in *jimenezi* and *santachloe*, the apex is upturned medially, forming a lip. The punctuation varies from coarse (sometimes coalescing to form longitudinal ridges) to fine, but is sometimes obscured by the pruinosity.

Legs. All legs have important characters, most of which are illustrated in Fig. 17-44. The anterior or protibiae are usually tridentate, but the extent and position of dentition varies, as does the sculpture and vestiture of the dorsal surface. In *garrota* (Fig. 332) the basal (lower) tooth is reduced and in *eladio* (Fig. 267) well developed. The meso- and metatibiae have many important character states (Fig. 17-31). Most Caribbean species (subgenus *Cnemarachis*) have clus-

ters of spines on the inside and outside of the metatibiae (Fig. 18, 20), marking the location where a transverse carina (Fig. 17, 19) rarely is complete (e.g., *androw*). The mesotibiae are usually the same, but a few have the carina complete. A longitudinal carina (often hidden behind the tibiae, Fig. 25) is well developed in a few species, but more commonly incomplete or poorly developed. The metatibial apex has a fringe of spines or spinules that vary from thick and short to long and fine; they are often closely spaced (Fig. 22, 27, 29), but sometimes widely so (especially in males, Fig. 23, *marcano* and Fig. 24, *minutissima*). The number of spinules in this fringe is relatively constant for each species, the males often having one-third or less than females. The apex also contains 2 moveable spurs (some N.A. species have one fixed), which are often sexually dimorphic (Fig. 29-30); females are broader, flatter, and shorter. Most are acuminate (usually sharp-pointed, but occasionally blunter) or sickle-shaped, but some are twisted (*eladio*, Fig. 28) or radically bent or spatulate-shaped (*esquinada*, Fig. 281-282). The one nearest to the tarsus is referred to as inner (usually longer) and the other is the outer spur (Fig. 25). The dorsal apex of the metatibia has a notch, exceptionally large in some smaller species (*imprima*, Fig. 25), which enables the beetle to elevate the tarsi almost vertically (reminiscent of the positioning in nature of some species of the genus *Serica*).

Tarsi have fewer characters of value, except the terminal claws. Some species do have special modifications of the first or second tarsal segments, usually with spinose extensions on the outer side. One of the smaller species (*minutissima*) has exceptionally long protarsi with exceptionally long hairs beneath (Fig. 507-508). Types of claws are shown in Fig. 32-43. Cleft (found in the subgenus *Phytalus* elsewhere) signifies the 2 teeth are near each other, with the angle between acute (Fig. 35-37, 40). Non-cleft claws have the middle tooth in varying positions, most frequently central, but varying in size and direction. The area behind the middle tooth may form a large U-shaped notch (Fig. 41-43), a shallow acute notch (Fig. 33-34), or gradually rounded to the tarsi (Fig. 38, 40). The claws are normally the same on all legs, but some variation occurs.

Abdomen. Although certain abdominal characters are distinctive, they are difficult to describe. The abdominal sternites are fused and immovable, the sutures between sometimes barely indicated. In many North American species there is considerable sexual dimorphism, especially in the modifications of the penultimate (seventh) and ultimate (eighth) sterni-

Table 1. *Phyllophaga* of Hispaniola checklist. Asterisks indicate new males and females or new country records.

	Male	Female	D. R.	Haiti	So. Isl.	No. Isl.
<i>aceitillar</i> n. sp., Woodruff	X		X		X	
<i>alcoa</i> n. sp., Woodruff	X	X	X		X	
<i>aliada</i> Sanderson (1951:279-280)	X*	X	X*	X		X
<i>androw</i> n. sp., Woodruff	X	X	X			X
<i>approxima</i> n. sp., Woodruff and Sanderson	X	X	X		X	
<i>audanti</i> Wolcott (1928a:27)	X	X	X	X	X	X
<i>baoruco</i> n. sp., Woodruff	X	X	X		X	
<i>barrosa</i> Sanderson (1951:280)		X		X	X	
<i>bonfils</i> n. sp., Woodruff and Sanderson	X	X		X	X	
<i>canoa</i> Sanderson (1951:279)	X*	X	X			X
<i>carnegie</i> n. sp., Woodruff	X		X			X
<i>cartaba</i> Sanderson (1951:274-275)	X	X	X			X
<i>costura</i> Sanderson (1951:264)	X		X			X
<i>davidsoni</i> n. sp., Woodruff	X		X		X	
<i>eladio</i> n. sp., Woodruff	X	X	X			X
<i>espina</i> Sanderson (1951:264-265)	X		X			X
<i>esquinada</i> Sanderson (1951:268)	X	X*		X	X	
<i>fossoria</i> Sanderson (1951:258-259)	X	X*	X			X
n. sp. near <i>fossoria</i> (see text)	X		X			X
<i>garrota</i> Sanderson (1951:262-263)	X		X			X
<i>haitiensis</i> n. sp., Woodruff	X	X		X	X	
<i>hogardi</i> (Blanchard) (1850:137)	X	X	X	X	X	X
<i>imprima</i> Sanderson (1951:276-277)	X	X*	X			X
<i>jaragua</i> n. sp., Woodruff	X	X	X		X	
<i>jimenezi</i> n. sp., Woodruff and Sanderson	X	X	X			X
<i>kenscoffi</i> Wolcott (1928a:24)	X	X*	X	X	X	X
<i>larimar</i> n. sp., Woodruff	X	X	X		X	
<i>latiungula</i> Wolcott (1928a:28)	X	X		X	X	
<i>leptospica</i> Sanderson (1951:262)	X	X	X*	X	X	
<i>mali</i> Wolcott (1928:25)	X	X	X	X	X	X
<i>marcano</i> n. sp., Woodruff	X	X	X			X
<i>mella</i> Sanderson (1951:278-279)	X	X	X			X
<i>minutissima</i> Wolcott (1928a:28, 76)	X	X	X*	X	X	X
<i>neglecta</i> (Blanchard) (1850:137)	X	X	X	X	X	X
<i>nunezi</i> n. sp., Woodruff	X	X	X			X
<i>ortizi</i> n. sp., Woodruff	X	X	X		X	
<i>panicula</i> Sanderson (1951:275-276)	X	X*	X*	X	X	
<i>pedernales</i> n. sp., Woodruff	X	X	X		X	
<i>permagna</i> (Moser) (1918:57)	X	X	X*	X	X	
<i>probaporra</i> Sanderson (1951:263-264)	X		X			X
<i>pseudocalcaris</i> Saylor (1940:309)	X	X	X			X
<i>rawlinsi</i> n. sp., Woodruff	X	X	X			X
<i>recorta</i> Sanderson (1951:268-269)	X	X	X*	X		X
<i>rex</i> n. sp., Woodruff and Sanderson	X	X	X			X
<i>romana</i> (Saylor) (1946:1)	X	X	X			X
<i>rustica</i> n. sp., Woodruff	X		X			X
<i>santachloe</i> n. sp., Woodruff	X	X	X			X
<i>toni</i> n. sp., Woodruff	X		X		X	

* = first males and females or new country records.

tes. We use the terms instead of numbers, because the first 2 abdominal segments are hidden under the metathorax and coxal plates, confusing the count. The Hispaniolan species show little differences in these last 2 sternites; usually males are less convex,

with slight depressions, more setae, or a transverse groove on the ultimate may be deeper and more punctate. Often sexes cannot be distinguished without dissection. One character not found in N.A. species is a patch of pruinosity (Fig. 382, 566) on the

penultimate sternite which varies in intensity, but is usually accompanied by a cluster of long hairs; more noticeable in the dorsally pruinose species. Punctuation and setation of most species are usually similar and difficult to assess or compare.

Genitalia. The most useful and diagnostic characters, for identification of species within the genus *Phyllophaga*, are the male and female genitalia. Because of this we have devoted more time and effort to illustrating them. Dr. J.B. Smith (1889) discovered their usefulness, but concluded that "No words could accurately describe their peculiar turnings and twistings.... I shall not undertake verbal descriptions of these parts, but prefer to let my figures answer most questions." It was not until the Scanning Electron Microscope (SEM) that these structures could be properly illustrated. Like Smith, I have only tried to briefly describe the salient features under each species treatment. I have attempted to illustrate the terminology of male morphological features (Fig. 45), but finding a typical species was difficult, as a perusal of the other examples (Fig. 48-55, and under each species) easily will show. An important difference from most continental species is the heavy sclerotization and complicated modifications of the aedeagus. It is often extruded naturally, but sometimes requires dissection. With our studies, none required clearing or slide preparation for viewing diagnostic features. Genitalia were once stored in glycerin vials pinned beneath specimens, but we recommend against this procedure. These are difficult to photograph (because of the viscosity of glycerin), and the vials are precarious for shipping and museum curation. In actuality the corks often desiccate, fall out, and leave the vial to roll around.

Female genitalia (Fig. 56-61, and under each species) are much simpler, usually consisting of 4 plates (rarely 5) and a few setae. In most cases, especially the more heavily sclerotized species, they are sufficiently distinct to be easily recognized. Some of the smaller species, with softer parts, are difficult to dissect and compare. Most consist of 2 relatively simple inferior plates, fused or separated, setate or glabrous, with various ridges and depressions. They sometimes terminate near the suture in an "internal process". Only in *mella* (Fig. 57), are they modified with long, moveable projections ("ice tongs"). Several species have a triangular plate which covers (entirely or partially) the median base of the inferior plates (Fig. 56, 58, 61), but others have no vestige of such a feature (Fig. 59). The superior plates usually extend above the inferior ones and terminate at lateral angles with various numbers, sizes, and positions of setae. A

few (Fig. 61, 159) have the inferior and superior plates fused at their apices. The shape of the space between the lateral projections and the setae is often diagnostic, as are the apices themselves. Only *cano*a (Fig. 60) has the superior plate elongated to resemble what is called a pubic process elsewhere. None has been found among Hispaniolan species to possess 3 sets of plates, as in some continental species.

Key to adult *Phyllophaga* of Hispaniola

Traditionally, revisions are accompanied by dichotomous keys to species. We have included this key for that reason, but with certain reservations. Because genitalia are the easiest, and often the only reliable character for species identification, we have illustrated all of them. Most users will find it more practical to peruse these illustrations than to use the key. Although they are referenced in the key, they are not described in detail because of limited space and limited descriptors.

The key is artificial, using easily viewed or compared features, without regard to phylogenetic relationships or function. Some character states (e.g., length) may be inexact or the extent of variability is not known (some known from only 2 specimens); these should be used with caution, and questionable specimens should be compared to the illustrations. In the case of *cano*a, the sexual dimorphism and the nearly cleft tarsal claws require it to appear 3 times. In the case of the unique female *barrosa*, it is placed next to the most similar male, with reference to the genitalia.

1. Antennal club composed of 4 complete lamellae (Fig. 7) or 3 and a partial 4th (Fig. 8-9) 2
- 1'. Antennal club composed of 3 lamellae only (e.g., Fig. 12-16) 4
- 2(1). Antennal club of 4 full lamellae and partial 5th; genitalia Fig. 323-325, female unknown
..... *garrota* Sanderson
- 2'. Antennal club of 3 full lamellae and partial 4th (Fig. 8-9) 3
- 3(2'). Clypeal/frontal suture raised (Fig. 253-254); male genitalia Fig. 248-250, female unknown
..... *costura* Sanderson
- 3'. Clypeal/frontal suture impressed; male genitalia Fig. 603-606, female unknown
..... *probaporra* Sanderson
- 4(1'). Tarsal claws cleft (e.g., Fig. 35-37, 40) 5
- 4'. Tarsal claws not cleft, lower tooth median or basal (e.g., Fig. 38, 39, 41-43) 12

- 5(4). Parameres of male genitalia with setae externally on sides (e.g., Fig. 523, 154, 288, 311) 6
- 5'. Parameres of male genitalia without setae externally on sides (most species) 9
- 6(5). Dorsally hairy, especially pronotum (Fig. 65, 529, 533) 7
- 6'. Dorsally with only few setae, pronotal disc glabrous 8
- 7(6). Smaller (L. 8 mm \pm), habitus Fig. 97; tarsal claw Fig. 40; genitalia 523-527 (male), 534-537 (female) *nunezi* Woodruff
- 7'. Larger (L. 12 mm \pm), habitus Fig. 65; tarsal claw Fig. 37; genitalia 149-157 (male), 158-160 (female) *androw* Woodruff
- 8(6'). Setae on male parameres short, stiff (± 15); phallobase dorsally divided, gap on each side with sharp pointed projections; genitalia and other features Fig. 288-310 *fossoria* Sanderson
- 8'. Setae on male parameres long, numerous (± 40); phallobase dorsally curved, evenly rounded, not divided; genitalia and other features Fig. 311-322 n. sp., near *fossoria*
- 9(5') Smaller (L. 10 mm \pm), pruinose, often bicolored; habitus Fig. 103; genitalia 614-627 *pseudocalcaris* Saylor
- 9'. Larger (L. 13-20 mm \pm), pruinose or glabrous; genitalia Fig. 136-143, 167-177, 223-234 10
- 10(9'). Dark colored, male pruinose, female shiny, larger (L. 20 mm \pm), habitus Fig. 71-72; genitalia 223-234 *canoa* Sanderson
- 10'. Light colored, shiny or matte, smaller (L. 13-14 mm \pm), habitus Fig. 64, 66; genitalia 136-143, 167-177 11
- 11(10'). Dorsally shiny, elytra often translucent; genitalia Fig. 167-177 *approxima* Woodruff and Sanderson
- 11'. Dorsally lightly pruinose, matte, elytra opaque; genitalia Fig. 136-143 *aliada* Sanderson
- 12(4'). Smaller (L. 10 mm or less) 13
- 12'. Larger (L. 10 mm or larger) 17
- 13(12). Elytra wrinkled, body narrow, elongate (habitus Fig. 80); metatibial spurs in both sexes spatulate, curved (Fig. 281-282); antennal club longer than 6 preceding antennomeres; genitalia Fig. 275-279, 284-285; Haiti, La Visite *esquinada* Sanderson
- 13'. Elytra not wrinkled (habitus Fig. 67, 74, 90, 95); metatibial spurs not as above; antennal club shorter than 6 preceding antennomeres; genitalia not as above 14
- 14(13'). Dorsally noticeably pruinose 15
- 14'. Dorsally glabrous, shiny 16
- 15(14). Pygidial punctures regular, surface not wrinkled; habitus Fig. 74; genitalia 241-247 *cartaba* Sanderson
- 15'. Pygidial punctures coalescing medially, surface wrinkled; habitus Fig. 90; genitalia Fig. 429-432, 436-439 *latiungula* Sanderson
- 16(14'). Smaller (L. 6-7 mm), base color light straw, nearly bicolored; front tarsi exceptionally long, with long setae ventrally (Fig. 508); habitus Fig. 95; genitalia Fig. 501-506; rare *minutissima* Wolcott
- 16'. Larger (L. 8-10 mm), uniformly brown; front tarsi not unusually long; habitus Fig. 67; genitalia Fig. 178-181; common *audanti* Wolcott
- 17(12'). Larger (L. 19-33 mm) 18
- 17'. Smaller (L. 10-19 mm) 35
- 18(17). Dorsum shiny, rarely oily (some *hogardi*) or light violet blush marginally (*santachloe*) 19
- 18'. Dorsum pruinose or iridescent, not shiny 25
- 19(18). Pygidium with apical margin upturned into a lip (Fig. 414, 415); genitalia 403-413 *kenscoffi* Wolcott
- 19'. Pygidial apex not noticeably upturned, although carinately margined; genitalia not as above 20
- 20(19'). Pronotum with exceptionally long, reddish hairs (habitus Fig. 70); body color uniformly chocolate brown; male aedeagus asymmetrical, genitalia Fig. 210-222; known from 2 specimens (Haiti: Furey) *bonfils* Woodruff and Sanderson
- 20'. Pronotum glabrous, except marginal setae; color variable; male aedeagus symmetrical 21
- 21(20'). Straw colored, pronotum darker (L. 19-21 mm); habitus Fig. 89; genitalia Fig. 416-424 *larimar* Woodruff
- 21'. Color uniformly dark brown to castaneous (L. 19-27 mm); habitus Fig. 71, 84, 87, 110; genitalia not as above 22
- 22(21'). Elytral suture terminating in large curved spine (Fig. 362); habitus Fig. 84; genitalia 353-357, 364-367; common lowland species *hogardi* (Blanchard)
- 22'. Elytral suture without large terminal spine; habitus Fig. 87, 71, 110; genitalia not as above ..23
- 23(22'). Smaller (L. 17-19 mm); females only (males pruinose); head irregularly punctate, lumpy; habitus Fig. 71; some elytral punctures coalescing,

- appearing wrinkled; genitalia Fig. 231-234
 *canoas* Sanderson
- 23'. Larger (L. 22-27 mm); head smoothly punctured, not lumpy; habitus Fig. 87, 110; genitalia not as above 24
- 24(23'). Male aedeagus with dorsal crest or hook near apex on median projection, lateral projections terminating at an angle (Fig. 710-715); female genitalia with inferior plates fused medially, no medial basal depression (Fig. 716-717); lowland species from northeast *santachloe* Woodruff
- 24'. Male aedeagus without dorsal crest on median projection, lateral projections acuminate and sharp pointed (Fig. 393-398); female genitalia with deep medial basal depression on inferior plates (Fig. 399-402); Cordillera Central, higher elevations ... *jimenezi* Woodruff and Sanderson
- 25(18). Elytral suture terminating in a spine (barely noticeable in *marcano*) (habitus Fig. 68, 78, 91, 93, 101, 111) 26
- 25'. Elytral suture not terminating in a noticeable spine (habitus Fig. 69, 72, 83, 92, 107, 109) 31
- 26(25). Pronotum and elytra noticeably hirsute; genitalia Fig. 718-722 (only males known); Baoruco Mountains (Larimar Mine) *toni* Woodruff
- 26'. Pronotum glabrous, elytra with or without scattered setae; genitalia not as above 27
- 27(26') Elytra without noticeable setae (habitus Fig. 78, 91, 93) 29
- 27'. Elytra with scattered setae (habitus Fig. 68, 101); aedeagus with boot or sock-like spinose tip (Fig. 191-194, 596-602) 28
- 28(27'). Male parameres elongate with teat-like projection (Fig. 191-194); known only from Dominican Republic (Baoruco Mountains)
 *baoruco* Woodruff
- 28'. Male parameres more truncate, apical carina not prolonged (Fig. 596-602); known only from Haiti
 *permagna* (Moser)
- 29(27). Smaller (L. 19-20 mm); elytral spine obvious; habitus Fig. 91; genitalia Fig. 440-449; South Island distribution *leptosfica* Sanderson
- 29'. Larger (27-33 mm); elytral spine reduced; habitus Fig. 78, 93; genitalia not as above; Cordillera Central 30
- 30(29'). Scutellum punctate (Fig. 474); male metatibial long spur gently curved (Fig. 475), not S-shaped; genitalia Fig. 476-481, 461-468; West end of Cordillera Central (Rio Limpio)
 *marcano* Woodruff
- 30'. Scutellum impunctate; male metatibial long spur bent into an S-shape (Fig. 265-266); genitalia Fig. 261-264, 268-269; East/central Cordillera Central (near Manabao) *eladio* Woodruff
- 31(25'). Head with large light colored "spots" (Fig. 6, 668); dorsal surface velvety (Fig. 670-671, 673-677); genitalia (Fig. 678-689); habitus unique (Fig. 664-677); Constanza area
 *rex* Woodruff and Sanderson
- 31'. Head uniformly colored, without "spots"; dorsal surface pruinose, but not velvety; (habitus Fig. 69, 72, 83, 92, 109) 32
- 32(31'). Base color dark grey, not ferruginous; pruinosity irregular, reflecting light in a pattern; males only (females shiny), genitalia Fig. 223-230; habitus Fig. 72; Cordillera Central *canoas* Sanderson
- 32'. Base color entirely ferruginous; pruinosity regular, sometimes with iridescent sheen; habitus (Fig. 69, 83, 92, 109); genitalia not as above 33
- 33(32'). Larger (L. 24 mm); habitus Fig. 83; male genitalia (Fig. 333-338) with parameres elongate basally, aedeagus with long, acuminate, dorsally hinged spine, superimposed over a unique bifurcate lower piece; female genitalia dark colored, heavily sclerotized, with a broad basal triangular plate sealing inferior plates; 2 specimens only from Massif de la Hotte, Haiti .. *haitiensis* Woodruff
- 33'. Smaller (L. 17.5-23 mm); habitus Fig. 69, 92, 109; genitalia not as above 34
- 34(33'). Male genitalia (Fig. 450-456) with unique bifurcate tip ("nail-puller") on aedeagus; female genitalia Fig. 457-460; size variable (L. 17-22 mm); common, widespread species *mali* Wolcott
- 34'. Male genitalia (Fig. 700-707) without bifurcate aedeagal tip; larger (L. 23 mm); pygidium rugose (Fig. 709); only 2 males known; Cordillera Central *rustica* Woodruff
- 34". Unique female (male unknown; Fig. 199-209); pygidium smooth (Fig. 205); smaller (L. 19 mm); known only from Fond de Negre, Haiti
 *barrosa* Sanderson
- 35(17'). Dorsal surface velvety, reddish brown, elytral costae darker (habitus Fig. 98); pronotal setae distinct (Fig. 560-562); genitalia Fig. 538-543 (male), 554-556 (female); (L. 14 mm); 2 only from Dominican Republic: Baoruco Mountains, Larimar Mine *ortizi* Woodruff
- 35'. Dorsal surface shiny or pruinose, not velvety; (L. 10.5-19 mm); genitalia not as above 36
- 36(35'). Dorsal surface shiny, no vestige of pruinosity ..
 37
- 36'. Dorsal surface at least partially pruinose 40

- 37(36). Larger (L. 17.5-19 mm); straw colored or yellowish; habitus Fig. 106; genitalia Fig. 644-652, 655-658 *recorta* Sanderson
- 37'. Smaller (L. 10-14 mm); brown or somewhat bicolored; genitalia not as above 38
- 38(37'). Light chestnut brown, exceptionally convex, parallel-sided (habitus Fig. 105); genitalia Fig. 628-641; "North Island" *rawlinsi* Woodruff
- 38'. Uniformly dark brown, less convex (habitus Fig. 62, 100); genitalia not as above; Baoruco Mountains, "South Island" 39
- 39(38'). Habitus Fig. 100; male genitalia (Fig. 584-587) with unique ventral plate between parameres recurved hook-like at tip, with 4 large, heavily sclerotized, aedeagal spines above; female genitalia Fig. 595; elytra slightly flattened medially; sea level to about 2500 ft *pedernales* Woodruff
- 39'. Habitus Fig. 62; male genitalia (Fig. 119-123) with aedeagus scoop-shaped, without ventral recurved tip; female unknown; higher elevations \pm 3000 ft *acetillar* Woodruff
- 40(36'). Elytral suture terminating in a noticeable spine (habitus Fig. 108); body color dark, pruinosity pronounced; (L. 17-19); genitalia Fig. 690-699; common "North Island" species *romana* (Saylor)
- 40'. Elytral suture not terminating in a noticeable spine; mostly smaller (L. 10-19 mm); genitalia not as above 41
- 41(40'). Smaller (L. 10-12 mm); habitus Fig. 85, 99 42
- 41'. Larger (L. 13-19 mm); habitus Fig. 63, 73, 76, 79, 86, 94, 96 43
- 42(41). Pygidium with dark glabrous center, surrounded by extensive pruinose area (Fig. 374-375), pygidial punctures mostly separated, not coalescing into wrinkles; habitus Fig. 85, females only partially pruinose; genitalia Fig. 368-373, 376-377; "North Island" *imprima* Sanderson
- 42'. Pygidium slightly pruinose, the punctures mostly coalesced into wrinkles, especially medially; habitus Fig. 99; both sexes pruinose; genitalia Fig. 569-575, 581-583; "South Island" *panicula* Sanderson
- 43(41'). Larger (L. 15-19 mm); genitalia Fig. 513-522; 484-487, 491-494; 270-274; 124-134; 384-389; "North and South Island" 45
- 43'. Smaller (L. \pm 13 mm); male genitalia Fig. 235-240; 255-260 (females unknown); "South Island" and Sierra de Neiba 44
- 44(43'). Pruinosity weak, elytra glabrous; male genitalia Fig. 235-240; Sierra de Neiba *carnegie* Woodruff
- 44'. Pruinosity strong, elytra with scattered setae; male genitalia Fig. 255-260; Sierra de Baoruco *davidsoni* Woodruff
- 45(43). Body color ferruginous to orange-yellow; pruinosity of elytra and pronotum similar; habitus Fig. 96; genitalia Fig. 513-522 *neglecta* (Blanchard)
- 45'. Body darker, not ferruginous; pruinosity of pronotum and elytra similar or dissimilar; habitus Fig. 63, 79, 86, 94; genitalia not as above 46
- 46(45'). Pronotum and elytra pruinose, elytra reflecting light resembling spots; elytra glabrous; genitalia Fig. 484-487, 491-494; "North Island" *mella* Sanderson
- 46'. Pronotum shiny or less pruinose than elytra, elytra pruinose; elytra with golden setae or not; Cordillera Central or "South Island" 47
- 47(46'). Elytra with golden setae, elytra pruinose, including humeral angles; aedeagus of male genitalia (Fig. 270-274) produced into 2 unique, extremely long flexible processes; female unknown; 2 specimens only from Cordillera Central *espina* Sanderson
- 47'. Elytra without setae, humeral angles at least partially shiny as pronotum, remainder caramel brown with light pruinosity; habitus Fig. 63, 86; "South Island" 48
- 48(47'). Pygidium irregularly punctate, somewhat rugose; pronotum slightly flattened anterior to scutellum; larger (L. \pm 18 mm); male genitalia asymmetrical (Fig. 124-134); 2 specimens known *alcoa* Woodruff
- 48'. Pygidium evenly, not rugosely punctate; pronotum evenly convex, not flattened; smaller (L. \pm 16 mm); male genitalia symmetrical (Fig. 384-389) *jaragua* Woodruff

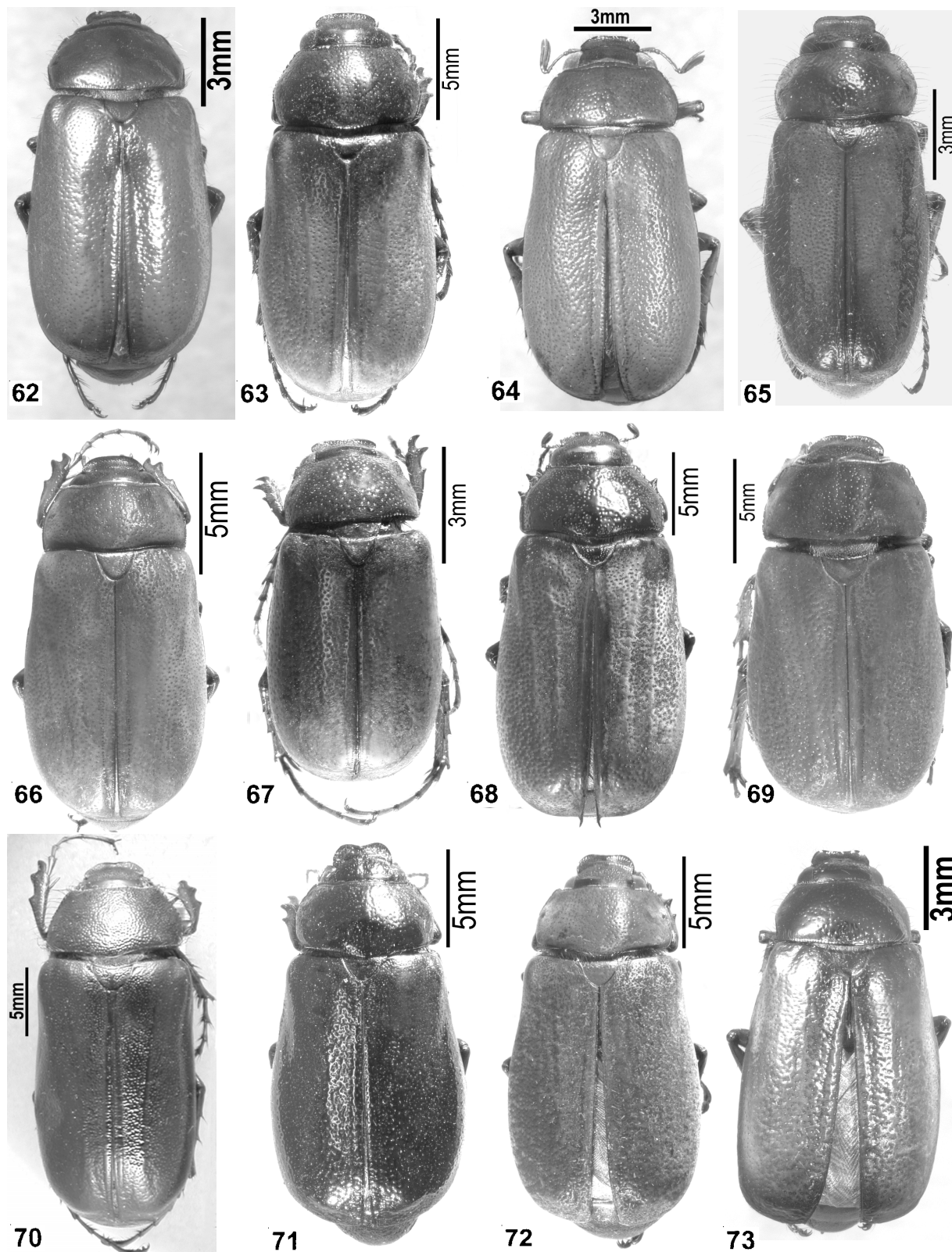


Fig. 62-73. *Phyllophaga* habitus: 62) *aceitillar* Woodruff; 63) *alcoa* Woodruff; 64) *aliada* Sanderson; 65) *androw* Woodruff; 66) *approxima* Woodruff and Sanderson; 67) *audanti* Wolcott; 68) *baoruco* Woodruff; 69) *barrosa* Sanderson; 70) *bonfils* Woodruff and Sanderson; 71) *canao* Sanderson, female; 72) *canao* Sanderson, male; 73) *carnegie* Woodruff.

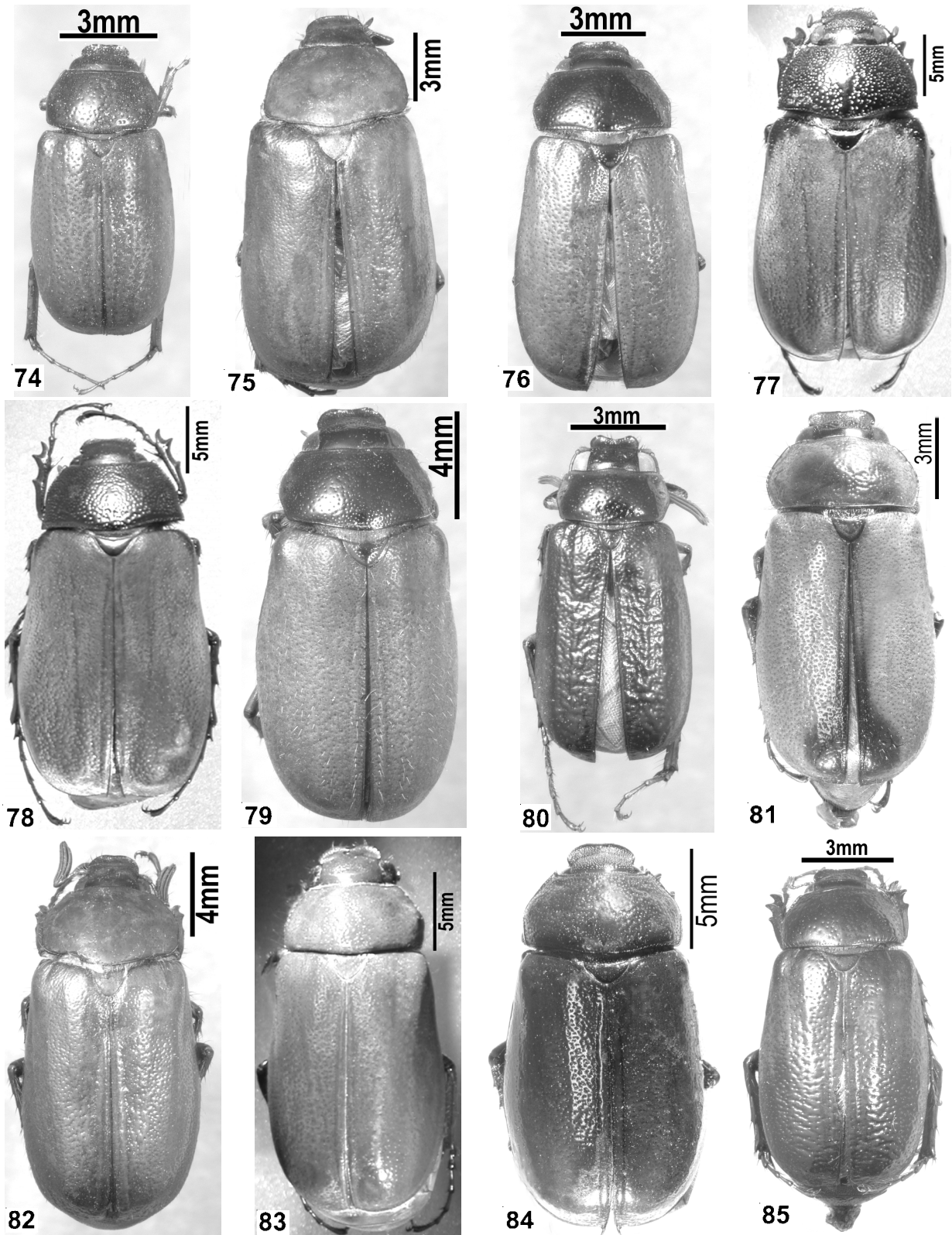


Fig. 74-85. *Phyllophaga* habitus: 74) *cartaba* Sanderson; 75) *costura* Sanderson; 76) *davidsoni* Woodruff; 77) *eladio* Woodruff, female; 78) *eladio*, male; 79) *espina* Sanderson; 80) *esquinada* Sanderson; 81) *fossoria* Sanderson; 82) *garrota* Sanderson; 83) *haitiensis* Woodruff; 84) *hogardi* (Blanchard); 85) *imprima* Sanderson.

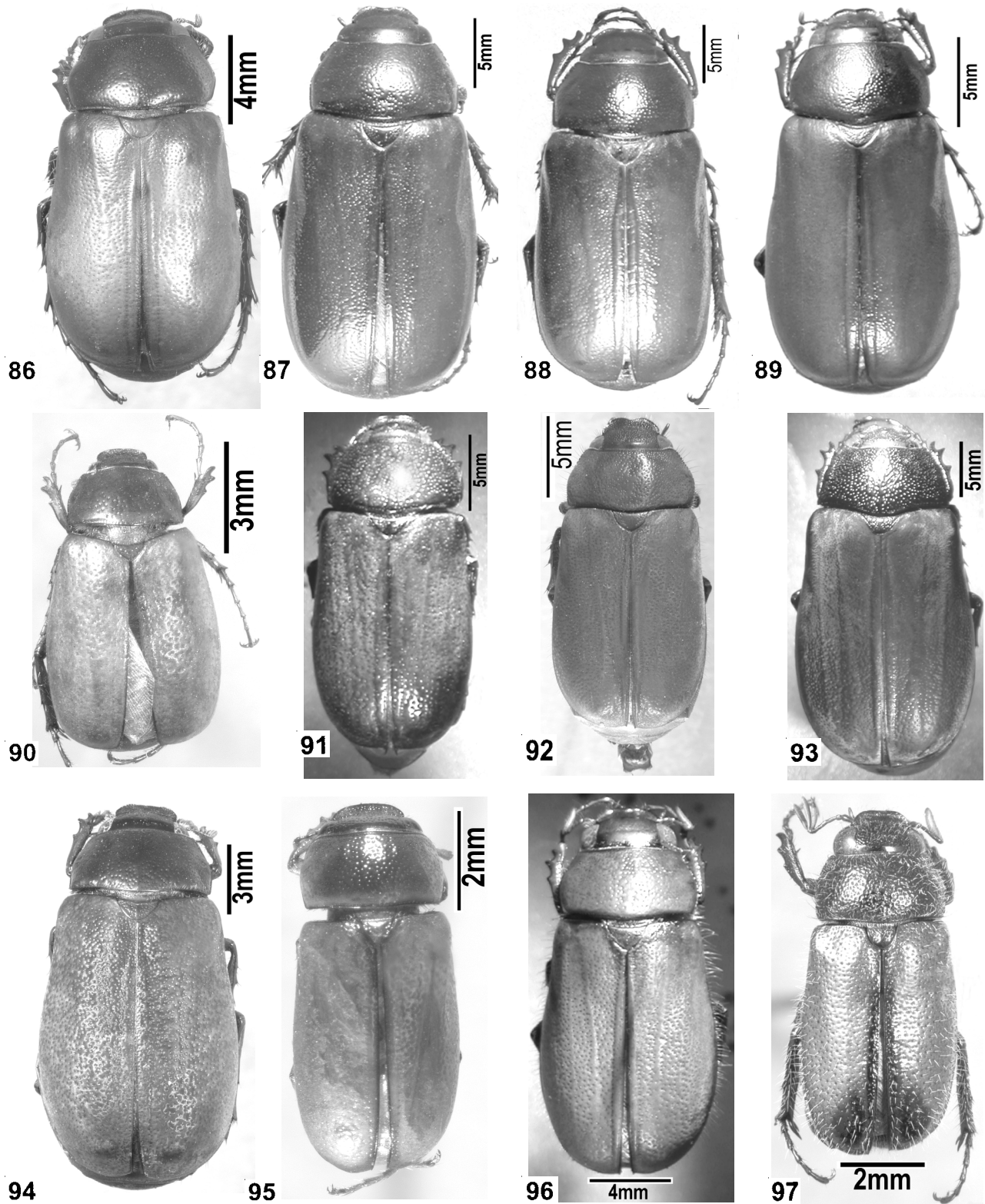


Fig. 86-97. *Phyllophaga* habitus: 86) *jaragua* Woodruff; 87) *jimenezi* Woodruff and Sanderson; 88) *kenscoffi* Wolcott; 89) *larimar* Woodruff; 90) *latiungula* Wolcott; 91) *leptospica* Sanderson; 92) *mali* Wolcott; 93) *marcano* Woodruff; 94) *mella* Sanderson; 95) *minutissima* Wolcott; 96) *neglecta* (Blanchard); 97) *nunezi* Woodruff.

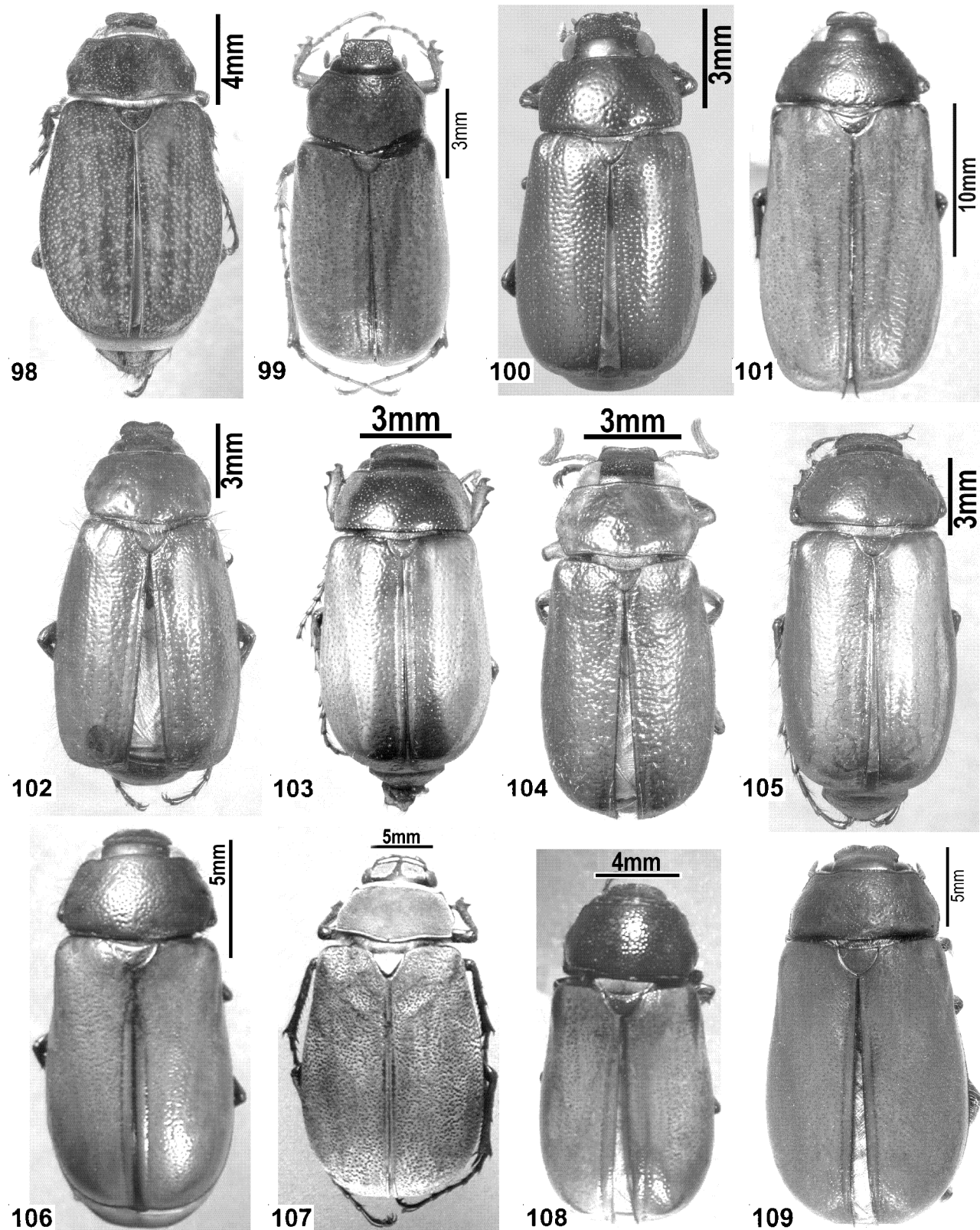


Fig. 98-109. *Phyllophaga* habitus: 98) *ortizi* Woodruff; 99) *panicula* Sanderson; 100) *pedernales* Woodruff; 101) *permagna* (Moser); 102) *probaporra* Sanderson; 103) *pseudocalcaris* Saylor; 104) *n. sp.* near *fossoria* (see text); 105) *rawlinsi* Woodruff; 106) *recorta* Sanderson; 107) *rex* Woodruff and Sanderson; 108) *romana* Saylor; 109) *rustica* Woodruff.

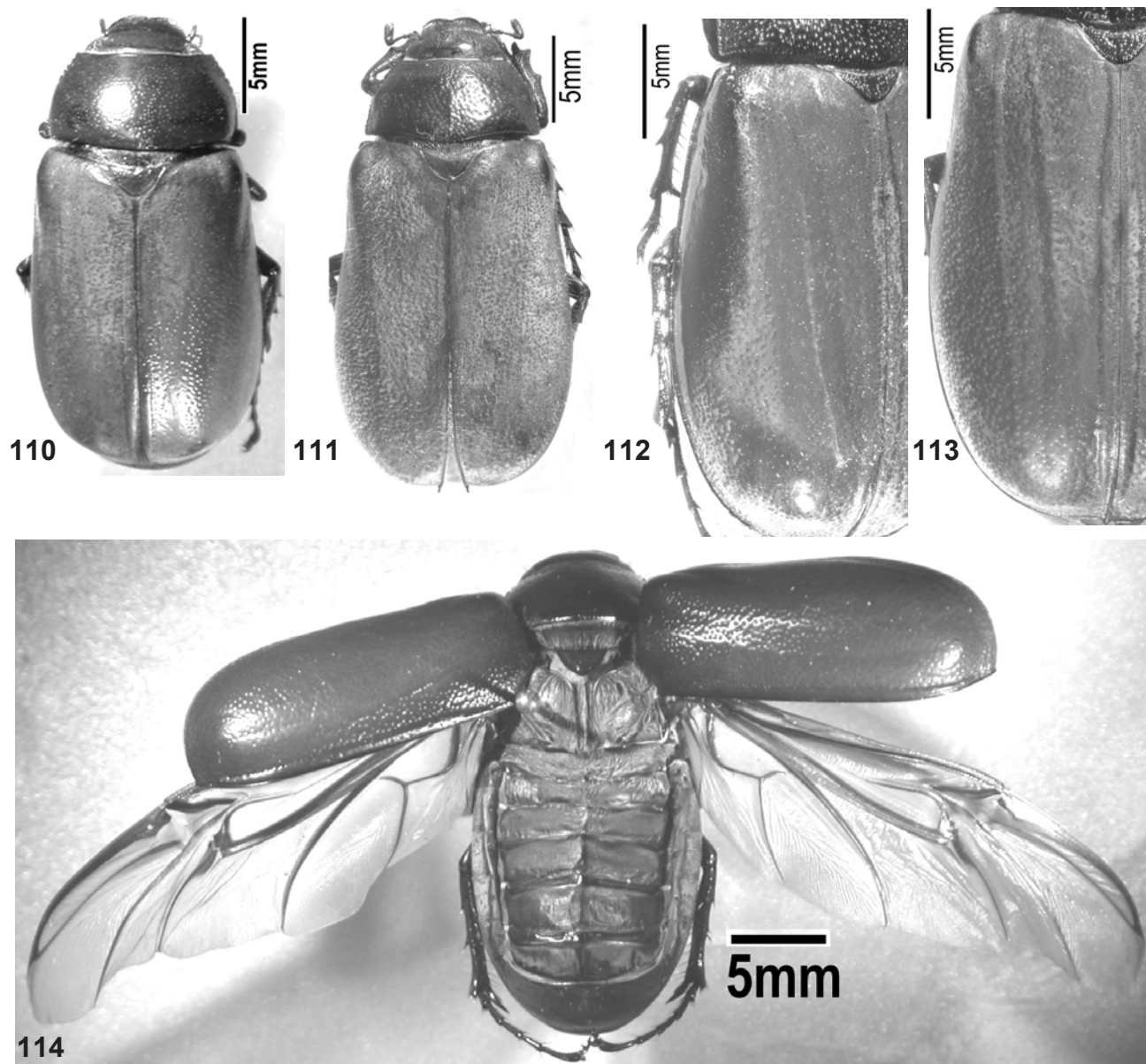


Fig. 110-114. *Phyllophaga habitus*: 110) *santachloe* Woodruff; 111) *toni* Woodruff; 112-113 *marcano* Woodruff: 112) female, note smooth shiny area above elytral margin; 113) male, note relatively uniform pruinosity in same area; 114) *kenscoffi* Wolcott, showing the well developed flying wings.

Economic Importance

Although *Phyllophaga* adults are often pests by defoliating trees, and larvae are well known soil-inhabiting crop pests, their damage rarely has been reported as economic in Hispaniola. The published records are summarized below, but we believe their impact is much more extensive and unrecognized. Part of this is because larvae of even the common species have neither been described nor recognized. We believe that pastures, golf courses, vegetable

crops, sugarcane, and ornamental plants are frequently attacked.

Wolcott (1928a) was the first to note that Hispaniola was "...comparatively little affected by the attacks of white grubs or May beetles." He noted that it was in striking contrast to the conditions in Puerto Rico, "...where white grubs are the major pest of most agricultural crops." He mentioned the devastation to sugarcane in Puerto Rico, but not seen in Haiti (although he says it was little grown there). As one interested in biological control, he recorded a fly

(Tachinidae: *Ptilodexia harpasa* Walker) reared from Haitian grubs, later mentioning a wasp (*Tiphia* sp.) as a suspected reason for few May beetles.

Santoro (1960), in the basic economic entomology of the Dominican Republic, refers to *Phyllophaga* on 10 occasions (p. 100, 125, 156, 192, 278, 306, 328, 334, 345, 389), but the only species names used are for 2 Puerto Rican ones (p. 100, *portoricensis* and *vandiniei*) and 2 from Hispaniola (p. 156, *hogardi* and *neglecta*). Most of these citations are repetitive under different crops, although twice the generic name is misspelled "*Phillophaga*". He indicated that the "Gusanos blancos de tierra or Majocás" are frequently encountered in soil around cacao, sugarcane, coffee, pineapple, peanuts, corn, citrus, etc. However, he also said that *Phyllophaga* in general are not a "notable plaga", because of effective controls. He emphasized biological control (listing several predators and parasites) over the use of the insecticides Aldrin and BHC.

The most recent treatment, entitled "Crop pests of the Caribbean" by Schmutterer (1990), listed 2 species (p. 86, *plaei* [= *portoricensis* Smyth] and *hogardi* (Blanch.)) from the Dominican Republic. In general he stated that *Phyllophaga* adults are polyphagous [some are very host specific] and small plants may be almost defoliated of sugarcane, cassava, coffee, flamboyant, casuarina, coconut, cocoa, bamboo, breadfruit, mango, and numerous other plants. He listed larvae as attacking roots of sugarcane, citrus, pigeon pea, cassava, sweet potato, cocoa, coffee, strawberry, pineapple, bean, groundnut, and tobacco, and stated that "...they may kill the damaged plants or reduce their growth and yield.... or may rot owing to infection by secondary organisms such as bacteria and fungi." *Phyllophaga hogardi* is shown on Plate 48. The most interesting report (p. 451) is that "White grubs may cause considerable damage to strawberries in the Constanza Valley. One larva is sufficient to kill a plant. A poor stand of strawberry fields (Plate 278) is often the result of the feeding activity of this pest." It is possible that *rex*, n. sp., or other species rare in collections known from this locality, is responsible for this damage.

We believe far more damage occurs in Hispaniola than has been reported. The economic literature is so voluminous that we cannot review it here, and there is an extensive World bibliography (Pike, et al., 1976). We list here some references on Caribbean Islands where they are noted as serious pests: **Puerto Rico** (Smyth, 1917; Wolcott, 1933, 1948, 1955), **Cuba** (Vandine and Christensen, 1932; Garcia-Vidal, 1975, 1978), **Guadeloupe** (Chalumeau 1983, 1985; Gruner, 1969), **Jamaica** (Frank and Bennett, 1970). In

addition, literature as a sugarcane pest is extensive: Aragón and Morón, 1993; Box, 1953; Cherry, 1984, 1985; Gordon and Anderson, 1981; Sosa, 1984; Wade, 1951.

In other Neotropical areas, much recent attention has been placed on these pests. In Central America, where they are called "gallina ciega" or "ronrones", several major papers have been published (King, 1984; King and Saunders, 1979; Cano, Monzón, and Schuster, 2000). The Mexican fauna has been extensively studied by Morón (1986, 1993, 1997), and new species are continuing to be described. They are sometimes referred to as ronrones de Mayo, escarabajos de Mayo, and May or June beetles.

Control

Since this treatise is primarily a taxonomic one, little will be said about chemical or biological control, except to cite significant references. In the past, use of chemicals such as BHC, Dieldrin, Aldrin, Heptachlor, Lindane, and DDT were used for larval control, but soil insects are notoriously difficult to kill. Most of these chemical are no longer available or recommended because of their toxicity to vertebrates or potential contamination of groundwater. Much of our knowledge of *Phyllophaga* in the Caribbean is the result of numerous studies by Wolcott (1928-1955) in Puerto Rico. He realized very early that biological control was the only means likely to succeed. Because Hispaniola had many *Phyllophaga*, and they were not reported to be serious pests, he searched there for predators and parasites (much of this unpublished). Further studies are warranted, to assess economic damage and biological control agents in Hispaniola.

Woodruff and Beck (1989) summarized the biological control literature and listed the many organisms involved (see that reference for details). The list includes many parasitic Diptera (Pyrgotidae, Tachinidae, Sarcophagidae, Bombyliidae, Asilidae, Tabanidae), and Hymenoptera (Tiphidae, Scoliidae, Ichneumonidae, Pelecinidae). Predators include Carabidae and Elateridae (especially the genus *Pyrophorus*, whose larvae disrupted rearing operations of *Phyllophaga bruneri* Chapin in Florida), and many birds, lizards, and especially the giant Surinam toad (*Bufo marinus* L.). Wolcott considered it the most successful control agent in Puerto Rico, possibly causing extinction of a localized species of *Phyllophaga*. Many other organisms play some role, such as mites (Crocker, et al., 1992), many kinds of parasitic worms (Nematoda, Eugregarina, Helminthidae), including intermediate hosts for parasites of swine and

other vertebrates. Protozoa, milky disease, and green muscardine fungus have been used with some success, using commercial formulations.

Generic Considerations

Sanderson (1951) discussed the history of the generic names applied to this group, and concluded that all should be in the genus *Phyllophaga* Harris (1827), in the process reducing *Cnemarachis* Saylor (1942) to subgeneric status. This has been followed by most recent workers, including the New World checklist by Evans (2003). Glasgow (1916) established the current usage of *Phyllophaga*, and that reference should be consulted for details.

Saylor (1942: 159) described the genus *Cnemarachis*, with genotype *Lachnosterna vandinei* Smyth, indicating that it "...includes nearly all the described West Indian species formerly placed in *Phyllophaga*." However, he did not list any of the species, except for the genotype. He characterized the genus thusly: "Either middle or hind tibiae or usually both, of both sexes, with an incomplete carina; lateral margins of the middle and hind tibiae usually with obviously serrate edges or with one to several moderately large to large spines; only rarely do the tibiae lack such carinae or spines or teeth." His other genus *Clemora* was based on the same characters, plus the tarsal claws were cleft (as seen here in several species; e.g., *fossoria*). All of Saylor's generic characteristics have been found on continental species, leading to suppression of both names.

By nearly doubling the number of species from Hispaniola in this paper, we have better established values and variability of characters and their states. We believe they all belong in the genus *Phyllophaga*, with species groups and subgenera of secondary importance. It can be expected that additional species will assist in evaluating genera. As Arrow (1938) stated: "Those who see the advantage of multiplication of generic names may perhaps discover some diagnostic feature by which the retention of one or both these names may be rendered possible. Such attempts seem to me, however, to only be resisting an inevitable process. As more and more species of any group become known, previous apparent gaps in the series necessarily become filled, and the disappearance of many genera is as natural as their erection at an earlier date, when the known species were fewer."

The generic name *Ancylonycha* (Dejean, 1833) was used originally for the 2 earliest Hispaniolan species described: *neglecta* and *hogardi* Blanchard (1850). This name, and its synonym *Holotrichia*

(Hope, 1837), are still used for Old World relatives. However, Saylor (1942: 165) indicated that "...the genus *Ancylonycha* cannot be separated in toto from the continental American genus *Phyllophaga* on other than geographical grounds, though many of the species placed by various authors in the genus *Holotrichia* are at least subgenerically differentiated."

Morón (1997: 229) estimated that there were more than 500 species of *Phyllophaga* in the American continents, of which 250 inhabited Mexico. He earlier (1986) separated these into 8 subgenera and 37 species groups. Various attempts have been made to assign generic names to some of these groups, but often they were based on taxa from a limited geographic area, utilized too few taxa, or emphasized certain variable morphological characters. Because the genus is so large, there will probably be future efforts to divide it into more and more genera. We believe that retention of the genus name *Phyllophaga* for the entire assemblage is the most practical and preferable way to deal with the group. Only a World revision could properly clarify this issue. Cladistical analysis, based on a small portion of the relevant taxa, is futile.

Most previous efforts to assign generic names to various groups have proven untenable or ill advised. Even if cladistics may better show relationships, the creation of many genera would obscure, rather than clarify these relationships. Subgeneric or species group names provide the best way to do this, without the attendant problems with the binomial (including homonymy). A recent paper (Coca-Abia, 2002) attempts to resurrect the old name *Trichesthes* (Erichson, 1847) for a group of species related to the North American *P. tristis* (Fabricius), basing it on a cladistical analysis. Her choice of characters and limited data matrix does little to justify her conclusions, leading Evans (2003) to keep it as a synonym of *Phyllophaga* and stating "...this action was not strongly supported due to the poor taxon sampling within *Phyllophaga* in the analysis." Cladistics may be a great tool to elucidate relationships, but that can still be done with species groups, without affecting the binomial. We believe that genera are subjective, and that using *Phyllophaga* for this entire assemblage places close relatives together and provides less confusion and greater nomenclatural stability.

Phylogeny and Species Groups

Because this study is primarily a descriptive one, little effort has been made to determine phylogenies or to use cladistics for analysis (see reference above). I recall reading that we don't know any phylogenies,

and we never will (Blackwelder, 1967). Because of the paucity of insect fossils (none for *Phyllophaga*) this axiom is undoubtedly true. However, the search for these relationships can add much to our bank of knowledge in zoogeography, ecology, behavior, and systematics. In that regard, and with time and space restrictions, we have organized below the Hispaniolan species into "groups", based on similarities (and our extensive experience with the genus).

The groups are arbitrarily named on the basis of the older or more common species. We have tried to group them by genitalic type, but the difficulty in homologizing or even describing such complicated structures precludes this. In addition, the results would be different if male or female genitalia were used. There is no character or group of characters that seem to be adequate for clearly defining these groups, and it is not implied that all are natural, although we hope some are. At this stage in our knowledge, they are useful primarily for sorting purposes.

1. "hogardi" group. Medium to large (L. 17-30mm), characterized by a large spine at elytral sutural tip, and genitalic parameres fused or nearly so. It includes *hogardi*, *eladio*, *marcano*, *toni*, *permagna*, *romana*, *leptospica*, and *baoruco*; *cano* belongs here but has the elytral spine obsolete.

2. "garrota" group. Medium to large (L. 14-22), characterized by exceptionally large male antennal club (with 3+ to 4 lamellae), aedeagus a simple tube generally unmodified, high altitude (to 3000 m), females unknown. It includes *garrota*, *probaporra*, and *costura*. Possibly includes *carnegie* and *dauidsoni* which are somewhat bicolored with different genitalic types.

3. "mali" group. Medium to large (L. 15-24 mm), characterized by ferruginous pruinosity, genitalia complicated and relatively large, the aedeagus with lateral and dorsal processes (often pointed) flexible at base. It includes *mali*, *neglecta*, *barrosa*, *haitiensis*, and *rustica*.

4. "kenscoffi" group. Large (L. 20-25 mm), brown, bulky, glabrous, shiny (rarely vague pruinosity), no elytral spine, the aedeagus 3 pronged as in the *mali* group. It includes *kenscoffi*, *jimenezi*, and *santachloe*.

5. "fossoria" group. Small to medium (L. 8-14 mm), antennal club long, often hairy, tarsal claws cleft, genital parameres with setae on lateral area. It

includes *fossoria*, *nunezi*, *androw*, *aliada*, *approxima* and n. sp. near *fossoria*. On the basis of some characters, *esquinada* belong here also.

6. "recorta" group. Medium (L. 17.5-21 mm), light yellow-brown, glabrous, shiny, aedeagus with heavy plates and saw-like projections, the female genitalia with enlarged triangular median plate covering inferior plate base. Includes the sister species *recorta* and *larimar*.

7. "imprima" group. Small to medium (L. 8-12 mm, first 4 spp.; 13.5-16 mm, last 2), mostly pruinose, glabrous, pygidium shiny in center and pruinose at sides (Fig. 374-375). It includes *imprima*, *cartaba*, *latiungula*, *panicula*, *mella* and *espina*. The latter 2 are larger and with peculiar aedeagus, but their habitus is similar to others of the *imprima* group.

8. "audanti" group. Small (L. 8-13 mm), brown, shiny, non-pruinose, strongly punctate, genital capsule short, tarsal claws with minimal notch (space) between median tooth and base. It includes *audanti*, *pedernales*, and *aceitillar*.

9. "jaragua" group. Medium (L. 16-18 mm), light brown, head, pronotum and parts of elytra shiny, elytra lightly pruinose. It includes *jaragua* and *alcoa* whose habitus' are similar (Fig. 86, 63), but the genitalia are of drastically different types (Fig. 384-385, 124-131).

There are 6 remaining species that appear to be so distinct that they do not fit into the above groups, and we prefer not to assign group names to them at this time. They are *bonfils*, *minutissima*, *ortizi*, *pseudocalcaris*, *rawlinsi*, and *rex*.

Zoogeography

The present distribution of Hispaniolan *Phyllophaga* is the result of many past geological events. Because all 48 known species (and there are probably more) are found nowhere else (precinctive, endemic), their origins and dispersal routes should provide important clues for the entire Caribbean. By their similarities and occurrence on opposite sides of the Enriquillo basin (Cul-de-Sac), many of these are "sister species", and appear to reflect the "north and south island" concept (see Schwartz, 1980, 1989). Based on our current knowledge, 15 species are restricted to the "south island", with 23 species restricted to the "north". The most common lowland species are more widespread (including *hogardi* and *mali*). How each

of the species got there, and determining their nearest relatives elsewhere, would be worthy of a much more extensive treatment than can be afforded here. The following remarks are made as only a brief introduction.

Except for *Phyllophaga*, there is probably no other group of insects that has so many species unique to a single island, but which reflects the geology so well. Recent studies (Liebherr, 1988; Donnelly, 1988, 1989; Woods, 1989) shed some light on the zoogeography of the area, but deal primarily with the entire Caribbean. Sourakov (1996, 1999) studied the butterfly genus *Calisto*, which is primarily Hispaniolan, finding "sister species" on each paleo island. He indicated that the 56 taxa in the West Indies (Satyridae: Satyrinae: Pronophilini) are related to other tribal members from the high Andes of South America.

There are no known fossils of *Phyllophaga* from the Caribbean, although an exceptional record of other scarab beetles and other insects occurs in Dominican amber (Pérez-Gelabert, 1999; Poinar and Poinar, 1999; Woodruff, unpub.). These deposits are considered Miocene in age. The discovery of the relictual beetle family Brachypsectridae in Dominican amber was exciting, but it was exceeded by the recent discovery of a living new species at Cabo Rojo (south island) (Woodruff, 2004). Of greater antiquity, fossil trees have been discovered in the volcanic Larimar deposit (Woodruff, 1986; unpub.; Woodruff and Fritsch, 1989) which is considered Cretaceous (De León, 1989). Four of the new species described herein are from that site, which suggests their possible age and origin.

This volcanic deposit in the Dominican Republic may be contemporaneous with the origin of the microtektites and shocked quartz found nearby in Haiti (Hildebrand and Boynton, 1991). Those are believed to be additional evidence for a giant meteorite (Chicxulub site) which hit off Yucatan, apparently ending the Cretaceous (about 65 million years ago). Donnelly (1988) indicated that the Greater Antilles started emerging 105 million years ago, with a rapid increase in size about 80 million years ago. Their exact size and position during subsequent geological periods has been the subject of considerable debate. However, most agree that the Caribbean plate has moved many times and the individual islands occupied different positions from today.

Perfit and Williams (1989: 102, Fig. 6) showed one scenario, which includes 3 "Hispaniola" islands in the mid-Eocene, but only 2 by the late Miocene-Pliocene. The "south island" presumably maintained its identi-

ty until the Pleistocene, when it made contact with the "north island". The subduction of the plate of the "south island" was responsible (along with lowering sea level) for forming the Enriquillo basin, and trapping the salt lake Enriquillo (now 40 meters below sea level). How the current population of crocodiles became trapped here is open to speculation.

There are two basic theories used to explain current geographic distributions, in relation to past geological events. They are **vicariance**, believed to be the transfer of continental faunas as units from mainland to islands, and **dispersal**, which implies movement of taxa in this case over water gaps. These theories are not necessarily mutually exclusive, and we believe both may have been involved with *Phyllophaga*. We believe that the strongest evidence for vicariance is the occurrence of several "sister species" on the 2 "islands". If we agree that the 2 have been contiguous since the Pleistocene, we would not expect these distribution patterns to be so rigid, unless the species were distinct already. Most of the "sister species" occur in the mountains, often above 2500 ft. Even though the Enriquillo basin is only a relatively narrow barrier, there seems to be almost no crossing over. Dispersal seems not to have taken place, except for species occupying lowland and coastal areas.

The species of the lowlands are more widely distributed, adapt to varying soils and climate, occur in large numbers, and seem to show a few relationships (similarities) to species of other islands. That is what would be expected for potential dispersal species. For example, *mali* is widespread, common at sea level and at 3300 ft, and similar to several Puerto Rican species. It also has "sister species" (possibly *haitiensis*, *rustica*, and *barrosa*) which are rare and localized. One of the unique small species (*pseudocalcaris*) occurs only on the north coast, often by the thousands, and is similar in habitus to a Cuban species group ("*suturalis*"). We believe that these may be examples of species which employed dispersal methods to arrive in Hispaniola. Agriculture and other human activities also undoubtedly play a role in moving soil, plants, and insects. This is most likely with the common species associated with sugarcane.

However, most of the entire Hispaniolan fauna of 48 species appears to have evolved on the "north or south" islands, and maintained their identity since contact. Thus, their present distributions are the result of vicariance events from possibly a Central American source. Almost every island in the Caribbean has a completely endemic fauna of *Phyllophaga*, another important reason for their continued study. Morón (1997: 229) estimated there were over 500

species of *Phyllophaga*, with 250 species in Mexico, and more than 100 in the U.S. In Florida there are 54, with 2 adventive from Cuba and the Bahamas (Woodruff and Beck, 1989). Cuba probably has more species (perhaps 75) than Hispaniola, partially the result of greater land area, and Puerto Rico has fewer. However, we believe that there may be nearly 200 species in the Antilles. Because relatively few species have reached South America (and mostly in the north), the group appears to have had its origin in Mexico or Central America.

Other insect groups have perhaps had different means of moving into the Caribbean. Howden (1996: 1514) suggested that, in the burrowing scarab genus *Neothyreus*, there were 3 fairly lengthy over-water dispersals: 1) over the Panamanian water gap in the Miocene; 2) over the Bahama Passage in the Pleistocene; and 3) over water in the Pleistocene to Grenada and St. Vincent from Tobago or Trinidad. Matthews (1966) studied the dung beetles of the Caribbean and concluded that "...this fauna is a greatly reduced sample of the North or Central American fauna of the distant past, perhaps of the Miocene or Pliocene, just after the establishment of the Panamanian 'bridge', when invasion by South American elements was just beginning.....the unquestionably high degree of endemicity of the Greater Antillean scarabaeine fauna is a reflection, not of special insular evolution, but of the continued survival of an ancient fauna for which these islands have become a refuge. This survival would not have been possible if the Scarabaeinae were capable of rapid over water dispersal..." A thorough analysis of our distribution data (not possible here) would be a worthwhile endeavor to assist in understanding the zoogeography of this important part of the Caribbean.

A recent website (see below) has an excellent resumé of the geology, and I briefly paraphrase portions here: Hispaniola was formed 10 million years ago, when 2 "paleo-islands" collided. The southern island originated as a part of Pangaea near the present Yucatan peninsula, and moved along the fault line between the Caribbean and North American plate. The collision created 2 mountain ranges over 2000 m high with a marine channel between. During glaciation water level dropped, and about 18,000 years ago sea level was 100 m below current levels. During glacier melting sea level rose again and about 6,000 years ago it had filled the valley, including the Neiba Valley, and forming a bay 85 km long and 15 km wide. It existed for nearly 1,200 years, until the Rio Yaque del Sur deposited sufficient mountain silt, closing the mouth of the bay and creating a

landlocked salt lake. Eventually the river's flushing converted it to fresh water. Dolphins and manatee historically inhabited the lake which was about 15 m above sea level when Columbus arrived 500 years ago. Lago Enriquillo's surface dropped 60 meters to 45 m below sea level in less than half a millenium. Its salinity rose from 36 ppt (1983) to 110 ppt (2003) and decreased in size from 280 km² (1968) to 160 km² (2004). [http://www.globalnature.org/docs/01_vorlage_news_neu.asp?id=11093&domid=1011&sp=E&addlastid=&m1=11089&m2=11093]

Behavior and Sex

Most adult *Phyllophaga* are nocturnal, emerge in early evening, fly to host trees where they feed and mate during the night, returning to cover during early morning hours. In Hispaniola there is at least 1 (and maybe more) exception. Prof. Eugenio Marcano collected a good series of *garrota* at La Pirámide, "capturado en el dia en vuelo 12-3 p.m.", at over 2200 meters elevation. Other specimens have been taken in Malaise traps at high altitudes (although time of day not recorded), some perhaps collected in daytime. We believe that the "*garrota* group" (including *probapora* and *costura*) may all be diurnal. They are known only from males, with enlarged antennal lamellae containing obvious receptors (Fig. 10-12), and from high altitudes. In these cases we believe females may be flightless, the males being adapted to locate them during the warmer daylight hours (where night temperatures make flight difficult). Under normal warmer conditions, the sexes congregate together on host trees, facilitating mate location. The noticeable receptors on the antennae of other species may also reflect a more diurnal activity period. Most have been rarely collected.

Because of the often bizarre and varied modifications of the genitalia, taxonomists are able to distinguish closely related species (for which we are thankful). However, little information is available on how these parts actually fit together and function. One of the most intriguing aspects of their behavior involves the mating process itself. Unfortunately, few original observations were made during this study, and we can touch only briefly on it here. We were extremely fortunate to retrieve a feeding female (*mella*) which was carrying the male genital capsule attached to her (the unfortunate male may have been eaten by a predator). The relationships of the genitalia can be seen readily (Fig. 495-500), and it does not involve the male parameres (only the aedeagus). At least in this

case, the old theory of “lock and key” mechanism (Shapiro and Porter, 1989) does not seem to apply. However, it may be exceptional, because the female of this species has a unique moveable process (“ice-tongs”) which appears to have held the male organ in place. The elaborate parameres may be merely “can-openers”, as my colleague Paul Skelley coined them. They may function in eliciting cooperation of the female, but the aedeagus may be the only part inserted between the simplified female genital plates. Some of these are flexible and not fused, while others are rigid, fused, and heavily sclerotized. Their form would dictate or permit the inclusion/exclusion of specific male parts, but not likely the parameres.

As mentioned earlier, Smith (1889) was the first to use these structures for identification in *Phyllophaga*. The use of genitalia for taxonomic studies in Coleoptera was reviewed by Nichols (1986). Woodruff and Beck (1989) illustrated the genitalia of the 54 Florida species with over 400 SEM photographs. But, the exact nature of the mating behavior is relatively unknown and begs for additional studies. Eberhard (1987, 1990, et seq.) has suggested that female choice may be far more relevant than the elaborate male organ (see our new species *rex*, Fig. 667). Could it be that the cleft claws of some species may be an adaptation for holding on to hairs during copulation? We have many more questions than answers.

Host Plants

Adult *Phyllophaga* feed on foliage of both broad leaved trees and conifers. Since most specimens have been collected at lights or in light traps, little information is available on actual feeding hosts. We have no specific Hispaniolan records of feeding on conifers, but we suspect that many of the higher altitude species (e.g., *aceitillar*, *alcoa*, *androw*, *carnegie*, *davidsoni*, *rex*) feed on pine or *Podocarpus* which are more common there. Those that feed on broad leaved trees are rarely host specific, but often prefer certain tree species and these may be favorites for several Scarabaeidae (pers. observ.). An example is the genus *Inga* which is a good host throughout the Caribbean and Central America. In the DR, *Rutela dorcyi* (Olivier) and one of our new species (*santachloe*) were more common on this host; the latter rarely found on citrus nearby.

Other recorded hosts for Hispaniolan species are listed here under each species: *aliada* [*Miconia azuensis* Urb. and Ekman (*assuaensis* on label) and *Tetrazygia* sp.]; *approxima* [*Trema lamarkianum* (Schult.) Blume; and *Spondias cytherea* Sonn. (*dulcis*

on label)]; *jimenezi* [*Byrsonima* (*Brysonia* on label) *crassifolia* (L.) HBK; *Cupania glabra* Sw., *Echites umbellata* Jacq., *Miconia rubiginosa* (Bonpl.) DC; *Psidium guajava* L. (*guayava* on label)]. In addition they are periodic pests on the foliage of the following commercial crops: citrus, coffee, cacao, sugarcane, tobacco, mango, papaya, flamboyant and many other ornamental and nursery trees. Significant data on host plants and possible specificity would be an excellent project for a collaborative effort between local botanists and entomologists. We had little opportunity to properly collect botanical samples for later identification.

Larval hosts are probably not specific, except roots of certain grasses (especially pastures, lawns, and golf courses) seem to be preferred. They appear to be able to subsist, in some cases at least, on rich organic contents of the soil without roots being present. They are not common in rocky or sandy soils, but prefer rich organic or lateritic soils. They do attack almost any kind of root crop on occasion, especially sugarcane, citrus, pigeon pea, cassava, sweet potato, cocoa, coffee, strawberry, pineapple, bean, groundnut, and tobacco.

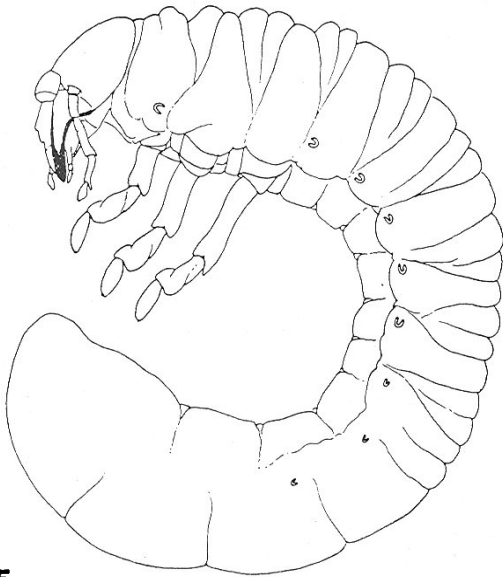
Immatures (Fig. 115-118)

Basically there have been no studies on larvae or pupae of Hispaniolan *Phyllophaga*, even though the grubs (gusanos blancos, majocá, or gallina ciega) are the most damaging stage. Good taxonomic characters are present on the mouthparts and last ventral abdominal segment, and the larvae are relatively easy to rear. We have no knowledge of the length of life cycle, but most may be annual (occasionally 2 to 4 years in colder continental areas). References on larvae of continental species include Ritcher (1966), Böving (1942b), Cherry (1984, 1985), King (1984), Morón (1993), Sosa (1984), and Woodruff and Beck (1989). We have illustrated here the characters of a Cuban species introduced into Florida (Fig. 115-118). It is in the same subgenus (*Cnemarachis*) and should assist in learning the nomenclature for larvae found in Hispaniola.

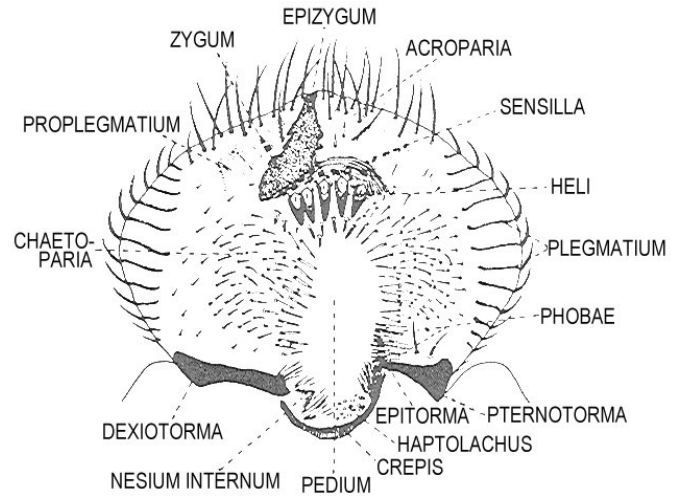
The only papers dealing with larvae of Caribbean species are Böving (1942a), from Guadeloupe (Gruner, 1969, et seq.), and Puerto Rico (Wolcott, 1948). Undoubtedly Wolcott reared several Haitian species during his studies of biological control agents, but these were never published. As a consequence, we have no larvae correctly associated with any of the 48 Hispaniolan species. Because they are of great economic importance to commercial crops, a special

Larval Morphological Characters of *Phyllophaga bruneri* Chapin

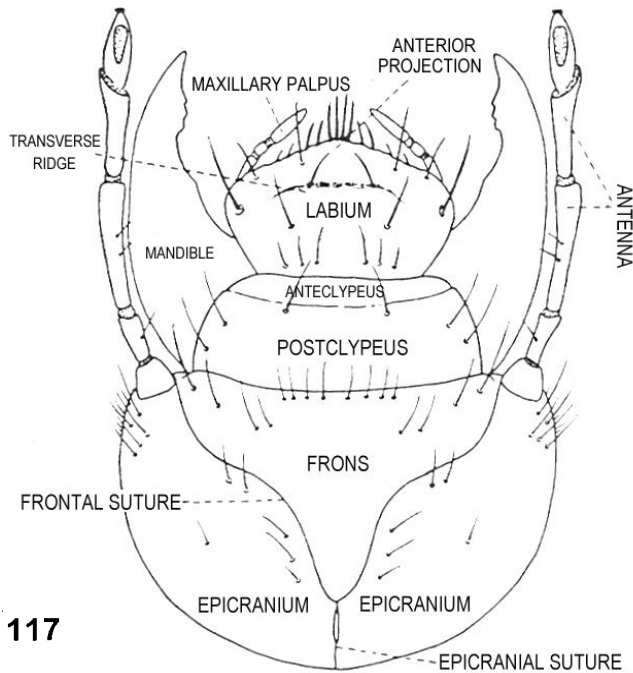
(A Cuban species in the subgenus *Cnemarachis* is illustrated for lack of Hispaniolan material)



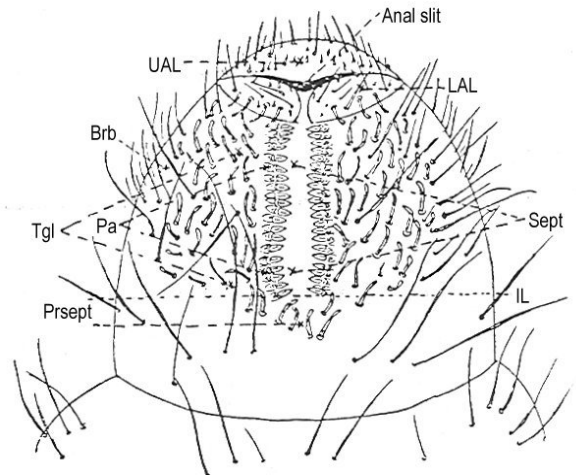
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118

Fig. 115-118. Larval morphological characters. 115) Typical larva, 3rd instar; 116) Epipharynx (upper lip), 3rd instar; 117) Head of 3rd instar larva; parts labeled; 118) Diagrammatic ventral 10th abdominal segment with raster: brb=barbula, LAL=lower anal lip, Pa=palidium, Prsept=preseptular setae, Sept=septula, Tgl=tegillum, UVA=upper anal lip. (After Böving, 1942).

effort should be made to study these larvae. Correct identification to species is absolutely essential in any control program, be it chemical or biological.

Böving (1942a: 170) indicated that he had seen larvae of *Cnemarachis neglecta* (Blanchard) from Santa Rita, Puerto Rico, but stated that it "...is so similar to that of *C. vandinei* (Smyth) that I have been unable to separate them." Since *neglecta* appears to be endemic to Hispaniola, and I have been unable to find any other reference to its occurrence in Puerto Rico, I believe these represent misidentifications. He mentions no other Hispaniolan larval specimens.

Species Treatments (alphabetically)

Phyllophaga aceitillar Woodruff, **new species** (Fig. 119-123)

Holotype male. DOMINICAN REPUBLIC: Prov. Pedernales, Sierra de Baoruco, Aceitillar, 23.6km. NE Pedernales, 18-09-23N, 71-34-09W, 1560M, 14 June 2003, C. Young, J. Rawlins, C Nuñez, R. Davidson, P. Acevedo, M de la Cruz, open pine forest with grassland, UV light, Sample 42112, Carnegie Museum Specimen Number CMNH -309-197 [CMNH].

General description (Fig. 62, habitus): Medium sized (L. 13 mm, W. 6 mm), shiny, uniformly chestnut brown, somewhat convex, nearly glabrous dorsally, except inconspicuous, fine, golden setae on elytral surface and margin, and margins of pronotum. Male genitalia simple, parameres similar to those of other related species, but with U- or V-shaped aedeagal tip (caudally) distinctive (Fig. 122-123).

Head. Clypeus emarginate, anterior angles rounded, strongly reflexed; posterior angles slightly convergent; venter with long, golden, curved setae; surface densely punctate, many punctures coalescing, especially medially. Eye canthus with 11 long, straight setae (about length of those on clypeal venter). Frontal suture deeply impressed, forming wavy line. Frons longer than clypeus, punctures more distinct than on clypeus, slightly depressed medially where punctures denser and coalescent, remainder separated by 1 to 2 diameters, but denser at junction of clypeus and eye canthus. **Antenna** 9-segmented, club 3-segmented, club as long as 5 preceding antennomeres, 6 very small, barely produced before club, 3 and 4 more elongate than others. Club yellowish, matte, with micro-receptors apparently evenly distributed.

Pronotum. Somewhat convex, shiny, lateral angles prominent, front angles barely produced, posterior angles not produced. Lateral margin slightly crenulate near anterior angle, from which arise numerous long, curved, golden setae (about length of those in eye canthus), extending also along entire posterior margin. Surface noticeably punctate with shallow, fine, scattered (most separated by 3-5 diameters), punctures slightly denser near anterior pronotal angles.

Scutellum. Shiny as elytra, densely punctate in more than one row, arranged in V-shaped pattern on lateral thirds, leaving another V-shaped impunctate area centrally. Otherwise unremarkable.

Elytra. Appearing shiny, glabrous, but with fine, short, golden setae arranged in irregular lines, plus a few more in humeral area, and some on elytral margin. Punctures noticeable, but fine and sparse; single row (somewhat darker) linearly arranged, defining a sutural costa, which is more convex, but depressed toward suture. Elytral tip regular, not produced or spine-like.

Pygidium. Triangular, broader at base, apex truncate, glabrous, except normal apical marginal fringe of golden setae; slightly convex, shiny, punctures shallower but about same density as elytra. Marginal carina extending entire circumference. No noticeable pruinose areas on surface or surrounding.

Legs. Relatively long, especially tarsi, all claws with sharp tooth at tip, middle tooth reduced, not cleft. Anterior tibia tridentate, lower tooth about equally developed; spur narrow, long, acuminate, sharp. Anterior tarsal claw with middle tooth behind center, short, broad, pointed to middle; base of claw broad, forming narrow notch before central tooth. Protarsal segments not as long as those on metatarsus; segments 2-3-4 subequal in length.

Meso- and metatibia with longitudinal carina and spinose notches on inner and outer surfaces at incomplete transverse carina. Metatibial spurs long, nearly straight, narrow, sharp; inner spur about 1.5X longer and outer spur shorter than first tarsal segment; both flattened on inner face and slightly concave. Metatibial apical spinule composed of 12 fine spines. Mesotarsal segments 1-2-3 about equal, 4th shorter. Metatarsal segments 2-3-4 gradually shorter; 2 unusually long, nearly double length of 4, 5 subequal to 3.

Abdomen. Ventrally, color nearly as in dorsum. Ultimate sternite transversely grooved, slightly de-

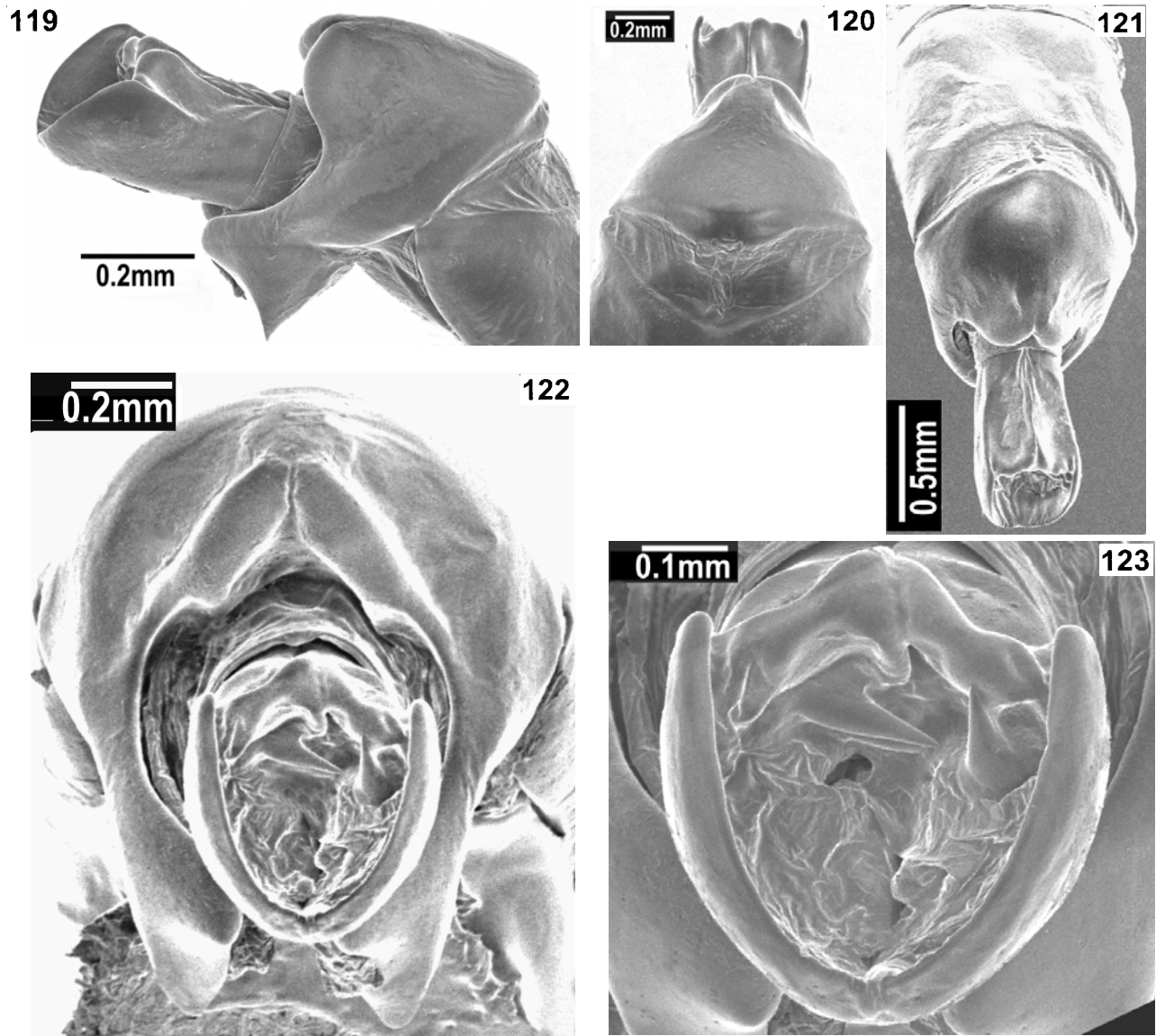


Fig. 119-123. *Phyllophaga aceitillar* Woodruff. Male genitalia: 119) lateral; 120) dorsal; 121) dorso/caudal; 122) caudal; 123) aedeagal tip, caudal.

pressed medially; about 10 long setae on each side, arranged in a line parallel to apical margin. Abdomen appearing nearly glabrous, although few fine setae scattered on most segments laterally. Punctate as in pygidium. Lateral pruinose patch (which occurs in many species) on penultimate sternite weakly defined, accompanied by a few long setae.

Genitalia (Fig. 119-123). Of simplified type, with aedeagus heavily sclerotized, but not greatly modified. Parameres of the *imprima* type, projecting sharply backwards in pointed tip (lateral); broader than many in this group; upper part hood-like, narrowed centrally and emarginate, but without large bulbous projec-

tions beneath (as in the similar *davidsoni*). Aedeagus caudally with U-shape, top weakly sclerotized; 2 large, broad, dark colored hooks recessed deep inside. **Female.** Unknown.

Specimens examined. Holotype and 23 paratypes (all DOMINICAN REPUBLIC): (21) same data as holotype; (1) Prov. Pedernales, 37 km N. Cabo Rojo, 18-09N, 71-35W, 11-VII-1987, R.H. Davidson, J. Rawlins, 1560 m; (1) same, but 25-IX-1991, Rawlins, Davidson, Young, Thompson, grassland with pine. Paratypes deposited in CMNH, FSCA, MHND.

Ecology. Apparently a high altitude species; most were collected at 1560 m elevation. I collected none at many stations below this. Labels indicate that most were taken at UV light (sample 42112), but 5 were collected in Malaise traps (sample 42182). Vegetation at this locality is primarily pine and open grassland (“acetillo”), as labels indicate. Specimens were taken in June (22), July (1), and September (1). The absence of females, coupled with the noticeable receptors on the male antennae, suggests that females may be flightless.

The area near the type locality was heavily mined for Bauxite for many years (none recent) and open scars of the operation still have little vegetation. The soil is bright red with sentinel pillars of limestone which were left standing after loose Bauxite was removed. Although a part of Parque Nacional Jaragua, this area and most of the lower parts of this road (where many interesting and endemic insects have been collected in the past) are being heavily invaded by Haitian and Dominican squatters, resulting in much of the land being cleared for crops. It is an extremely important habitat that requires immediate attention of conservationists.

Comparisons: The closest relative would seem to be *davidsoni* (compare genitalia Fig. 119 vs 255). It is exceptionally shiny, but somewhat similar to the smaller *pedernales* (genitalia Fig. 584) which occurs along the same road at slightly lower elevations down to sea level at Cabo Rojo.

Etymology: The name *aceitillar* is from the type locality with the same name. Aceitillar is located on the road north of Cabo Rojo (constructed by Alcoa for Bauxite mining) from about kilometer 33 to 37 north of Cabo Rojo. The labels for most of the type series give the longitude/latitude as 18-09-23N, 71-34-09W, and 23.6 km NE of Pedernales at 1560 m elevation. Two additional older specimens bear the label 37km N. of Cabo Rojo, 18-19N, 71-35W. They probably represent the same locality, with less precise measuring equipment. At present it is about as far as one can drive, because the road is impassable to Las Abejas at higher elevation. My notes from collecting near this locality indicate km 33 at 4200 ft is in the Parque Nacional Jaragua, by a ranger station near the road.

My good friend José Marcano has provided the following information: The locality is apparently named for a common grass called “acetillo”; *aceitillar*= the place where *acetillo* grows. It is also called “acetilla, espartillo, and maicote (Creole)” and is *Andropogon*

gracilis var. *firmior* Hitch. It is native to the West Indies and Florida.

Phyllophaga alcoa Woodruff, **new species**
(Fig. 63, 124-135)

Holotype male. DOMINICAN REPUBLIC: Prov. Pedernales, 17 km N. Cabo Rojo, 255 m, 18-04N, 71-38W, 21-X-1991, R. Davidson, C. Young, S. Thompson, J. Rawlins, dry deciduous forest, CMNH Specimen Number 305,459 [CMNH].

General description (Habitus, Fig. 63). Medium sized (L. 18, W. 8 mm), tan, head and pronotum shiny, elytra pruinose, except for shiny humeral angles (appearing rubbed). Male and female genitalia of unique type (Fig. 124-135).

Head. Clypeus glabrous, shiny, emarginate, margin reflexed, densely punctate medially, with 2 small, bare, diagonal areas but otherwise punctures less than their diameter apart; posterior angles rounded, barely constricted at frontal suture; frons twice length of clypeus, frontal suture slightly curved but not emarginate medially, noticeably impressed, frons punctures less dense than clypeus, some coalescing, often separated by their diameter; posterior band lightly punctate on posterior, with impunctate band in front of them. **Antenna** 9-segmented, club 3-segmented; antennomere 3 longer and narrower than 4, 5, or 6; club ovate, length equal to previous 5 antennomeres, no noticeable receptors at 20X, club yellowish.

Pronotum. Surface glabrous, except lateral margins with long, curved, golden setae, which continue partially around posterior margin, but becoming smaller toward center; punctures larger but less dense than clypeus and frons, often separated by 2 to 3 diameters; lateral pronotal margin slightly crenulate, pronotum widest near middle at lateral angle; anterior angles obtuse, posterior angles rounded, surface shiny, dark chocolate brown.

Scutellum. Impunctate in center with 8-9 punctures on each side similar to pronotum, posterior slightly depressed.

Elytra. Surface pruinose except for V-shaped shiny area on basal third, behind scutellum and humeral angles; pruinosity appearing dull, although iridescent in lateral view; punctation shallower than pronotum, separated 2-3 diameters, no setaceous punc-

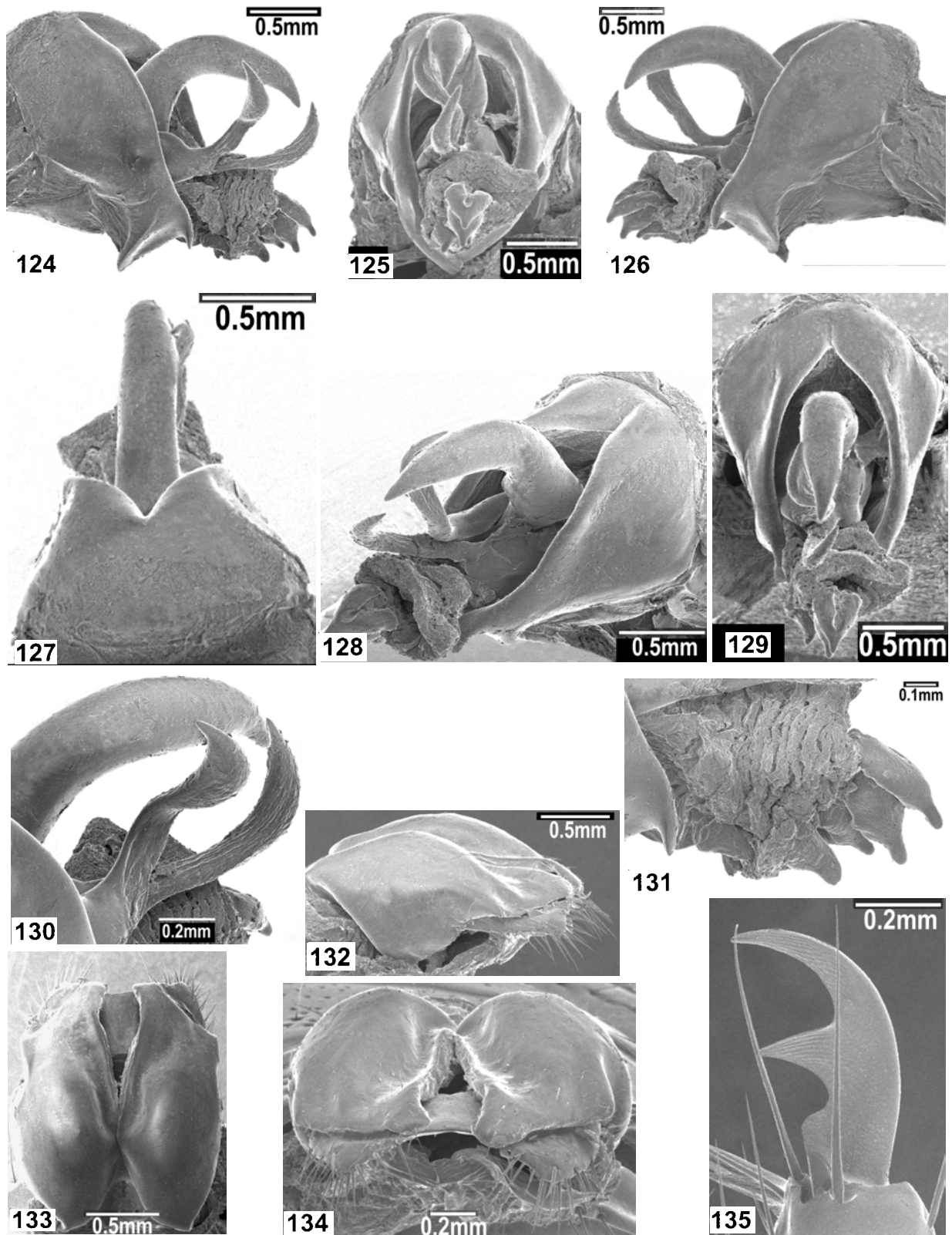


Fig. 124-135. *Phyllophaga alcoa* Woodruff. 124-131 Male genitalia: 124) left lateral; 125) caudo/ventral; 126) right lateral; 127) dorsal; 128) caudo/lateral; 129) caudo/dorsal; 130) aedeagal tip; 131) papillose area of lower aedeagal tip; 132-134 female genitalia: 132) lateral; 133) ventral; 134) caudal; 135) protarsal claw, female.

tures; elytral margin barely raised, suture well defined by weakly convex costae with a few scattered punctures. Elytra terminating in obtuse angle with no spine.

Legs. Protibiae tridentate, spur sharply pointed, and barely reaching base of first tarsal segment, protarsal segments 1-4 subequal in length, fifth 1.5X longer than previous segments. Protarsal claws with middle tooth central, triangular, acute, but not sharply pointed, terminal tooth sickle-shaped (Fig. 135, female). Mesotibia with longitudinal carina well developed; transverse carina incomplete, marked by 2 sets of large spines forming outside, and a large spine opposite 2 middle spines, but on inside. Mesotibial spurs elongate and sharp pointed, narrow and acuminate; inner spur 3/4 length of outer. Mesotarsal segments similar to anterior ones. Metatibial apical spurs similar to mesotibia, long spur broader, inner surface noticeably concave, shorter spur 2/3 length, narrower; neither sharp pointed as on mesotibia; apical fringe of 27 spines (more than most species). Metatarsal segments 1-4 becoming gradually shorter, fifth 1/4 longer than 4, tarsal claws with teeth similar to protarsi, except central tooth somewhat sharper pointed.

Pygidium. Surface pruinose as elytra, punctures scattered, surface glabrous except for terminal fringe.

Abdomen. Venter with setae on each segment, but scattered, more numerous laterally in slightly pruinose patch on penultimate sternite; ultimate sternite with slight longitudinal depression in middle.

Male genitalia (Fig. 124-13). Asymmetrical, parameres broadly truncate at bottom, with slight tooth at anterior tip. Aedeagus with a large, curved, dorsal hook, and 2 lateral "parameres" projecting upward, covered with microsetae (Fig. 130); left one with angular curve, noticeably different from right smooth curved one (appearing as if they may be capable of twisting together). Tip of aedeagus below with a group of 4 papillose projections (Fig. 131), unique within the genus. In dorsal view, phallobase notched, angle somewhat acute.

Allotype female. Data same as holotype, except CMNH Specimen number 308,120 [CMNH]. Nearly identical to male, except frons somewhat more densely punctate medially, pronotum more shining, surface of elytra similar to male, non-pruinose areas somewhat more extensive and including posterior

tumulosity; terminal sternite without central depression and slightly more convex. Metatibial apical inner spur somewhat more spatulate-shaped, broader near tip than base; apical fringe of 33 spines (27 in holotype). **Female genitalia** distinctive (Fig. 132-134), elongate, inferior plates joined in center, ventrally convex, terminus projecting into a truncate lobe. Superior plates extending beyond inferior plates, center (viewed ventrally) with smooth arc to obtuse angulate tips containing 16-18 setae.

Specimens examined: Only the holotype and allotype are known. Several collectors, including myself, have collected near the type locality, but no other specimens have been found.

Ecology. The type locality is on the road from Cabo Rojo north to Aceitillar and Las Abejas, which is well marked with kilometer posts and which provides easy access for collectors. There is little legal habitation along this road. It is sometimes referred to as the "Mercedes" road, although that is the only town, a short distance to the west, accessed at about km 21 (1200 ft). The road was constructed by Alcoa (Aluminum Company of America; for whom this species named), to access bauxite mining areas higher up. The entire area along the road is rapidly being modified with illegal clearing by squatters (both Haitian and Dominican), even though it is a part of the Parque Nacional Jaragua.

The habitat at kilometer 17 is labeled as "dry deciduous forest" at an altitude of 255 meters. Habitats below this are much drier and desert-like; above gradually elevated through moist tropical forest to pure pine forest. *P. alcoa* appears to occupy a narrow habitat or a specific adult host tree, since only a single pair has been collected. The same area is inhabited by a huge land iguana (*Cyclura*), as well as the endemic mammal *Solenodon*.

The area along this road, transecting most habitats from sea level to 5000 feet, is of great endemism, and a special effort should be made to protect its interesting fauna and flora for future generations. One of 5 new species which are endemic to the "South Island", *alcoa* (including *davidsoni*, *jaragua*, *pedernales*, and *aceitillar*) is known only from this small portion of the Baoruco Mountains.

Comparisons. Superficially *alcoa* is similar to *jaragua* in its coloration and the extent of glabrous and shiny areas (on a pruinose base) on the pronotum and elytra. It is slightly larger (L. 18 vs. 15 mm), has less swollen elytra posteriorly; but few specimens are

known. The 2 appear to be "sister species" by external characters, but the male and female genitalia are drastically different (compare Fig. 124-134 vs. 384-389). The female of *alcoa* has 16-18 setae on each projection of the superior plates, whereas *jaragua* has only 8. Although data are lacking on altitudes, *jaragua* appears to be a species of lower elevations.

Etymology. I take great pleasure in naming this species for Alcoa (Aluminum Company of America), who not only built the road which accesses the type locality and other collecting sites, but has graciously provided accommodations and assistance for an untold number of naturalists over nearly half a century. The staff of Alcoa and Ideal Dominicana (their successor), from managers, engineers, and guards to the "empleadas", have always been extremely courteous and helpful in many ways. I personally wish to thank the two companies and Ramon Cáceres who made most of our collecting possible, as well as Rafael Reyes and Hans Leiter (our residence hosts).

Phyllophaga aliada Sanderson
(Fig. 64, 136-148)

Phyllophaga aliada Sanderson (1951: 279-280; fig. 59).

Holotype (examined). Female [MCZC type 30517, examined]: Mt. Basil, N. Haiti, to [struck out] 4700 ft, Sept. 9, 1934, [P.J.] Darlington. Because the male was previously unrecognized, the allotype male is described below.

Allotype male (here designated). DOMINICAN REPUBLIC: Prov. La Vega, La Ciénega de Manabao, Parque Nacional Armando Bermudez, headquarters, 3000 ft, R.E. Woodruff, 3-5-VII-1999, night on *Tetrazygia* sp. [FSCA].

General description, male allotype. Medium sized (L. 14, W. 6 mm), similar to female, but narrower, subparallel, posterior tibial spurs longer and less flattened. All claws cleft. Antennal club much larger, nearly as long as width of clypeus and longer than previous 5 antennomeres. Color generally light yellow, but not translucent (compared to *approxima* n. sp.), head and pronotum more reddish-brown. Dorsum appearing dull, matte, but iridescent in diagonal lighting. Genitalia distinctive (Fig. 136-140), similar to *approxima* (see description below).

Head (Fig. 144, female). Color orange-brown, slightly darker than elytra. Clypeus emarginate, anteriorly rounded, posterior angles diverging, until sharp angle to frontal suture, clypeal margin reflexed, surface evenly punctured, punctures about a diameter apart, frontal suture deeply impressed, emarginate in the middle. Frons less densely punctured than clypeus, punctures larger, separated mostly by 2 diameters, posterior band impunctate except near the lateral base, center of both frons and clypeus somewhat depressed longitudinally, that weak depression continuing on pronotum. **Antenna** orange, 9-segmented, club 3-segmented, elongate, longer than previous 5 antennomeres, 3 and 4 cylindrical and subequal, division weakly marked (Fig. 146), club with noticeable receptors (in both sexes) (Fig. 147).

Pronotum. Anterior pronotal margin wide and impunctate, anterior angles slightly obtuse, posterior angles smoothly rounded, sides slightly convergent from near middle to basal angles, base wider than apex, few long setae on lateral margin, not continuing to the posterior margin, punctation denser in spots but less so in central third, denser at anterior angles.

Scutellum. Punctate in a V-shaped pattern, with approximately 3 rows on each side with a V-shaped smooth area in middle anteriorly.

Elytra. Surface slightly pruinose, appearing dull, mostly coppery-orange, darker at apical declivity below tumosity and extending short distance up suture. Lateral marginal setae few and not obvious; elytra with few scattered setae only, punctation fairly uniform, except sutural striae which have few scattered punctures. Elytral suture without terminal spine. Elytral margin barely raised laterally.

Pygidium. Convex, shining, glabrous except for terminal fringe, irregularly punctate, some punctures coalescing to form longitudinal rugosities, apex slightly truncate.

Legs. Protibia tridentate, basal tooth fairly developed, middle tooth somewhat rounded but nearer proximal than basal, spur reaching beyond base of first tarsal segment. First protarsal segment shortest, next 3 subequal, fifth 1.25X longer; claw cleft, middle tooth broader and shorter than apical one (Fig. 148). Mesotibia with longitudinal carina not obvious, no transverse diagonal band of setae, but clusters on outer face as normal; inner apical spur shorter, dagger-like, both spurs shorter than first tarsal seg-

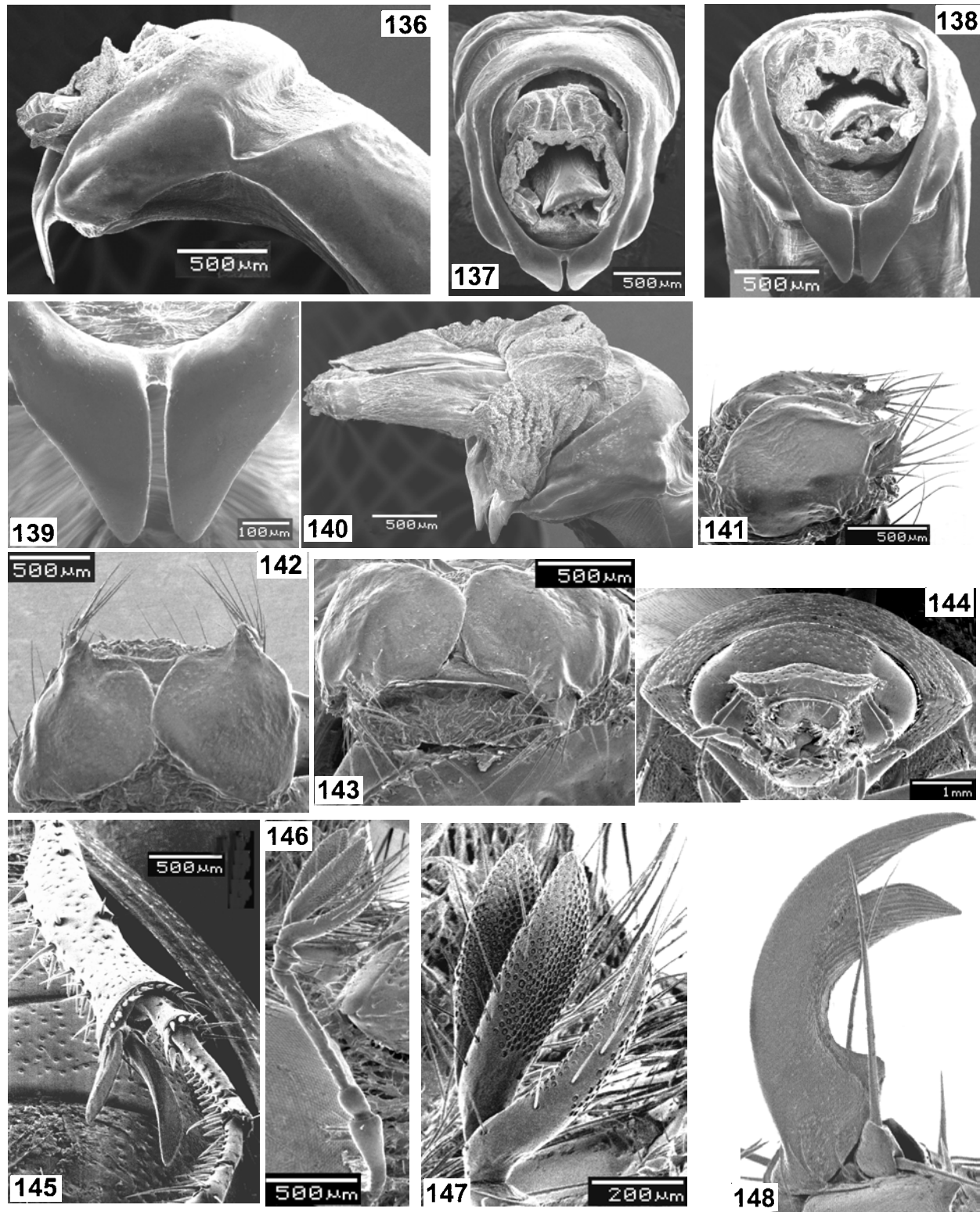


Fig. 136-148. *Phyllophaga aliada* Sanderson. 136-140 Male genitalia: 136) lateral; 137) caudal; 138) ventral; 139) paramere tips; 140) aedeagus extended (lateral); 141-143 female genitalia: 141) lateral; 142) ventral; 143) dorsal; 144-148 female: 144) head; 145) metatibial apex; 146) antenna; 147) antennal club; 148) tarsal claws.

ment. Mesotarsal segments progressively shorter, with 5 and 1 about equal, spurs cleft as protarsi. Metatibia as in mesotibia, inner spur about 2X length of first tarsal segment, spur curved inward and machete-like; outer spur about equal to first tarsal segment; longitudinal carina on metatibia suggested by long row of stiff spines, but not carinate or darkened; dorsal tibial notch obvious, external angle produced with longer spines; apical fringe of 11-12 spinules (female with 16). Second metatarsal segment unusually elongated, nearly 2X longer than first, 2-4 progressively shorter until fifth which is subequal to 2nd; tarsal claws cleft as protarsi, but middle tooth broader and equal in length to apical tooth. Metatarsal segments 2-4 containing 2 rows of sharp, stiff spines on their inner surface (Fig. 145).

Abdomen. Venter pale yellow, convex, somewhat translucent, barely pruinose in patch on sides of penultimate sternite, otherwise shiny; sutures well marked.

Male genitalia (Fig. 136-140). Relatively simplified, the aedeagus normally recessed. Paramere tips turned abruptly backward, fused medially only at base; labia nearly triangular, flattened on face; laterally a smoothly rounded convexity. Phallobase evenly rounded dorsally, not notched. Aedeagus poorly sclerotized, harder central piece caudally as an inverted "shovel", surrounded by several groups or clusters of spinose areas imbedded in flexible tissues (Fig. 140).

Female (Fig. 141-148). Similar to male, except antennal club shorter, ovate, receptors not uniformly covering lamellae (Fig. 147). Metatibial spinule with 16 spines (11-12 on male). **Female genitalia** distinctive (Fig. 141-143); inferior plates not fused, with teat-like projection apically, terminating in cluster of about 4 long setae; superior plates fused and evenly curved medially; apically with cluster of 8 extremely long setae on terminal projections (Fig. 142).

Specimens examined. In addition to the holotype female from Haiti and the allotype male from Dominican Republic, I have seen 67 additional specimens (all DOMINICAN REPUBLIC, **new country records**) as follows: (16) same data as allotype [all FSCA]. **Prov. La Vega:** (1) La Cienega de Manabao, Pk. Hdqtrs. [Parque Nacional Armando Bermudez], 20-21-IV-2000, R. E. Woodruff, T. J. Henry, 3000 ft, black-light trap [FSCA]; (3) Valle Nuevo, 6-V-1959, Sanderson and Farr, R59-9[1], feeding on *Miconia assuaensis* [INHS]; (1) Constanza, 10-V-1972, J. and S. Klapper-

ich, 1250 m [NHMB]. **Prov. Monseñor Nouel:** (3) 1km E. Paso Alto de Casabito, 7km NW La Ceiba, 19-02N, 70-29W, 28-VII-1992, 1130 m, cloud forest, J. Davidson, J. Rawlins, C. Young, S. Thompson [CMNH]. **Prov. San Juan:** (40) Sierra de Neiba, 9.4km SSW El Cercado, 18-39-18N, 71-32-51W, 1973m, 22-VI-2003, Sample 32242, R. Davidson, C. Nuñez, C. Young, J. Rawlins, P. Acevedo, M. de la Cruz, meadow near mature pine forest, hand collected [CMNH]. **Prov. Elias Piña:** (1) 9.0km WSW Hondo Valle, 18-41-34N, 71-46-52W, 1843 m, 25-VI-2003, Sample 31312, R. Davidson, C. Nuñez, C. Young, J. Rawlins, P. Acevedo, M. de la Cruz, disturbed montane woodland with pine, UV light [CMNH]; (1) same, except 9.3km WSW, 18-41-31N, 71-47-03W, Sample 31112 [CMNH]. **Prov. Independencia:** (1) Sierra de Neiba near crest, 5.5km NNW Angel Feliz, 18-41N, 71-47W, 1750 m, 21-22-VII-1992, J. Rawlins, S. Thompson, C. Young, R. Davidson, dense cloud forest [CMNH].

Taxonomic notes. This species was originally described from a unique female. Retrospectively, Sanderson and I agree that perhaps the species name should have been established on the basis of males, because their genitalia are more distinctive. Actually, some of our specimens were labeled as a new species, and Sanderson gave them the manuscript name "*cuparia*" many years ago. During the present study they were so considered, until the holotype of *aliada* was borrowed from the Museum of Comparative Zoology. The female genitalia are preserved in a glycerine vial and are somewhat cleared. Because the tissues that connect the superior and inferior plates are flexible, they did appear different from our specimens. However, when the inferior plates were positioned as our fresh material, they were obviously the same as in Fig. 142. We therefore avoided the unnecessary description of a synonym and have firmly established the association of the sexes; especially important in *Phyllophaga*.

Some may question the description of an allotype, especially many years after the original description and by subsequent authors. However, the original description of the term "allotype" clearly includes this provision (see earlier discussion on this topic in Methods and Materials; and Fernald, 1939).

Comparisons. In external and genitalic characters it is most similar to *approxima* (compare Fig. 136-143 vs. 167-177). Externally *aliada* is matte, opaque, while *approxima* is shiny, translucent.

Phyllophaga androw Woodruff, **new species**
(Fig. 65, 149-166)

Holotype male. DOMINICAN REPUBLIC: Prov. San Juan, Sierra de Neiba, 9.4km SSW El Cercado, 18-39-18N, 71-32-51W, 1973 m, 22-VI-2003, R. Davidson, C Nuñez, C. Young, J. Rawlins, P. Acevedo, M. de la Cruz, sample 32212, meadow near mature pine forest, UV light, CMNH specimen number 307,025 [CMNH].

General description (Habitus, Fig. 65). Medium sized (L. 12, W. 6 mm), base color light orange-brown, with darker area in pronotum and posterior portions of suture and elytral apical declivity; head nearly black. Color similar to *fossoria*, but vestiture denser and obvious.

Head. Color nearly black, except lighter clypeus. Clypeus one-third length of frons, almost quadrate, sides nearly parallel, smoothly emarginate; margin highly reflexed; surface densely punctate, punctures more numerous medially, frontal suture slightly impressed, emarginate medially, diminished at sides, some clypeal punctures setiferous, frons noticeably hirsute with long, posteriorly curved reddish setae, posterior band impunctate, exceptionally dark, nearly black; punctation of frons dense, coarse, coalescing in lateral thirds, basal band projecting forward in the middle, slightly raised. Eye canthus carinate, with 8 long curved setae. **Antenna** (similar to Fig. 164) orange-brown, segments 2, 3, 4 progressively shorter, club 3 segmented, lamellae flattened, receptors noticeable at 20X, longer than preceding 5 antennomeres.

Pronotum. (Fig. 65). Vestiture hirsute, dense setae longest in anterior center and lateral and posterior margins, but covering disc also. Lateral margin noticeable crenulate at setal insertions. Punctation coarse, denser at anterior angles. Pronotum widest at rounded, near medial, lateral angles; anterior and posterior angles not projecting or acute, posterior more rounded. Color orange-brown, with weakly defined darker band in center disc. Posterior marginal line raised.

Scutellum. Surface slightly alutaceous, punctures shallow, scattered, a few setiferous with straight short setae.

Elytra. Dorsally somewhat flattened, orange-brown, with a darker chevron pattern near elytral apices,

extending up suture and sutural striae. Noticeably hirsute, more densely so at humeral angles and on lateral margins. Sutural apices not projected into a point, marginal line barely reflexed.

Pygidium. Convex, hirsute, slightly alutaceous, punctures nearly evenly spaced, separated by 1-2 diameters, nearly all setiferous, margin reflexed with terminal fringe; apex slightly truncate.

Legs. Protibiae tridentate, basal tooth weakly projecting, middle tooth nearer proximal than basal; apical spur not reaching base of first tarsal segment, short and not finely pointed. Protarsal segments 1-4 subequal, fifth 1.25X longer; claws cleft (Fig. 166), lower tooth shorter and broader than apical. Mesotibia with longitudinal carina obvious, diagonal band of 7-8 stiff setae located about one-third length from apex; terminal spurs nearly equal in length, inner longer. Mesotarsal segments 1, 2, 5 subequal, 3 and 4 progressively shorter; claw cleft as protarsi. Metatibia with transverse carina well marked (Fig. 17, 19), setae as on mesotibia; inner apical spur longer and slightly broader, both spurs longer than first tarsal segment. First metatarsal segment reduced, next 3 progressively shorter to 5th which is subequal to second; claws cleft as on protarsi.

Abdomen. Ventral surface with microsetae on 3 sternites; penultimate sternite with elongate setae similar to pygidium; terminal sternite with similar but shorter setae.

Male genitalia (Fig. 149-157). Extremely similar to *fossoria* (Fig. 288-298), but differs in minor details, lateral projection of aedeagus more "hand-like". The long, saw-like projection from the aedeagal tip (Fig. 152) is also found in *fossoria*, but it is difficult to dissect. Often when genitalic differences are minor, there are excellent external characters for separation. In this case *androw* is extremely hirsute, especially on pronotum, whereas *fossoria* has pronotal disc glabrous.

Allotype female. Data same as holotype, except Salcedo's Caseta, 7.8 km SSW El Cercado, 18-39-56N, 71-31-57W, 19-VI-2003, sample 30042, 1659 m, hand collected [CMNH]. Length 12 mm. Similar to holotype in most respects, including fuscous pattern. Shape slightly more robust, elytra not as parallel-sided, broader (6.5 mm at widest). **Female genitalia** (Fig. 158-160) with inferior and superior plates connected at apex laterally (as in *fossoria*), inferior plates

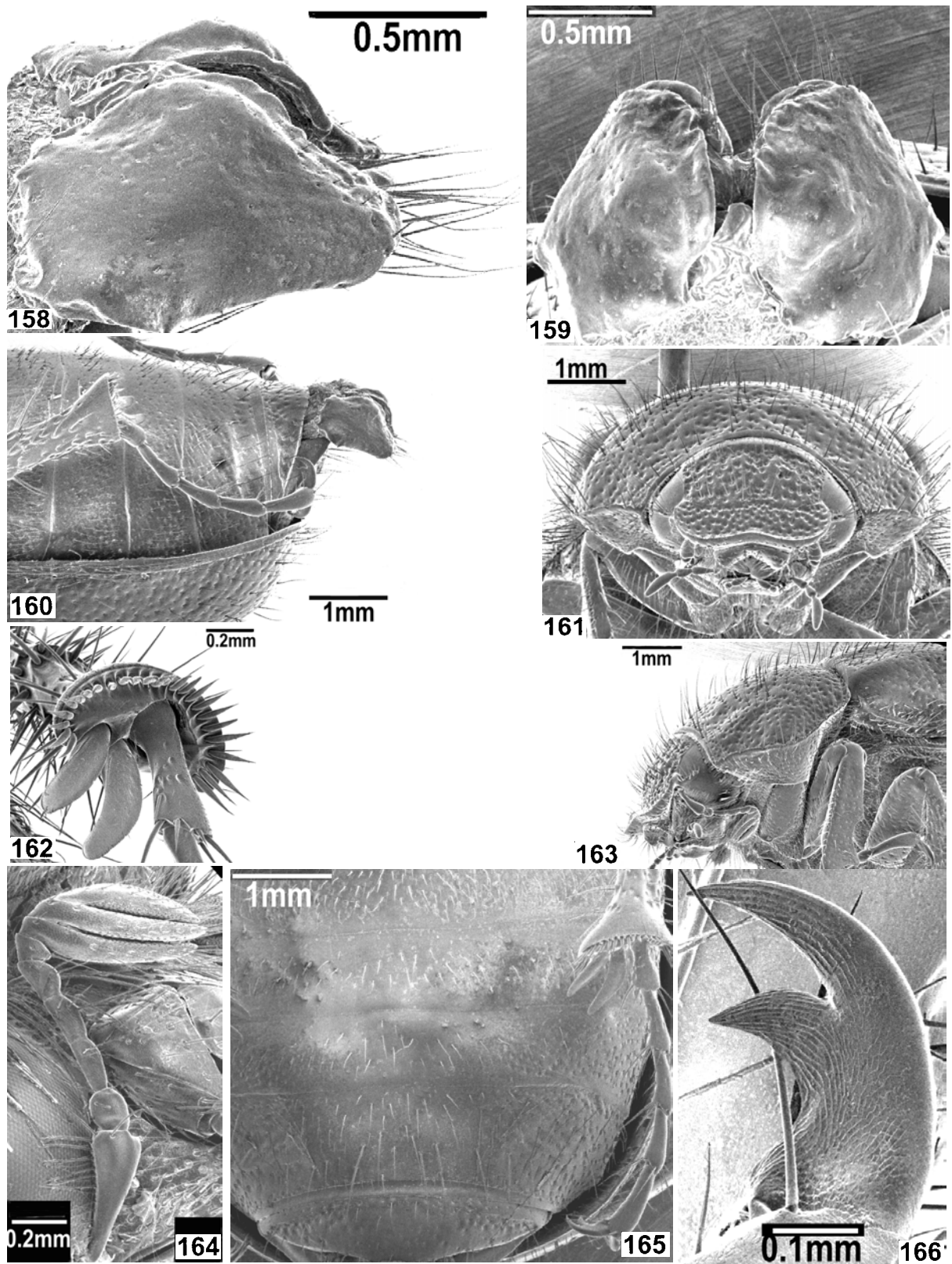


Fig. 158-166. *Phyllophaga androw* Woodruff. Female. 158) genitalia, lateral; 159) genitalia, ventral; 160) abdomen, lateral, genitalia extruded; 161) head, frontal; 162) metatibial apex; 163) head and pronotum, lateral; 164) antenna; 165) abdomen, ventral; 166) metatarsal claw, lateral.

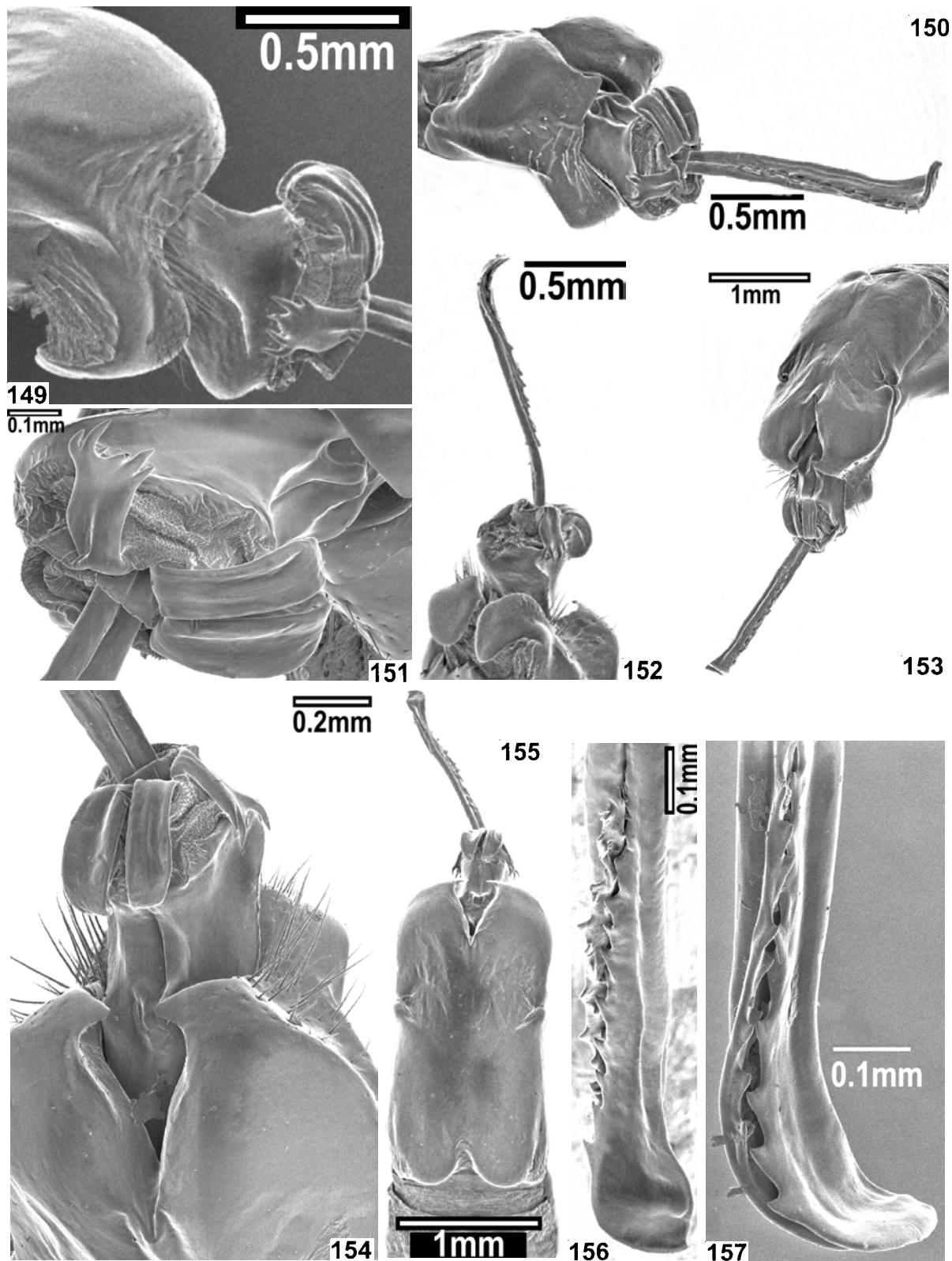


Fig. 149-157. *Phyllophaga androw* Woodruff. Male genitalia: 149) lateral (aedeagal tip cut off); 150) caudo/lateral with tip included; 151) aedeagal tip with "hand"; 152) ventral, aedeagal tip; 153) caudo/dorsal; 154) dorsal, paramere tip and aedeagal base; 155) dorsal, entire; 156-157) tip of aedeagal extension.

convex medially, with a carina paralleling division. A weakly sclerotized triangular plate divides base, superior plates with about 13 terminal setae on each projection. Pygidium more flattened than in holotype, punctation of head and frons somewhat denser, appearing more rugulose, antennal club (Fig. 164) ovate in outline, shorter than preceding 5 segments. Metatibial spurs much broader and spatulate-shaped, terminal fringe composed of about 33 spines (about 21 on male). A single female is known.

Specimens examined. In addition to the holotype and allotype above, I have designated 12 paratype specimens as follows: 1 male with same data as holotype and 11 males with same data as allotype [CMNH, FSCA, MNSD].

Ecology. Because of the noticeable receptors on the antennal lamellae, I suspect that adults are primarily diurnal (as are those of other species from high altitudes). The fact that only 2 were collected at "UV light" and 12 were hand collected adds to that supposition. Altitudes range from 1659 m at the hand collecting site, to 1973 m at the UV light collections. The latter was "meadow near mature pine forest", and the other was "pastures, pine woodland". It is probable that pine is the host plant of adults.

Comparisons. This species is extremely close to *fossoria*, and was not immediately recognized at first encounter. However, the locality did not coincide with known distributions of that species and closer scrutiny revealed this interesting "sister species". The Sierra de Neiba is another of the mountain ranges with several endemic plants and animals. In addition to being a slightly smaller species (av. 12 vs. 14 mm), *androw* has the entire pronotal surface noticeably hairy (Fig. 161, 163). The genitalia are similar, but distinctive (compare Fig. 149-160 with 288-304).

Etymology. It is with great pleasure that I name this species for Robert Androw, who greatly facilitated my work by his dedication and care in preparing and dissecting the extensive Carnegie collections, although he did not get the enjoyable benefits of the field work to collect them. His efforts not only assisted in this study, but have made these specimens both useful and aesthetic. Rarely have we seen such well-prepared material.

Phyllophaga approxima Woodruff and Sanderson,
new species
(Fig. 66, 167-177)

Holotype male. DOMINICAN REPUBLIC: Prov. La Vega, 5-7 mi S. Constanza, 5-V-1959, [M.W.] Sanderson and [T.H.] Farr, RD59-4(1), feeding on *Trema lamarkiana* [INHS].

General description (Habitus, Fig. 66). Medium sized (L. 13, W. 6 mm), color pale yellowish orange, integument translucent, head and pronotum slightly more orange, but not dark. All legs and abdomen somewhat translucent. Shape elongate, parallel-sided. Genitalia distinctive (Fig. 167-172).

Head. Clypeus smoothly rounded to truncate apex, not emarginate, half length of frons; margin reflexed, surface shallowly but noticeably punctate, denser in anterior depression but punctures separated by a diameter or more in remainder, posterior clypeal angles rounded to frontal suture; suture impressed, barely emarginate in center. Frons less densely punctate than clypeus, some punctures larger but separated by 1-2 diameters, center depressed, with denser cluster of punctures; posterior band impunctate. **Antenna** yellowish, 9-segmented, club 3-segmented, capable of being flatly compressed, club with noticeable receptors, lamellae as long as previous 5 antennomeres; antennomere 3 and 4 subequal in length, narrow, 5 broader but nearly equal in length, 6 short and barely expanded.

Pronotum. About 1.75X wider than long, color somewhat orange compared to elytra; surface glabrous, shiny. Anterior angles bluntly rounded; pronotum widest at lateral angles, but not noticeably angulate; posterior angles subquadrate. Punctation denser at sides, forming a slight longitudinal impression on disc, marginal setae scattered, fine, not extending on posterior margin, which is indicated by row of depressed punctures, margin carinate.

Scutellum. Punctures smaller and denser than those on elytra, in a V-shaped pattern, some coalescing with a V-shaped impunctate area in center.

Elytra. Color pale yellow, translucent, shiny, not pruinose; surface densely, shallowly punctate, punctures usually separated by a diameter, but some coalescing below humeral angles; elytral margin barely reflexed, weakly so in posterior third; sutural carina and costae barely noticeable near scutellum

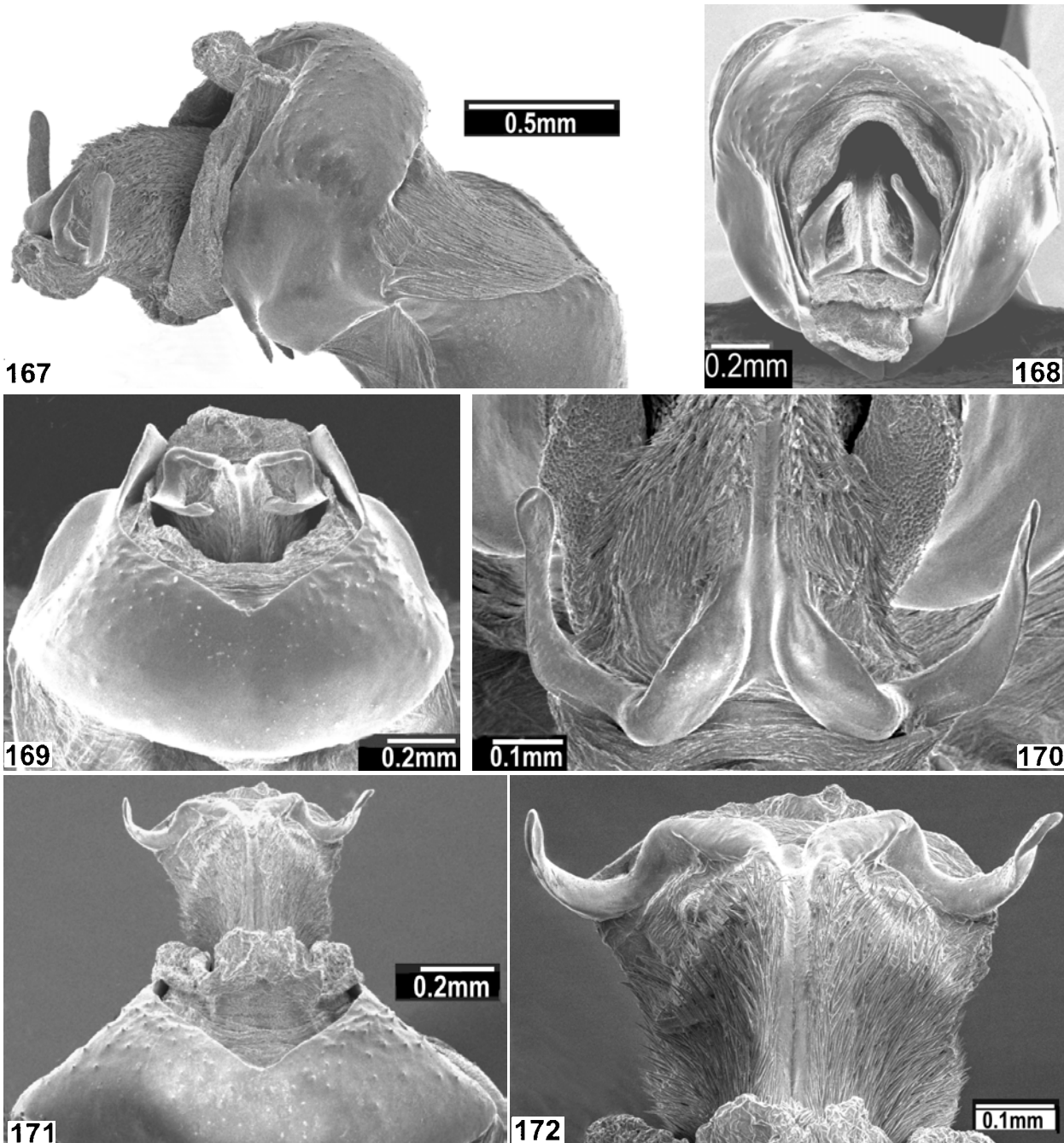


Fig. 167-172. *Phyllophaga approxima* Woodruff and Sanderson. Male genitalia: 167) lateral; 168) caudal; 169) dorsal; 170) aedeagal tip, caudal; 171) aedeagus extruded, dorsal; 172) aedeagal tip enlarged, dorsal.

but better developed throughout, punctate similar to elytra, sutural apex without spine, obtusely rounded.

Pygidium. Surface nearly glabrous, except for marginal fringe, but scattered short, pale setae present; densely, coarsely punctate, many punctures coalescing, appearing longitudinally wrinkled; apex somewhat truncate.

Legs. Protibiae tridentate, basal tooth weakly projecting, middle tooth nearer proximal than basal; tibial spur long, acuminate, and dagger-like, projecting beyond base of first tarsal segment. Protarsi long, segments 2, 3, and 4 subequal, fifth 1.25X longer; claw distinctly cleft, lower tooth shorter and broader than upper (Fig. 166, female). Mesotibial spurs sharp, dagger-like, inner spur 1.25X longer than outer spur;

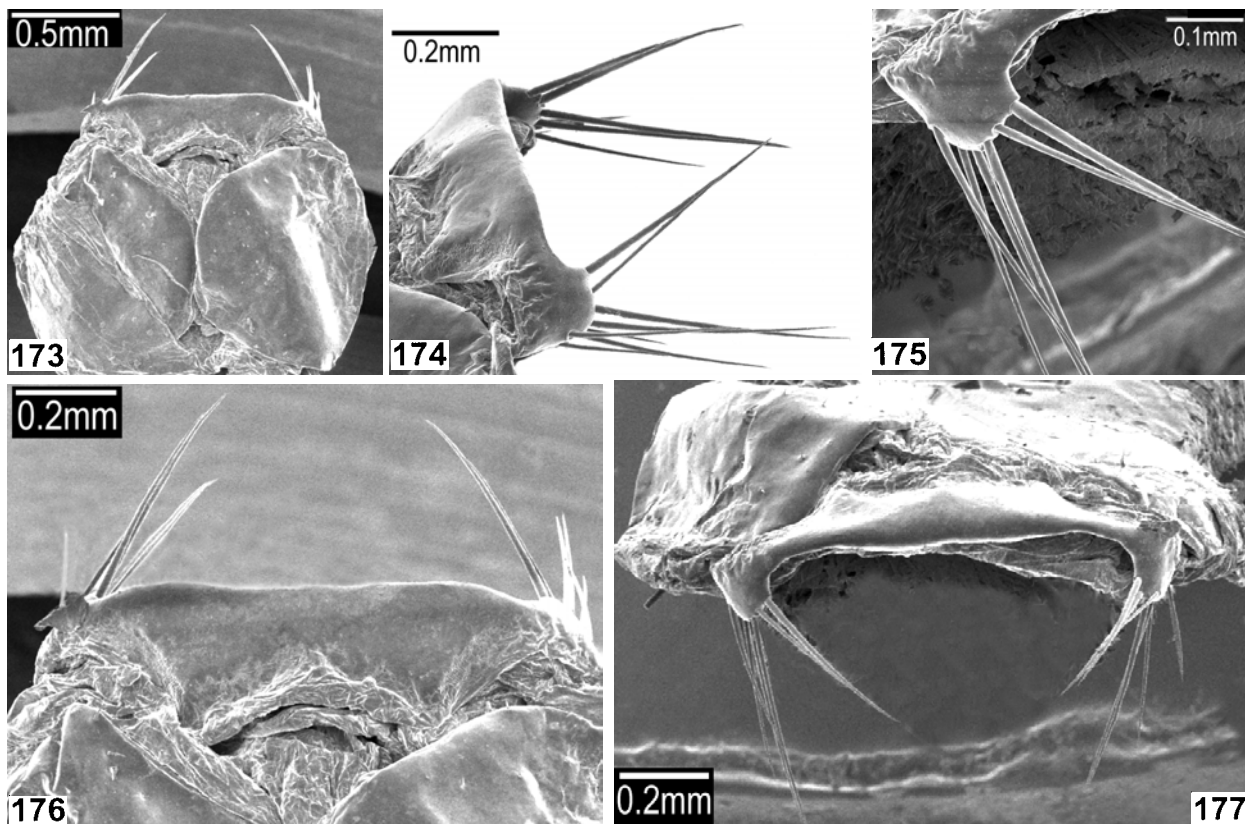


Fig. 173-177. *Phyllophaga approxima* Woodruff and Sanderson. Female genitalia: 173) ventral; 174) diagonal/lateral; 175) enlarged tip of right superior plate, ventral; 176) superior plate, ventral; 177) dorso/caudal.

diagonal transverse band of setae one-third distance from apex, longitudinal carina not noticeable. Mesotarsal claws as in protarsi, tarsal segments 2, 3, and 4 progressively shorter, with 5 subequal to 1, claws nearly identical to protarsi. Metatibia curved dorsally, longitudinal carina not noticeable, but transverse carina marked by patch of setae as in mesotibia; inner apical spur long, narrow, sharply pointed, equal in length to first tarsal segment, outer spur 1.3X longer than first tarsal segment, narrow, pointed; apical fringe of 14 spinules (some shorter than others). Metatarsal segments 1 and 4 subequal in length, 2 longest, 3 and 5 subequal, all with long sharp setae on the inner face, claw similar to anterior but middle tooth broader and longer.

Abdomen. Ventral surface glabrous except for large cluster of setae on pruinose patch of penultimate sternite, setae somewhat shorter in center, ultimate sternite with long setae on posterior margin similar to fringe on pygidium.

Genitalia, male (Fig. 167-172). Generally similar to *aliada*, but phallobase dorsally broadly notched, and

aedeagal tip with 2 ram-like horns, the area behind them covered with spinose setae. Caudo/lateral area of parameres carinate and flange-like. Dorsum of phallobase with numerous bumps (possible vestiges of setal bases).

Allotype female. (Genitalia Fig. 173-177). Data same as holotype [INHS]. Generally similar to male in most respects, slightly wider posteriorly. Antennal club ovate, lamellae not flat or compactable, much shorter than previous 5 segments. Metatibial inner spur more curved, slightly broader. Apex of metatibia with more (about 16) setae in fringe. **Female genitalia** with 6 exceptionally long setae at lateral angles of fused superior plates; area between nearly straight, rounded to corners, no median indentation. Inferior plates not fused, convex, without carinae or depressions, apically prolonged in acute angle, but not sharp-pointed, no long setae; base at median not closed by triangular plate.

Specimens examined. In addition to the holotype and allotype, we have designated the following 18 paratypes (all from DOMINICAN REPUBLIC): (13)

same data as holotype, some on *Spondias dulcis* [INHS, FSCA, MCZC]. (4) Prov. La Vega, Convento, 12 km S. Constanza, 6-13-VI-1969, Flint and Gomez [USNM]. (1) Prov. San Cristobal, San Cristobal, 8-9-VI-1969, Flint and Gomez [USNM]. The latter record is questionable. Based on the known altitudinal preferences, the fact that labels were similar in printing, the same collectors, and the dates overlap, we believe that the latter specimen is likely mislabeled. Inquiries to Dr. O.L. Flint shed no light on this specimen.

Ecology. Adult host plant records include 2 trees: *Trema lamarckiana* (9 males, 3 females) and *Spondias dulcis* (5 males). Seasonal records extend from May 5 to June 13. Several other workers have collected in the vicinity of the 2 known localities, but further specimens were not encountered. There are no light trap collections, indicating that its rarity may be due to its sedentary habits. The noticeable receptors on lamellae of the antennal club suggest they may be more active in the daytime.

Comparisons. In both general appearance and genitalic features, *approxima* is nearest *aliada* Sanderson. From that species it can be separated by the shiny, non-pruinose dorsum, translucent integument, and non-emarginate clypeus. The male genitalia have the same basic shape, but *approxima* has 2 bull-like horns (Fig. 172) on the aedeagus, whereas *aliada* has the aedeagus without such horns and it projects into a tongue-like, truncate projection clothed with microsetae (Fig. 140).

Variation. Little variation was noted in the type series (L. 12-13.5, W. 5-6 mm). Apical fringe of metatibia in male varying from 8 to 14 spinules (20 tibiae examined). The clypeus of 1 male was more rectangular than others and one had the pronotum noticeably more convex.

Etymology. The name *approxima* refers to the similarity of this species to *aliada*, and other light colored species in the same size range.

Phyllophaga audanti Wolcott

Phyllophaga audanti Wolcott (1928a: 27). Sanderson (1951: 273-274; Fig. 44,45,71,72). (Habitus Fig. 67, male genitalia Fig. 178-181, female genitalia Fig. 185-188.)

This small, shiny, glabrous species (L. 8-10, W. 4.5-5 mm) is relatively common in the southern

lowlands of the Dominican Republic, from Santo Domingo west to Port-au-Prince, Haiti (from which the types came). It appears to be found throughout the year, and is frequent at lights. It has potential as an economic pest; several hundred were collected near a sorghum field (13 km W. Los Tres Charcos, Prov. Pedernales) on May 22, 1985. Adults were feeding on mesquite and small herbaceous plants near the soil, which is a bright red, sticky lateritic clay. The area is a semiarid coastal plain, only a few meters above sea level, that is heavily cultivated. It is likely that larvae damage various crops grown here. Altitude records are from sea level to 475 m.

Records include the following DR Provinces: Azua, Barahona, Distrito Nacional, Independencia, Pedernales, Puerto Plata, San Juan, Santiago. Haitian records include Port-au-Prince and Petionville.

Phyllophaga baoruco Woodruff, **new species**
(Fig. 68, 191-198)

Holotype male. DOMINICAN REPUBLIC: Prov. Barahona, Larimar Mine, nr. Filipinas, 3300 ft, 26-VI-1992, blacklight trap, P. Landolt, F. Skillman, P.E. Skelley, R.E. Woodruff [FSCA].

General description. (Habitus, Fig. 68). Large (L. 23, W. 7 mm). Reddish brown, anterior third shiny, glabrous, elytra pruinose, pile producing an iridescent sheen; elytral suture terminating in outward projecting spine.

Head. Clypeus slightly emarginate, margin reflexed, punctures coarse, rarely separated by 1 diameter, smaller and denser medially; lateral margins rounded, slightly indented at frontal suture, suture deeply impressed, especially at eye. Frons punctate similarly to clypeus; smaller, coarser, denser line of punctures above eye. Posterior band impunctate, a few punctures at posterior corners behind. **Antenna** 9-segmented, club 3-segmented; lamellae shorter than preceding 5 antennomeres, 3 and 4 subequal, elongate, 5 wider than long, slightly projecting anteriorly, 6 wider than long. Color dark orange-brown.

Pronotum. Wider than long, lateral angles not prominent, widest at posterior angles. Lateral margin somewhat crenulate at marginal setae. Posterior line marked by row of punctures, but weakly reflexed. Surface glabrous, shiny, reddish-brown. Punctures coarse, irregularly spaced from 1 to 4 diameters; vague indication of impunctate longitudinal line in central disc (more extensive on some specimens).

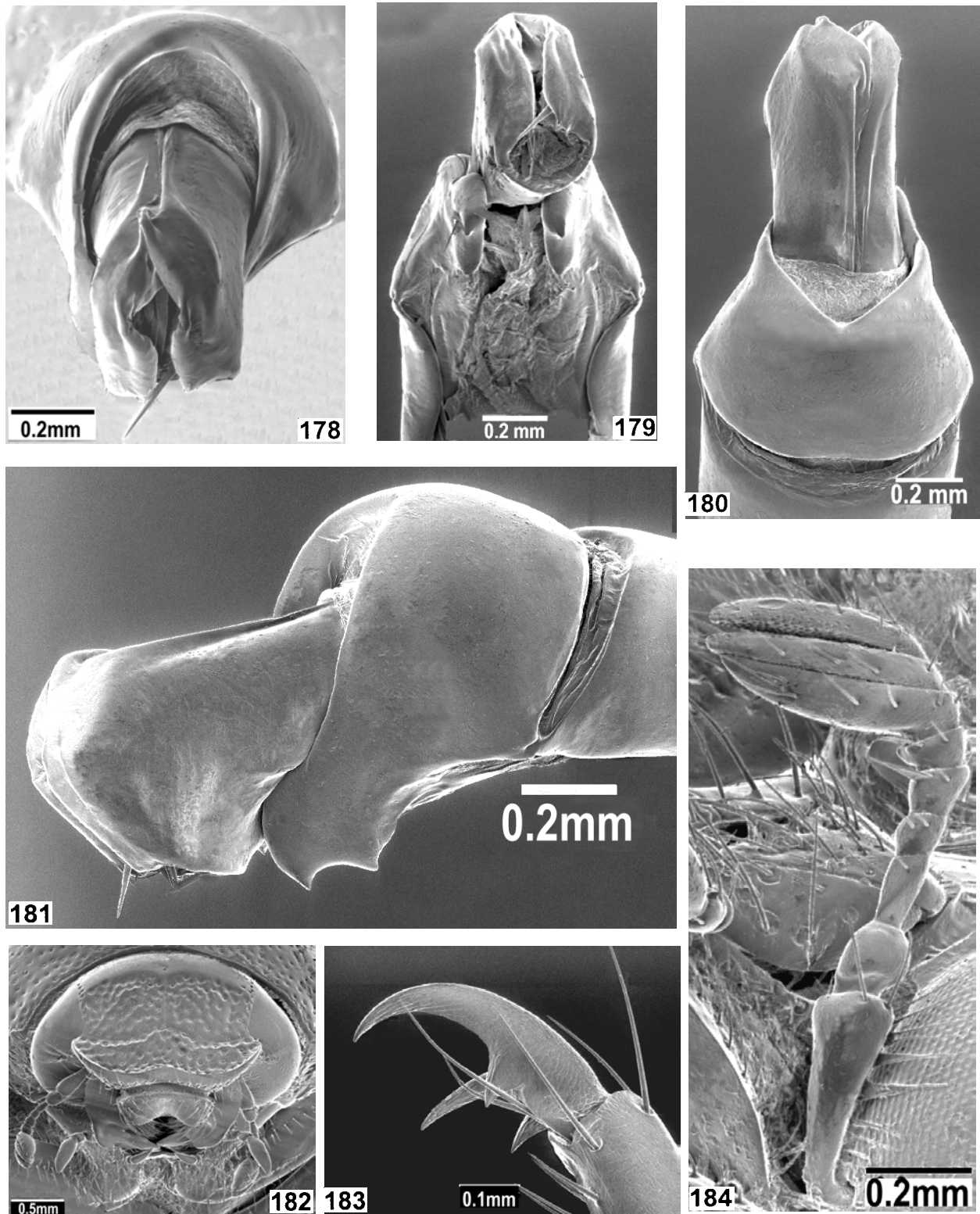


Fig. 178-184. *Phyllophaga audanti* Wolcott. Male. 178-181 genitalia: 178) caudal; 179) ventral; 180) dorsal; 181) lateral (right); 182) head, frontal; 183) protarsal claw; 184) antenna.

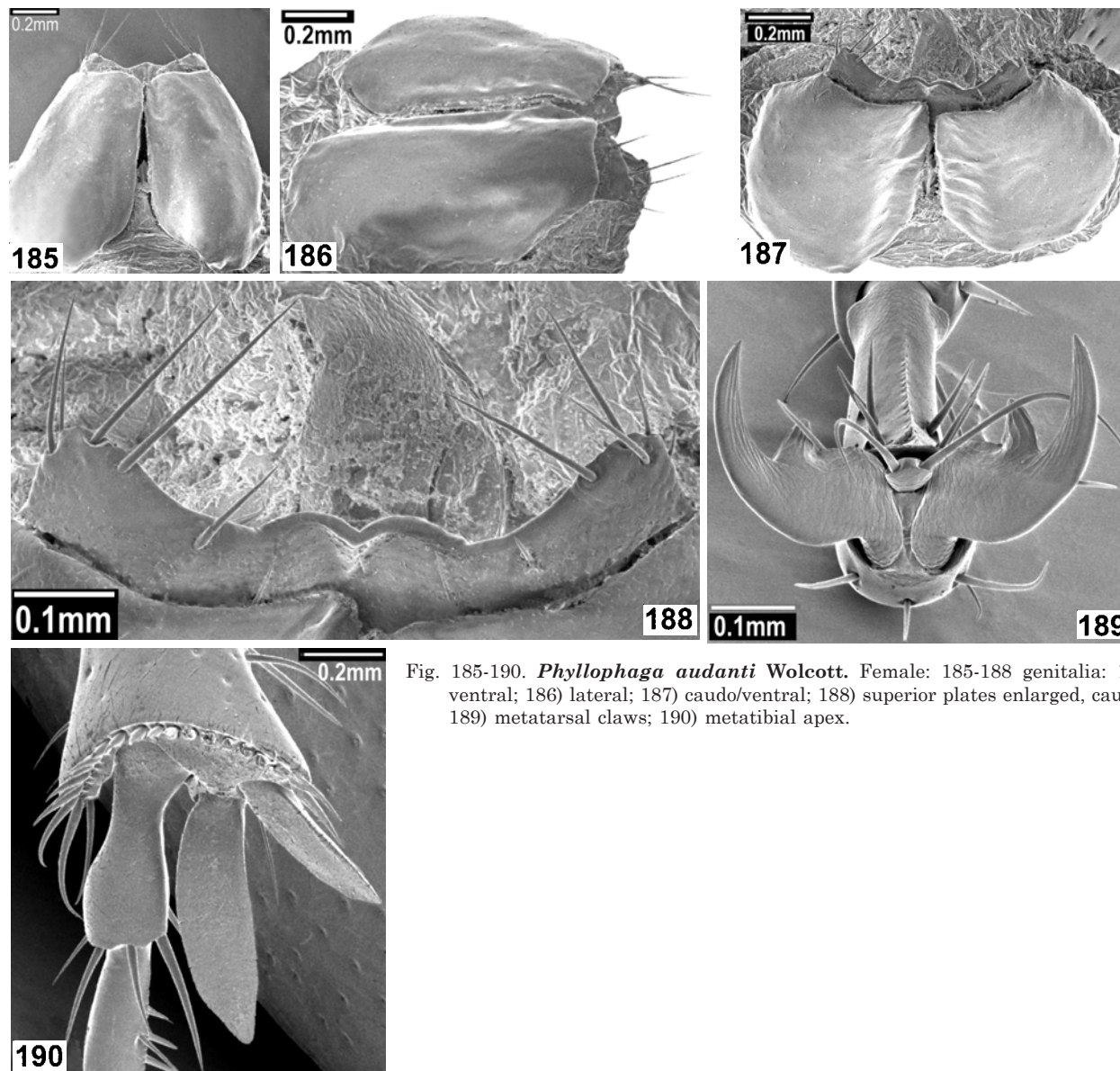


Fig. 185-190. *Phyllophaga audanti* Wolcott. Female: 185-188 genitalia: 185) ventral; 186) lateral; 187) caudo/ventral; 188) superior plates enlarged, caudal; 189) metatarsal claws; 190) metatibial apex.

Punctures denser and smaller at anterior angles, which are sharply projected and laterally reflexed. Anterior margin slightly raised and bordered posteriorly by a row of small, nearly contiguous punctures.

Scutellum. Shiny, glabrous, slightly convex, center impunctate, margins with fine punctures.

Elytra. Two elytral costae indicated by convex ridges. Surface uniformly pruinose except humeral angles and small band along basal area shining. Surface somewhat iridescent from grey-blue to reddish-brown. Punctures shallower than pronotum, fairly evenly spaced, separated mainly by 2 to 4 diameters. Elytra with scattered, short, microsetae, nearly arranged in

rows, not noticeably pubescent, nearly invisible except in lateral view. Suture barely carinate and sutural costae inconspicuous until near apical declivity. Suture internally margined with golden microsetae, terminating in sharp outwardly curved spine (similar to *hogardi*). Sutural costae slightly convex with few scattered punctures. Lateral elytral margin barely reflexed and poorly indicated on apical declivity, except by a row of microsetae.

Pygidium. Pruinose, but not as strongly as elytra, more alutaceous. Punctures shallow, evenly spaced on dorsum, but finer and denser toward pygidial apex. Most punctures setiferous, with fine, short, straight, golden, setae.

Abdomen. Venter shiny, pruinose only on sides. Setae barely noticeable, size and shape as on pygidium. Penultimate sternite more heavily punctured medially, with a slight depression. Ultimate sternite with a narrow central depression, and coarsely punctate.

Legs. Protibiae tridentate, basal tooth well developed, nearly equal to middle tooth. Apical spur reaching beyond base of first tarsal segment. Protarsal segments 1 through 4 subequal; fifth 1.5X longer; claws elongate, C-shaped, terminal tooth bent sharply inward, middle tooth near center, longer than tip of apical tooth; base expanded, forming a large cup between it and middle tooth. Mesotibiae without transverse carina, its location marked by large teeth with stiff spines. Longitudinal carina complete. Apical spurs sharp, nearly parallel sided; inner spur about half first tarsal segment length; outer 25% shorter than inner. Mesotarsal segments 1 through 4 progressively shorter; first tarsal segment with spines prominent on both sides, outside spines better developed; fifth tarsal segment 1.5X longer than fourth; claws same as protarsi. Metatibia without transverse carina, indications as in mesotibiae; longitudinal carina complete. Metatibial apex expanded, inner spur longer than first tarsal segment, outer spur shorter than first tarsal segment. First tarsal segment shorter and broader at tip than that of mesotibia; inner spur parallel sided, not explanate, but concave on inner surface; inner spur barely curved; apical fringe with 16 short, narrow, straight spines. Metatarsal segments 1 through 4 nearly equal; fifth 1.5X longer than fourth; claws as in protarsi.

Genitalia, male (Fig. 191-194). Genital capsule relatively simple, of *hogardi* type; opening oval; parameres elongate, projecting downward into 2 terminal lobes, tips projecting well beyond medial projections; not fused medially. Dorsally, phallobase with smooth curve, not notched. Aedeagus plug-like and spinose at tip, which is "sock-shaped" (Fig. 193), similar to *permagna*, but paramere tips distinct. Cylinder behind spinose tip heavily sclerotized, twisted somewhat.

Allotype female. Data same as holotype, except 3-VII-1993, R.E. Woodruff [FSCA]. Similar to male, except elytra more expanded (wider) posteriorly. Antennal club about length of previous 4 segments. Elytral setae less noticeable. Metatibial spurs both broader, more sickle-shaped, ventrally flattened, and more curved than male. Apical fringe about 16 spines

as in male (often females of other species have many more than males). **Female genitalia** (Fig. 195-198) with inferior plates large, broader than long, loosely connected medially; tips barely projecting, somewhat wrinkled, with few short microsetae; no triangular basal plate. Margin of superior plates gently curved medially, lateral tips each side terminating in about 9 long setae (3 on ventral surface and about 6 on dorsal face), not fused to inferior plates.

Ecology. The type locality is located at the Larimar Mine (a unique Dominican gemstone), and specifically the finca of Sr. Ramón Ortiz. It is a volcanic deposit of Cretaceous age in the Baoruco Mountain range (a part of the "South Island"), at about 3300 ft elevation. The site is a disturbed cloud forest, with coffee as an understory. Shade grown coffee requires that mature trees are conserved. Collecting dates were over a 3 week period in 1992. Rain was continuous for the first week, and daily thereafter. Several blacklight traps and a mercury vapor light were operated at the Ortiz house.

Other species collected at the same time and place were: *kenscoffi*, *larimar*, *leptosfica*, *mali*, *ortizi*, *panicula*, and *toni*. The geology of the Baoruco has been detailed by DeLeon (1989).

Specimens examined. Total 59, including holotype and allotype (all DOMINICAN REPUBLIC). Paratypes as follows: (26) same data as holotype [FSCA, INHS, MCZC, USNM, MHND]; (2) same data as allotype [FSCA]. **Prov. Pedernales:** (1) km 24 N. of Cabo Rojo, 11-VI-1998, 3000 ft, R.E. Woodruff and P.H. Freytag, blacklight trap [FSCA]; (1) nr. Cabo Rojo, 300-700 m, 12-IX-1973, T.J. Walker and J.C. Schuster, Coll. #1 [FSCA]; (1) 25.5 km N. Cabo Rojo, 20-V-1992, M.C. Thomas [FSCA]; (1) 25 km N. Cabo Rojo, 12-VII-1996, R. Turnbow [RHTC]; (1 female) La Abeja [Las Abejas], 38 km NNW Cabo Rojo, 18-09N, 71-38W, 11-17-VII-1987, K. Johnson, D. Matusik, 1250-1340 m [CMNH]; (1 male) 23.5 km N. Cabo Rojo, 18-06, 71-38W, 26-27-IX-1991, Young, Davidson, Thompson, Rawlins, wet deciduous forest [CMNH]; (3) 37 km N. Cabo Rojo, 18-09N, 71-35W, 11-VII-1987, R. Davidson, J. Rawlins [CMNH]; (4) 13 km N. Pedernales, along Rio Mulito, 18-09, 71-46W, 17-VII-1992, Young, Davidson, Thompson, Rawlins, 230 m, riparian woodland [CMNH]; (3) 5 km N. Mercedes, 24-VI-1999, R.E. Woodruff, feeding on *Inga* leaves at night. **Prov. Barahona:** (4) 4.5 km S. Barahona, 4 km W. Hwy. 2, 17-V-1992, M.C. Thomas [FSCA]; (3), 4.5 km S and 5 km W Barahona, 17-V-1992, mv+uv, R. Turnbow [TAMU, EGRC]. **Prov. Azua:** (4) Sierra Martin

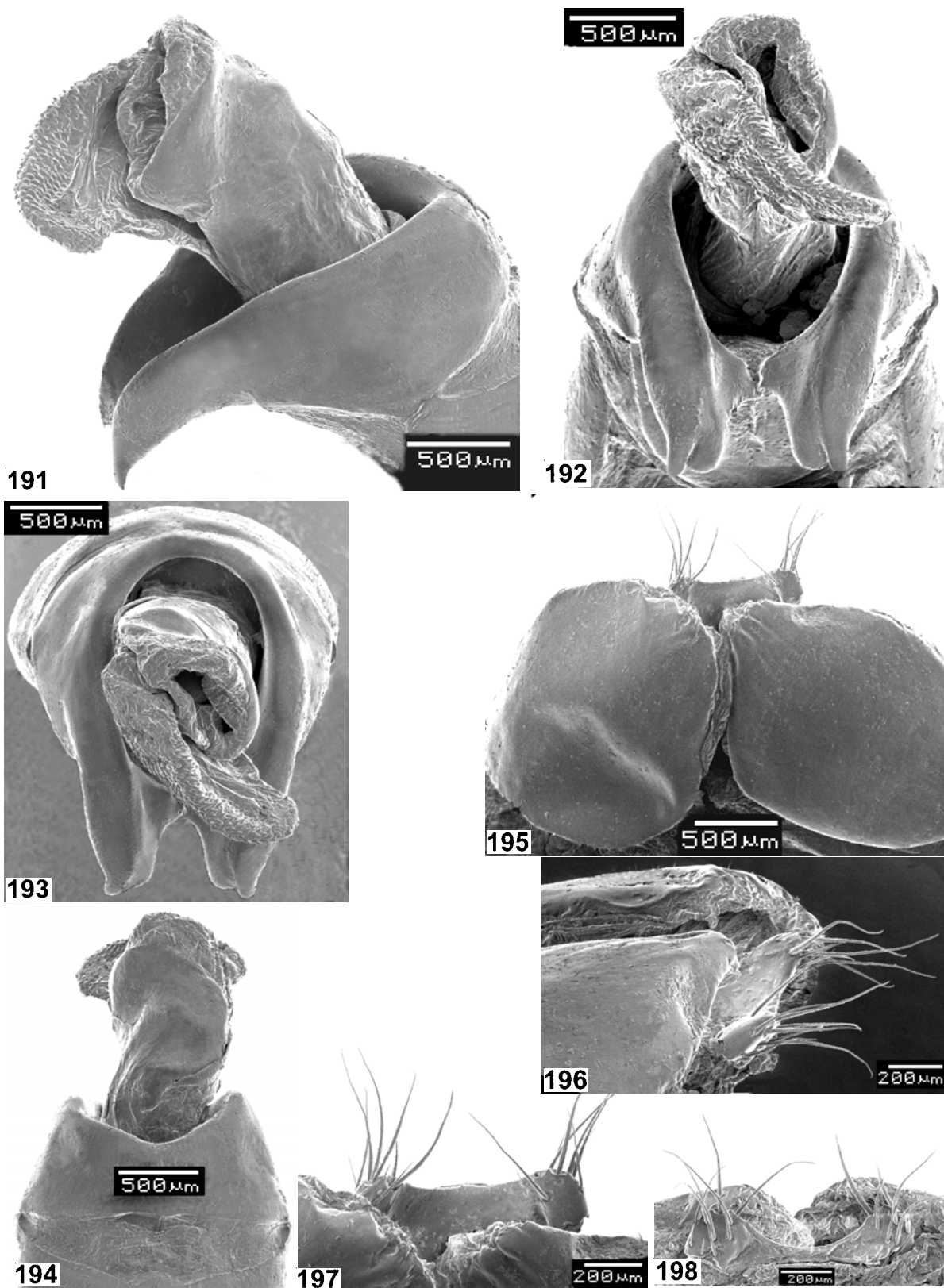


Fig. 191-198. *Phyllophaga baoruco* Woodruff. 191-194 Male genitalia: 191) lateral; 192) ventral; 193) caudal; 194) dorsal; 195-198 female genitalia: 195) ventral; 196) lateral; 197) superior plates, ventral; 198) superior plates, dorsal.

Garcia, km 7 WNW Barrero, Eastside Crest, 18-21N, 70-58W, 25-26-VII-1992, Young, Davidson, Thompson, Rawlins, 860 m, cloud forest adj. disturbed forest [CMNH].

Comparison. Similar to others in the *hogardi* group, by the presence of distinct curved spines at elytral sutural apices. It is most similar in appearance to *leptospica*, *toni*, and *permagna*, from which it can be separated easily by the distinctive genitalia. The pygidium of *leptospica* is shiny, not pruinose, punctures larger and nearly glabrous, whereas in *baoruco* it is pruinose and covered with short, stiff, golden setae (best viewed laterally) and the pronotum is much shinier, the shiny area extending partially onto the elytra. In *toni* the pronotum is shiny, but also hirsute (glabrous in *baoruco*) and it is larger (L. 27 vs. 23 mm). The genitalia are closest to *permagna*, but the paramere tips are distinctive, and the body of *permagna* is also larger (L. 27 vs. 23 mm).

Etymology. Named for the mountain range in which it occurs, not to be confused with the small town of the same name on the coast. On maps and documents the name is spelled both “Baoruco” and “Bahoruco”, but the “h” is silent in Spanish. I have chosen the simpler spelling, which reflects the pronunciation. The Baoruco were a part of the paleo “South Island” and which contain a relictual fauna, often having “sister species” to the north of the Enriquillo basin.

Phyllophaga barroosa Sanderson
(Fig. 69, 199-209)

Phyllophaga barroosa Sanderson (1951: 280; Fig. 76).

This species was one of 3 described from unique females (Sanderson, 1951), from Fond de Negres, HAITI in 1927. It is now the only one remaining for which the matching male still is pending. It is a large species (L. 19, W. 10 mm), reddish, pruinose, related to *mali*, *haitiensis*, and *rustica*. The female genitalia illustrated here (Fig. 207-209) are of the holotype, and they are easily distinguished from female *mali* (Fig. 457-460) and *haitiensis* (Fig. 346-352); the latter much more heavily sclerotized, inferior plates fused and truncate, without basal median plate of *barroosa* (Fig. 204). The other related species, *rustica*, is known only from 2 males. Although a possibility exists that *rustica* represents the male of *barroosa*, there is currently no way to associate them. This can only be clarified when a mating pair or associated large series has been collected. Originally I suspected

that *haitiensis* was the missing male, but an associated female confirmed that it was distinct.

The head (Fig. 199) was described by Sanderson as having the “Clypeo-frontal suture deeply triangularly impressed on each side toward eye.” Except for this character and the female genitalia, little was recorded for this species. Therefore, the following brief description was made from the holotype [USNM, but without number]. The metatarsi and right mesotarsus are broken off.

Dorsal surface ferruginous, pruinose, iridescent, glabrous except marginal setae. Clypeus emarginate, margin reflexed, frontal suture impressed, more so at eye. Antenna (Fig. 201) 9-segmented, club 3-segmented, club ovoid, about as long as preceding 3 antennomeres, receptors barely visible at 40X. Pronotum convex, lateral margin crenulate at setal origins; widest at lateral angles, which are behind middle; anterior angles only slightly produced, not acute or projecting; lateral angles rounded; posterior angles nearly quadrate, tip rounded; posterior marginal line obsolete medially. Scutellum (Fig. 206) wider than long, glabrous, pruinose, coarse punctures scattered on lateral thirds. Pygidium (Fig. 205) glabrous, pruinose, punctures fine, but obscured by surface sculpture. Meso- and metatibia with well developed longitudinal carina, accompanied by 4 sharp tooth-like spines (only 2 teeth, carina less developed on *mali*); transverse carina absent, barely indicated by spines on inner and outer surface. Metatibial apical fringe of 30 spinules (Fig. 202, some broken); inner spur longer than first tarsal segment, flattened, widest about middle, curved on inner face, not sharp pointed; outer spur 2/3 length of inner, slightly curved, flattened. Metatarsal claws (Fig. 203) with teeth sharp, middle tooth median, extending straight and slightly longer than apical tooth.

The female genitalia were stored in a glycerine vial, from which they were dried, photographed with the SEM, and returned to the vial. Shape closer to Fig. 207, but Fig. 208, although showing superior plates clearer, is slightly widened due to distortion during photography. Angle from medial tip toward posterior angle of inferior plate an acute diagonal (compare *mali*, Fig. 457-460). Suture of inferior plates fused in basal half, divided in narrow V in anterior half. Superior plates nearly truncate, apically with about 8 long, stiff setae, with 3 or 4 shorter from below at lateral angles. The most diagnostic feature (Fig. 204) is the crescent-shaped basal, median closure (none in *mali*).

No additional specimens have been taken since it was collected 77 years ago (by A. Whetmore, an

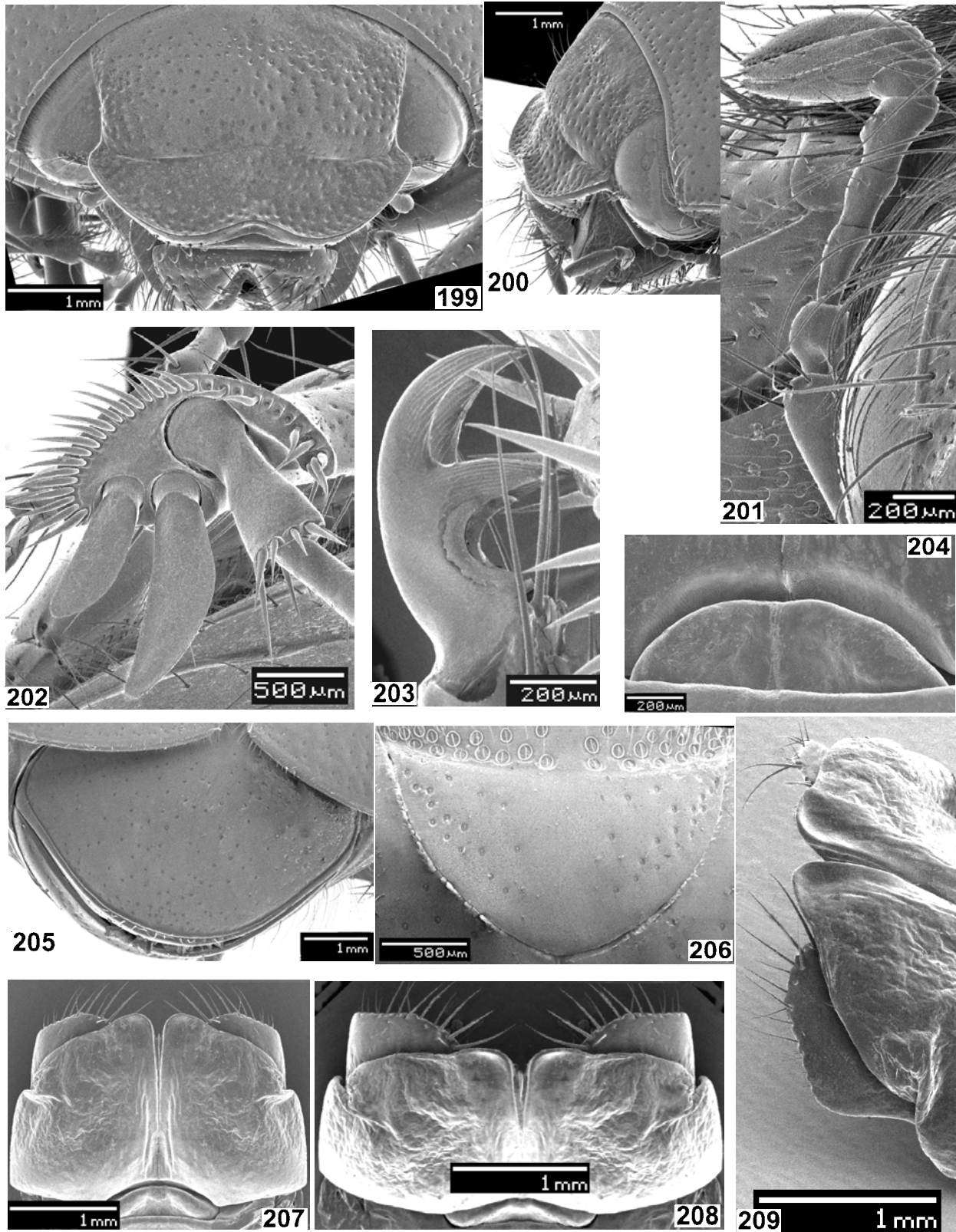


Fig. 199-209. *Phyllophaga barrosa* Sanderson. Unique female holotype: 199) head, frontal; 200) head, lateral; 201) antenna; 202) metatibial apex; 203) mesotarsal claw; 204) base center of basal plates; 205) pygidium; 206) scutellum; 207) female genitalia, ventral; 208) same, caudo/ventral (lateral distortion due to angle of SEM photo); 209) same, lateral.

ornithologist), and in over 50 years since it was described, during which there has been fairly intensive collecting in Hispaniola. However, few specimens of *Phyllophaga* have been seen from this part of Haiti, indicating that the species may be very localized, have specialized hosts, or possibly extinct. Recent floods in Gonaïve indicate the precarious nature of the Haitian landscape where trees have been cut and erosion is uncontrolled. Additional collecting is needed in Haiti to clarify several species problems and to determine which species have survived under the severe environmental destruction there.

Phyllophaga bonfils Woodruff and Sanderson,
new species
(Fig. 70, 210-222)

Holotype male: HAITI: Dept. de l'Ouest, Furcy, 15-V-1959, M.W. Sanderson, et al., H59-3 (2). [aedeagus dissected, originally in glycerine vial Acc. #50274; now mounted on card point, along with genital capsule] [INHS].

General description. (Habitus, Fig. 70). Large (L. 27 mm, W. 12 mm), narrow and nearly parallel sided, not expanded apically. Color uniformly dark chocolate brown; surface shiny, glabrous except pronotum, not pruinose. The long, fine, reddish hairs of pronotum are the most distinctive dorsal external feature. Genitalia distinct, aedeagus asymmetrical (Fig. 210-218).

Head. Clypeus broadly emarginate, shiny, without setae, punctures irregularly spaced but coarse and dense, denser medially, some coalescing, at most separated by a diameter; lateral angles rounded, obtusely joined to frontal suture; anterior margin reflexed. Frontal suture impressed on sides, slightly elevated in center; frons densely punctate as clypeus, one-third longer than clypeus; row of punctures paralleling eye, extending to posterior posterior band, all punctures nonsetiferous. **Antenna** 9-segmented, club 3-segmented, slightly longer (1.2X) than funicle, 1.8X longer than clypeus medially.

Pronotum. Wider (1.9X) than long, widest at anterior third, sides parallel behind posterior angles, smoothly rounded, margined with long (some half length of pronotum), fine, erect, reddish hair, few additional hairs medially behind anterior margin, but disc of pronotum glabrous; lateral margin somewhat crenulate anteriorly, where marginal setae arise. Surface unevenly punctate similar to head, punctures separated at most by 2 diameters, somewhat less

dense medially. Sides nearly parallel in basal half, before broadly rounded posterior angles; convergent in front of middle to angulate anterior angles.

Scutellum. Surface shiny, without setae, punctate except for small central line, punctures small on outside, growing larger toward that line, more or less flat, not depressed or raised above elytra.

Elytra. Surface shining, more shallowly and less densely punctate than head and pronotum, punctures mostly separated by a diameter or more; lateral margin barely reflexed; sutural margin ending in a very tiny spine (not produced as in *hogardi*), overall shining, glabrous except very fine golden setae below lateral margin.

Pygidium. Large, wider than long; color as in elytra; coarsely punctate as pronotum, slightly wrinkled, exceptionally convex, shining, glabrous except marginal fringe.

Legs. Protibiae tridentate, middle tooth nearer proximal tooth than basal one; tibial spur reaching beyond base of first tarsal segment, cylindrical, not finely pointed; tarsal segments 2-4 subequal, 1 longer than 2, fifth longest, nearly equal to 2 preceding; apices of first 3 segments slightly produced, all 5 carinate on lower surface. Protarsal claw sturdy, middle tooth nearly central and sharply pointed, with a U-shaped notch formed with basal rectangular area. Mesotibia with incomplete transverse carina, its presence marked by 2 groups of elongate setae in clusters (holotype without portions of both mesotarsi). No longitudinal carina. Mesotibial apex with spurs nearly equal in length, inner slightly more flattened than outer, but both nearly parallel sided. Metatibia similar to mesotibia, apex broadly expanded; apical spurs unequal, both concave and drastically curved, spatulate-shaped. Long spur longer than first tarsal segment; metatibial apical fringe of 21 coarse setae. Metatarsal segments 2, 3, 4 progressively shorter, fifth 1.5X longer than 4; segments 2-4 each with fine carina on lower surface, opposite of which is a row of coarse setae. Metatarsal claws nearly identical to protarsi.

Abdomen. Ventral surface shiny, convex medially, with a depression on both penultimate and ultimate sternites, punctation very light, lighter medially. Fine, golden setae on sternites in rows, prostrate, less noticeable medially. A cluster of fine setae (finer than pygidial fringe) in front of depression on penultimate sternite. Ultimate sternite as long as penultimate.

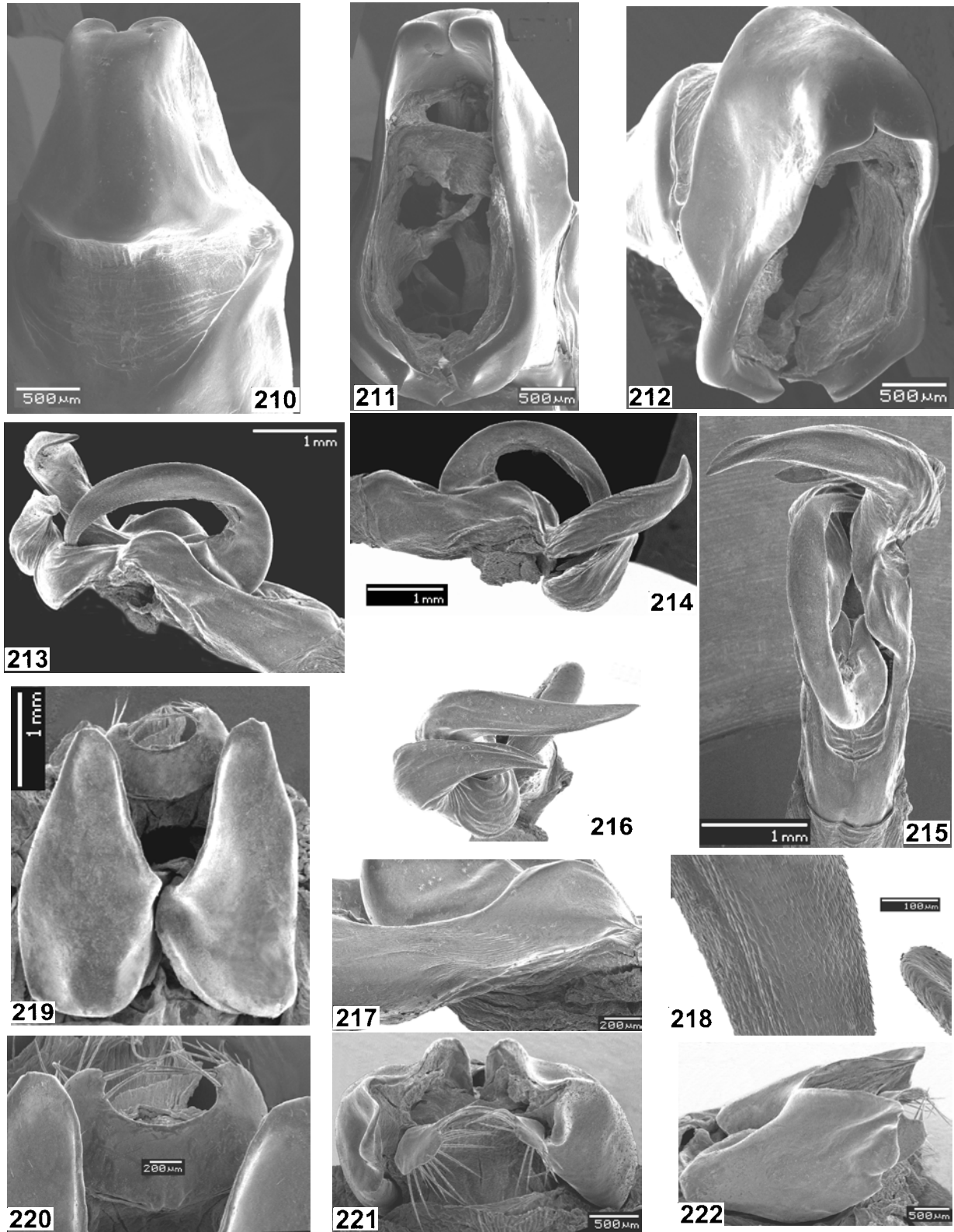


Fig. 210-222. *Phyllophaga bonfils* Woodruff and Sanderson. 210-216 Male genitalia (210-212 with aedeagus removed): 210) dorsal; 211) caudo/ventral; 212) caudo/lateral; 213-218 aedeagus: 213) right lateral; 214) left lateral; 215) dorsal; 216) left caudo/lateral; 217) right aedeagal paramere; 218) enlarged dorsal projection; 219-222 female genitalia: 219) ventral; 220) superior plates, ventral; 221) caudal; 222) lateral.

Genitalia, Male (Fig. 210-218). Phallobase large, with huge opening, wider at apex; dorsally, shallowly notched. Entire clasper structures projecting backward with sharp angle, terminating below in doubly lobed, appressed, but not fused, parameres. Basal piece strongly attached at articulation; dorsal membrane long (nearly as long as parameres dorsally), latter appearing to allow for great up and down flexibility between phallobase and basal piece. Aedeagus asymmetrical (Fig. 215-216), exceptionally sturdy and heavily sclerotized; with 2 large, pointed, elongate lobes (both twisted, but in different plane), above which arises a hinged, curved process (enlarged in Fig. 215), point lying to side of one lateral lobe.

Allotype female. Label data same as holotype, except "INHS Insect Collection 44293" [genitalia formerly in glycerin vial (Acc. #50277), now mounted on card point below specimen; missing left anterior tibia and tarsus]. Antennal club similar to male, but shorter; antennomeres 5 and 6 projecting forward, wider than long. Antennal club about equal in length to preceding 4 antennomeres, longer than clypeus medially. Color uniformly dark chocolate brown. Metatibial apex more broadly expanded, outer spur tightly appressed and forming an extension of carinate edge of tibial margin; both spurs extremely flattened, broad, concave; inner spur bent at nearly right angles and longer than first tarsal segment; outer spur subequal in length to first tarsal segment; metatibial apical fringe of 33 and 36 closely spaced setae. Tarsal segments 2, 3, and 4 subequal; claws as in male. Penultimate and ultimate sternites more convex. **Genitalia** (Fig. 219-222). In ventral view, inferior plates large, butterfly-like, attached loosely at about middle, tips diverging, but not sharply pointed and without setae; internal margin grooved in line paralleling central connection to near apex, plate convex laterally to groove. Base not sealed with triangular plate. Superior plate (Fig. 220) uniquely shaped, not fused to inferior plate, extending slightly beyond apex of inferior plates in a crescent collar, medially with smooth, deep curve, tips broadly terminating with spines (about 12) pointed inwardly toward each other.

Specimens examined. Only the holotype and allotype from Haiti are known.

Ecology. Nothing is known about the habits of this species. Both specimens were collected at night (mating?), but field notes on the host and altitude were not available. Other species collected at the same locality

and time included (numbers in parentheses): *recorta* Sanderson (46), *mali* Wolcott (81), *permagna* Moser (5), *panicula* Sanderson (5), *hogardi* (Blanchard) (1). From the topographic map, the locality appears to be above 1000 m and about 10 miles directly south of Port-au-Prince, and about 5 miles south of Kenscoff, in the Massif la Selle.

Etymology. The name was chosen by Sanderson to honor the late J. Bonfils, who hosted him in 1959, one of few Haitian entomologists, and who published several papers on the insects of the French Antilles.

Phyllophaga canoa Sanderson
(Fig. 71-72, 223-234)

Phyllophaga canoa Sanderson (1951: 279; Fig. 60).

This is another of the 3 that were described by Sanderson (1951) from unique females. It has taken over 50 years to find the associated male, described as the allotype below. The first male seen was so distinctive that it was being described as a new species (manuscript name *casabito*). However, the 4 specimens in the Carnegie Museum of Natural History from the same site, with both sexes, provided the first association. Not only is it a rare species, but it is one of the few in which there is great sexual dimorphism.

Allotype male (here designated). DOMINICAN REPUBLIC: Prov. La Vega-Monseñor Nouel, Loma Casabito summit, 19-13N, 70-31W, 1390 m, 19-23-XI-1992, J. Rawlins, H. Klinger, R. Davidson, S. Thompson, cloud forest, Specimen Number CMNH 305,026 [CMNH].

General description (Habitus, male Fig. 72, female Fig. 71). Large (L. 20, W. 9 mm). General shape as in female holotype, narrowed in front and widest near elytral declivity. Distinctly different from female by its pruinose coating, uneven surface producing a patch-like or mottled iridescence on elytra similar to *mella*. **Head.** Clypeus produced or swollen above frontal suture, but much smoother, less densely punctate than female; clypeus noticeably emarginate. Eye canthus carinate, well-developed with 8 long setae. Frons pruinose as pronotum, basal band impunctate. **Antenna** with antennomeres 3 and 4 elongate, subparallel, weakly constricted between, 5 longer than wide but slightly produced anteriorly, 6 reduced and wider than long. Club length subequal to previous 5 antennomeres, lighter colored, with noticeable receptors, including small yellow spots arranged

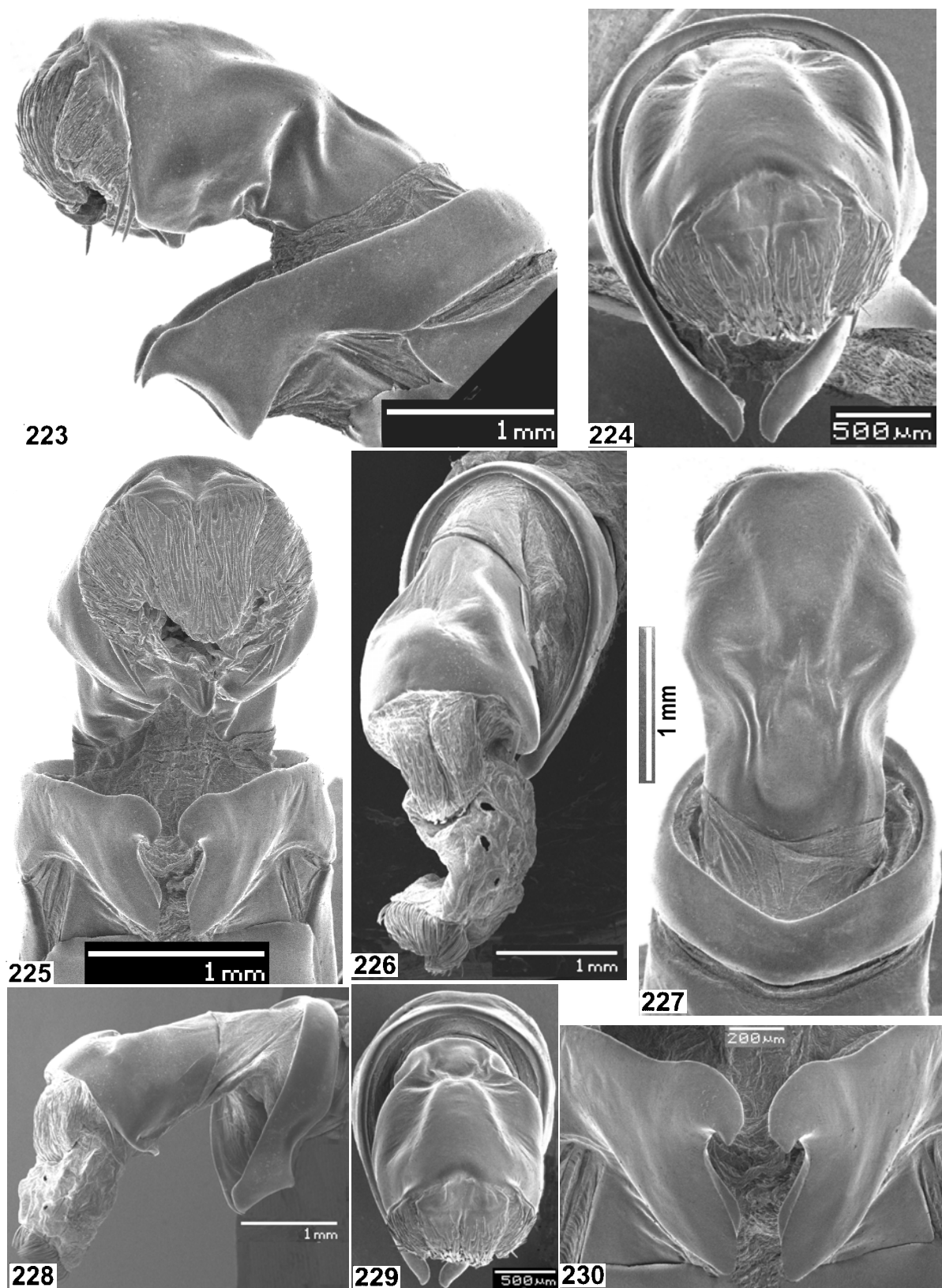


Fig. 223-230. *Phyllophaga canoa* Sanderson. Male genitalia: 223) lateral; 224) caudal; 225) ventral; 226) caudo/lateral; 227) dorsal; 228) lateral (aedeagus extended); 229) dorso/caudal; 230) paramere tips, ventral.

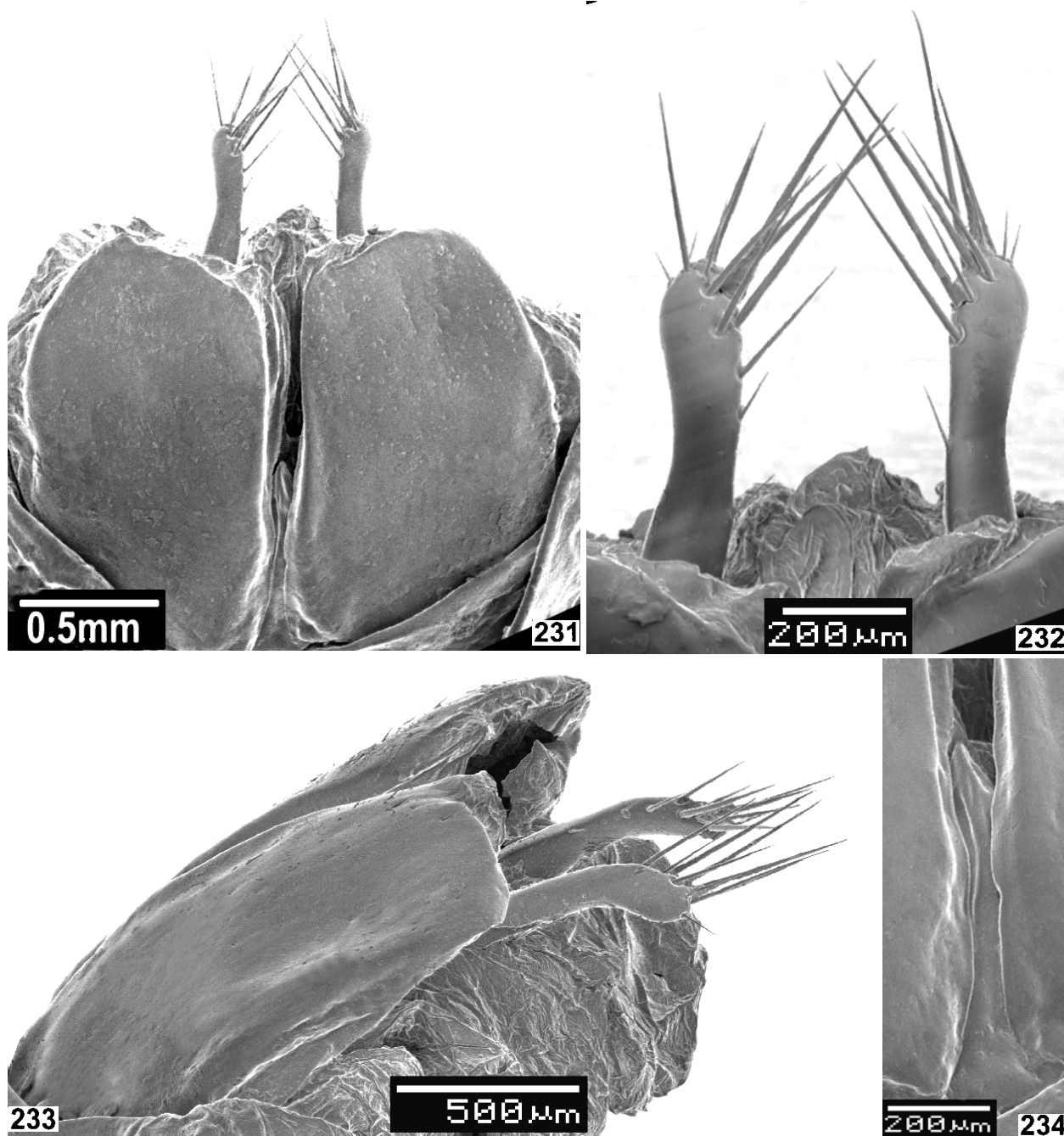


Fig. 231-234. *Phyllophaga canoa* Sanderson. Female genitalia: 231) ventral; 232) enlarged superior plates (pubic process?), ventral; 233) lateral; 234) junction of inferior plates (note narrow plate between).

in irregular longitudinal rows. **Pronotal** posterior angles slightly more pronounced. Surface entirely pruinose, glabrous. **Scutellum** lightly punctate at sides. **Elytra** regularly punctate near humeral angles, but punctures coalescing into wrinkles on posterior 80%, wrinkles causing light refraction in distinctive pattern. Humeral angles shiny, without pruinosity. **Pygidium** pruinose, glabrous, except for termi-

nal fringe. Venter of abdomen entirely pruinose; evenly punctate, except penultimate sternite more densely punctate with slight longitudinal depression medially and more coarsely punctate. Penultimate sternite laterally with large patch of darker pruinosity accompanied by long golden setae. Ultimate sternite with very shallow transverse groove, apically margined with a few golden setae, shorter than

pygidial fringe. **Genitalia:** Male parameres (in lateral view, Fig. 223) similar to many species, aedeagus (Fig. 225-229) distinctive, heavily sclerotized tube, with 2 spinose areas, one terminating in a “mop-like” tip. **Legs:** Male apical metatibial fringe of 16 spines (female 18); apical spurs long, narrow, and little modified, inner 30% longer than first tarsal segment; outer shorter than first tarsal segment (more flattened and spatulate in female). First protarsal segment much narrower at tip than in female. All tarsal claws nearly cleft, angle between fairly acute, but deeply divided, middle tooth curved as terminal; basal notch quite pronounced.

Comparison. The female is shiny and glabrous, whereas the male is matte and distinctly pruinose. The genitalia of both sexes are unique (Fig. 223-234). The female is the only known Hispaniolan species which has the superior plate elongated into a process that may be homologous to the pubic process of others; the junction of the inferior plated is joined by an extremely elongate (half their length) triangular plate. Although the male parameres are similar to many species, the aedeagus (Fig. 225-229) is distinctive for its heavily sclerotized tube, with 2 spinose areas, one of which constitutes the “mop-like” tip.

The deeply emarginate clypeus, making it appear somewhat bilobed, shows similarity to *hogardi*. Although the female is glabrous and shiny like *hogardi*, it lacks the terminal spine at the elytral suture, and the genitalia are of different types. The male, in its pruinosity and genital type, appears related to *mella*, but that species has no “mop-like” terminus, and the lateral border of the aedeagus has a saw-like ventral edge (Fig. 487). The size is larger in *canoas* (20 vs. 13.5-15 mm).

Specimens examined. Total 9 (6 females, 3 males; all DOMINICAN REPUBLIC): The holotype female: [Prov. La Vega] vicinity Valle Nuevo, cloud forest 6000 ft, August 1938, Darlington [MCZC]. (3 females) same data as allotype. (1 male) Prov. La Vega, Cordillera Central, Loma Casabito, 15.8 km NW Bonaio, 19.02.12N, 70.31.08W, 28-V-2003, J. Rawlins, C. Young, R. Davidson, C. Nuñez, P. Acevedo, evergreen cloud forest, east slope, 1455 m, UV light, Sample 21212, CMNH 310.300 [FSCA]. (1 female) Prov. Duarte [?], Casabito, 24-XII-1970, E.J. Marcano #9384 [FSCA]. (1 female) Prov. La Vega, Yaquecillo, VIII-1958, E.J. Marcano #152 [FSCA]. (1 male, 1 female) [Distrito Nacional] Santo Domingo, 14-VII-1974, 30 m, J. and S. Klapperich [NHMB, FSCA].

Ecology. Most Hispaniola species which have been collected at higher altitudes (above 3000 ft) are rarely found at lower elevations. Because most specimens of *canoas* were collected in the Cordillera Central near Casabito (from 4-6000 ft), the Santo Domingo records at 30 m remain questionable. The habitat appears to be cloud forest. Dates include November and December, suggesting the species is more active in a cooler climate.

Etymology. Sanderson (1951) did not give a source for this name, although “canoas” means canoe in Spanish. There is a town by that name in the Province of Barahona (near Vicente Noble), but no specimens have been collected there, and it is low elevation.

Phyllophaga carnegie Woodruff, **new species**
(Fig. 73, 235-240)

Holotype male. DOMINICAN REPUBLIC: Prov. Elias Piña, Sierra de Neiba, 9.3 km WSW Hondo Valle, 18-41-31N, 71-47-03W, 1901m, 25-VI-2003, J. Rawlins, C. Young, R. Davidson, C. Nuñez, P. Acevedo, M. de la Cruz, montane forest with Podocarpus, UV light, Sample 31112, CMNH 309, 985 [CMNH].

General description. (Habitus, Fig. 73). Medium sized (L. 13, W. 6 mm). Dorsally glabrous, head and pronotum shiny, elytra dull, slightly pruinose. Nearly bicolored, elytra with dark brown longitudinal median area, bordered by lighter, straw-colored stripes; lateral margin with a dark border. Superficially similar to *davidsoni*. Genitalia distinctive (Fig. 235-240), parameres simple, aedeagus heavily sclerotized, with a large up-turned spine dorsally, intromittent portion with 5 large conical spines.

Head. Clypeus emarginate in gentle curve, anterior angles rounded, sides nearly parallel, barely constricted at frontal suture; surface irregularly punctate, punctures shallow, ill-defined, separated by about 1 diameter. Anterior clypeal margin noticeably reflexed; frontal suture deeply impressed, mimicking shape of clypeal margin in outline. Frons densely, coarsely punctate, more so than clypeus. Eye canthus relatively short with 4 long setae. Posterior band impunctate. **Antenna** 9-segmented, club 3-segmented, club longer than preceding 5 antennomeres, 3 and 4 elongate, nearly parallel, 5 with a small projection but longer than wide, 6 wider than long; antennal club with noticeable receptors.

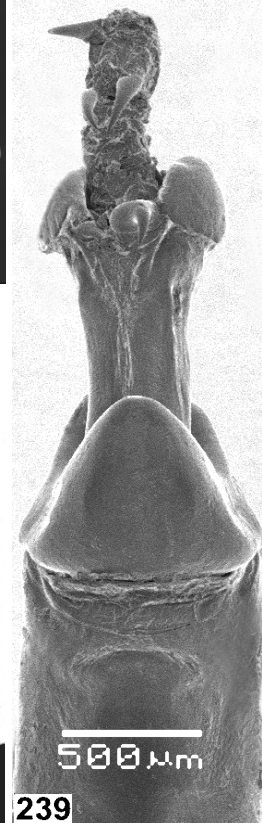
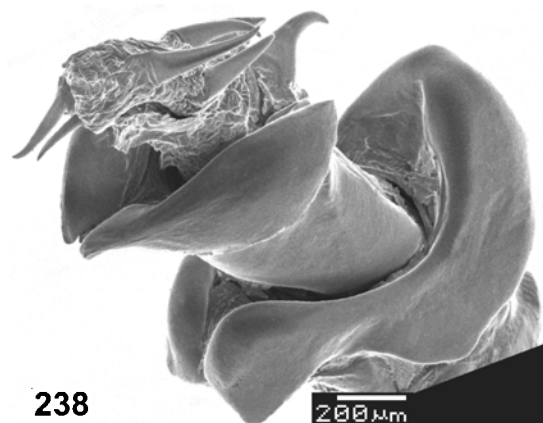
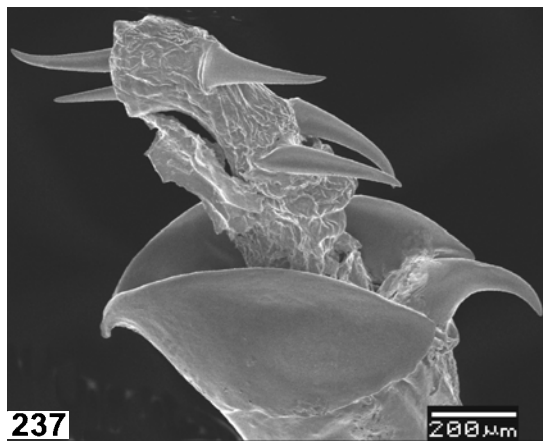
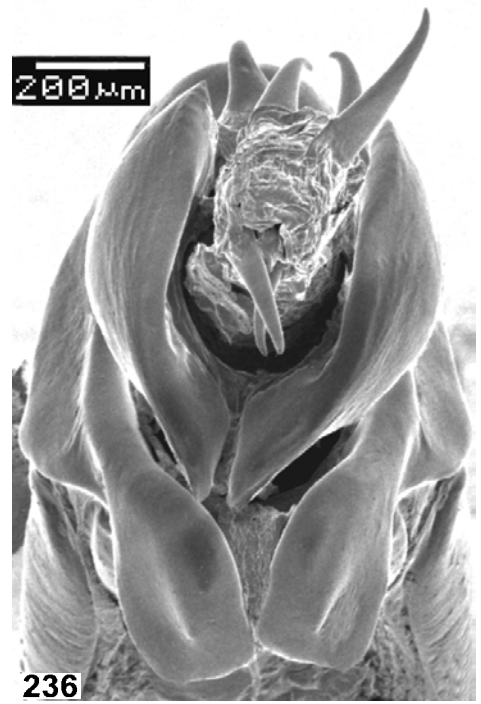
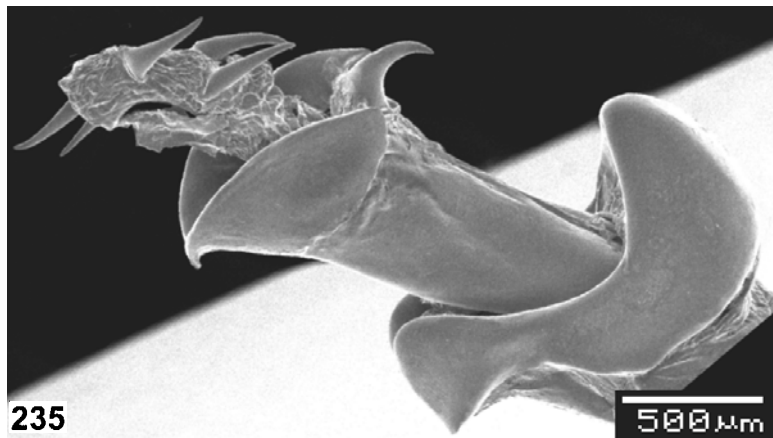


Fig. 235-240. *Phyllophaga carnegie* Woodruff. Male genitalia: 235) lateral; 236) caudal; 237) aedeagal tip; 238) caudo/dorsal; 239) dorsal; 240) ventral.

Pronotum. Wider than long, shiny; lateral margin nearly parallel from lateral to posterior angles; frontal angles obtuse, posterior angles nearly 90 degrees; lateral margin with long setae, but not crenulate. Punctuation irregular, fairly coarse, most punctures on disc 2 or more diameters apart, denser in anterior angles; color dark (darker than elytra) brown with lighter lateral angles.

Scutellum. Nearly flat, slightly wider than long, glabrous, punctures mostly on lateral areas, center impunctate.

Elytra. Surface completely glabrous, nearly bicolored with longitudinal dark band paralleling suture, lighter on sides until lateral margin which is dark as on pronotum, surface barely iridescent. Surface punctate, punctures shallow, some in rows, barely indicating vague costae. Sutural margin barely carinate until apical declivity. Elytra terminating abruptly, nearly truncate, suture not ending in an obvious spine; lateral elytral margin slightly reflexed, more so below humeral angles.

Pygidium. Glabrous, dark colored as in dark area of elytra, contrasting to yellowish abdomen, punctures finer than elytra and irregular, most separated by more than 1 diameter, a few coalescing into shallow wrinkles; apical fringe with normal long setae.

Legs. Protibia tridentate, basal tooth well developed, middle tooth closer to proximal than basal tooth; spur acuminate, sharp pointed, reaching beyond base of first tarsal segment; tarsal segments subequal, fifth slightly longer; claws not cleft, middle tooth pointing somewhat forward, nearly as long as sharp apical tooth. Mesotibia with longitudinal carina, transverse carina indicated by 2 large teeth and setae on external margin; terminal spurs acuminate, sharp pointed, less than half length of first tarsal segment, mesotarsi similar to protarsi, including claws. Metatibia with longitudinal carina, transverse carina indicated weakly by external teeth and spines; inner spur longer than first tarsal segment, outer subequal to first tarsal segment; apical fringe of 12 spines; metatarsal segments 2, 3, and 4 progressively shorter, 2 and 5 subequal; outer edge somewhat wrinkled and alutaceous; tarsal claws as on other legs.

Abdomen. Metasternum hairy and shallowly punctate. Penultimate sternite with a dark pruinose patch on sides anteriorly, remainder of abdominal venter

straw colored, and fairly uniformly, shallowly punctate, surface nearly glabrous.

Genitalia. (Fig.). Phallobase of simple type, paramere labia rounded on dorsal angle, projecting abruptly backwards, acute, but not sharply pointed at posterior angle; caudal face broad, each paramere with median tumosity. Phallobase dorsum produced as a hood (Fig. 235) over aedeagus. Aedeagus of 2 parts: 1) long, heavily sclerotized, ending in flanged opening, divided ventrally, dorsum with enlarged, backward projecting, hook-like spine; 2) internal protrusible portion fleshy, with 5 large, conical spines, similar in size to dorsal hook.

Female. Unknown.

Specimens examined. Total: 4 males (all DOMINICAN REPUBLIC), including holotype and 3 paratypes: (1) same data as holotype [CMNH]. (1) same except 9.0 km WSW Hondo Valle, 18-41-34N, 71-46-52W, 1843 m, disturbed montane woodland w/pine, Malaise trap, Sample 31382, CMNH 310,560 [FSCA]. (1) Prov. San Juan, Sierra de Neiba, 9.4 km SSW El Cercado, 18-39-18N, 71-32-51W, 1973m., 22-VI-2003, J. Rawlins, C. Young, R. Davidson, C. Nuñez, P. Acevedo, M. de la Cruz, meadow near mature pine, hand collected. Sample 32242, CMNH 307,897 [CMNH].

Ecology. Apparently another species restricted to the Sierra de Neiba at high altitudes (1843 to 1973 meters). Only 2 specimens were collected at UV light, the others may have been in daytime. One was captured in a Malaise trap and the other hand collected. The noticeable receptors on the antennal club, and the lack of females, suggests that males of this species may be primarily diurnal. Such activity (as is known in *garrota*, *probaporra*, and *costura*) would be advantageous because of the lower night time temperatures and stronger winds at such elevations. All were taken within a week, near the end of June. Because pine or *Podocarpus* are mentioned on all specimens, it suggests that adults may be conifer feeding species.

Comparisons. In color, size, and habitus, adults are externally most similar to *davisoni* (known only from 2 specimens from the Bahoruco [Baoruco] Mountains). However, that species has scattered setae on the elytra and is somewhat lighter in color. The genitalia are of the same basic form, but distinctive (compare Fig. 235-240 vs. 255-260). The large conical setae on the aedeagus of *carnegie* and the "pollinia-

shape” of the phallobase cap of *davidsoni* will easily distinguish them.

Etymology. It is with great pleasure that I name this species after Andrew Carnegie, as well as the Carnegie Museum of Natural History. This and 6 other new species were discovered in material collected during the faunal surveys being conducted in Hispaniola by the staff of this institution. Their specimens were instrumental in documenting distributions of known species, as well as permitting description of these new ones. Many of their collecting localities are remote, interesting, cloud forest sites, which are difficult to access and require considerable personal sacrifices to do so.

Phyllophaga cartaba Sanderson
(Fig. 74, 241-247)

Phyllophaga cartaba Sanderson (1951: 274-275; Fig. 46, 47, 70).

This small species (L. 8-10 mm) was described from a series of 7 specimens, merely labelled “S. Dom.” Early specimens often carried that label for any place in Hispaniola, not just the Dominican Republic or Santo Domingo. I have seen the following 13 specimens (all DOMINICAN REPUBLIC): (3) paratypes, S. Dom. [INHS]. (6) Prov. Santiago, St. Thomas de Jánico (Jánico), 8-V-1959, [M.W.] Sanderson, [T.H.] Farr, RD59-13 (1) [INHS, FSCA]. (4) [Prov. Samana], Samana, 2-V-1973, J. and S. Klapperich [NHMB, FSCA].

This species is one of the smaller pruinose ones, along with *latiungula* (429-432), *panicula* (569-575), and *imprima* (368-378) [genitalia Fig. in parentheses]. It is most similar in both external and genitalic characters to *latiungula*, known only from Haiti (“South Island” species?). The above records seem inconsistent, the peninsula of Samana being mostly low elevation (although having a central ridge), and an area of endemism for other animals (especially land snails). The other locality, Jánico, is on the other side of the Cordillera Septentrional, near the Rio Bao, more than 80 miles to the northwest, and at much higher altitude. Additional specimens will be required to determine if the 2 populations are conspecific.

Phyllophaga costura Sanderson
(Fig. 75, 248-254)

Phyllophaga costura Sanderson (1951: 264; Fig. 20-21)

This medium sized species (L. 14-16 mm) was described from 2 males from “Dominican Republic, Loma Rucilla and mountains north, 5000-8000 ft, June, 1938, P.J. Darlington”. I have seen only 1 additional male from: DOMINICAN REPUBLIC, Prov. San Juan, Piquito del Yaqui, 26-III-1964, E.J. Marcano #410 [FSCA]. The road map shows “La Rucillo” or “Pico del Yaque” at 3045 m, in the route from La Cienega to Pico Duarte (highest Hispaniola peak at 3175 m). The Darlington and Marcano specimens were probably collected en route to the peak, so exact locations would be difficult to record without modern equipment. It may be a very localized species, especially if the females are flightless.

Adults are unique in having the frontal suture raised instead of impressed (Fig. 253-254, arrow). It is related to *probaporra* and *garrota*, in having the 6th antennomere enlarged and forming a partial lamella. All 3 have noticeable receptors on the antennal lamellae, and all 3 are known from males only. In *garrota* the club has 4 complete lamellae (Fig. 328, 330, unique in Hispaniola), and it has been collected flying in the daytime. I suggest that the unusual antennal receptors are an adaptation for locating the female, which may be flightless and subterranean. Diurnal activity would also be an advantage to species occurring at such high altitudes, where nights are cold and winds are strong. The March collection would seem an early date for such high altitudes, but perhaps reflecting its relictual nature.

The genitalia of the 3 are similar (compare Fig. 248-250, 323-326, 603-606). In *costura* the parameres (caudal view) are expanded laterally, the labia nearly triangular-shaped, also extended inwardly as a recessed, narrow, finger-like projection, not meeting medially. In *probaporra* the outer labia of the parameres (caudal view) are pointed downward, as are the internal teat-like projections, with a wider gap between.

Phyllophaga davidsoni Woodruff, **new species**
(Fig. 76, 255-260)

Holotype male. DOMINICAN REPUBLIC: Prov. Pedernales, La Abeja [Las Abejas], 38 km N. Cabo Rojo, 18-90N, 71-38W, 1250 m, 15-VII-1987, J. Rawlins, R. Davidson, CMNH 308,594 [CMNH].

General description. (Habitus, Fig. 76). Medium sized (L. 13, W. 6.5 mm). Somewhat bicolored (resembling *carnegie*), elytra longitudinally with dark central area and lighter lateral third, margin darker on posterior half. Head and pronotum shining, but elytra

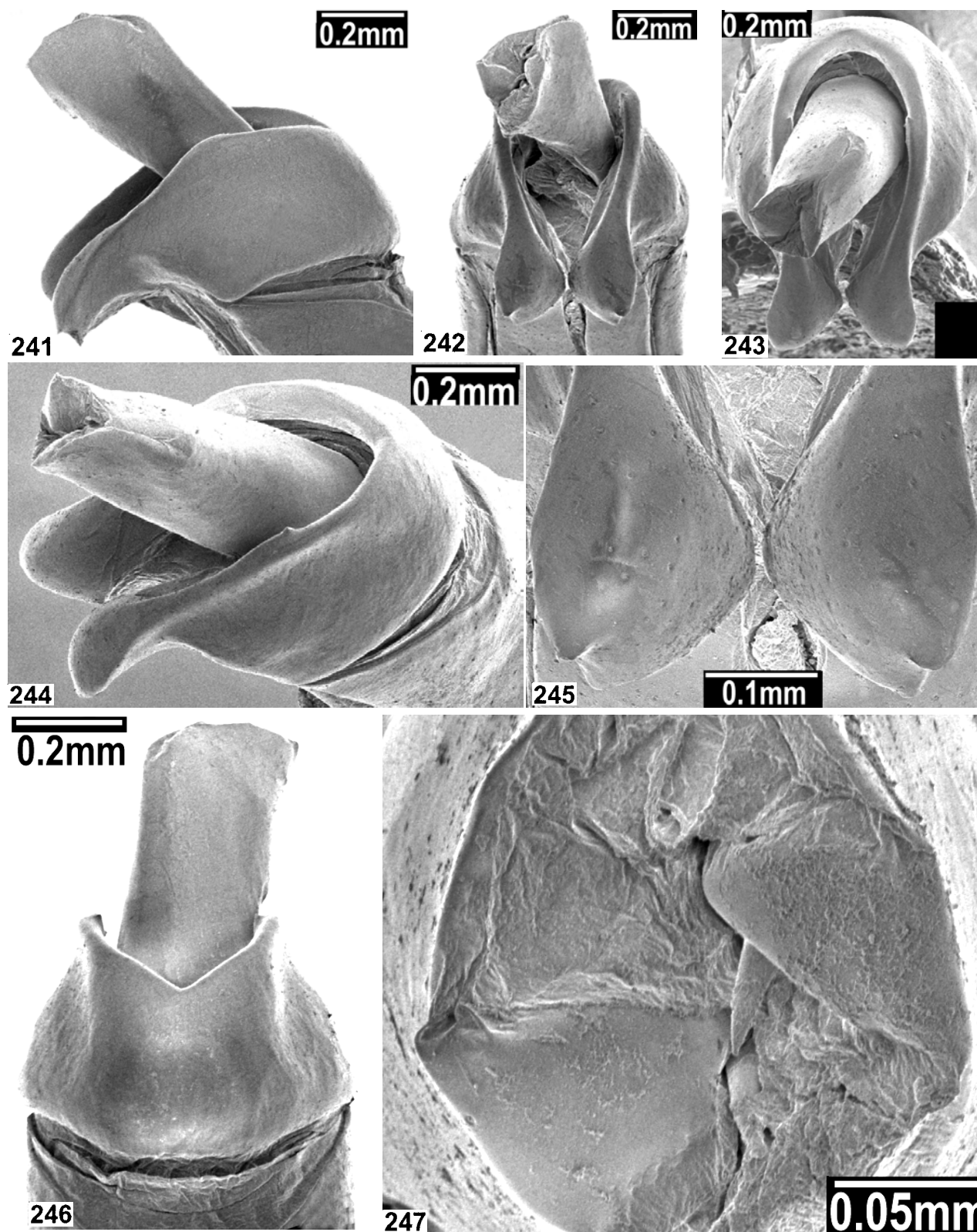


Fig. 241-247. *Phyllophaga cartaba* Sanderson. Male genitalia: 241) lateral; 242) caudo/ventral; 243) caudal; 244) caudo/lateral; 245) paramere tips enlarged, caudal; 246) dorsal; 247) aedeagal tip, caudal.

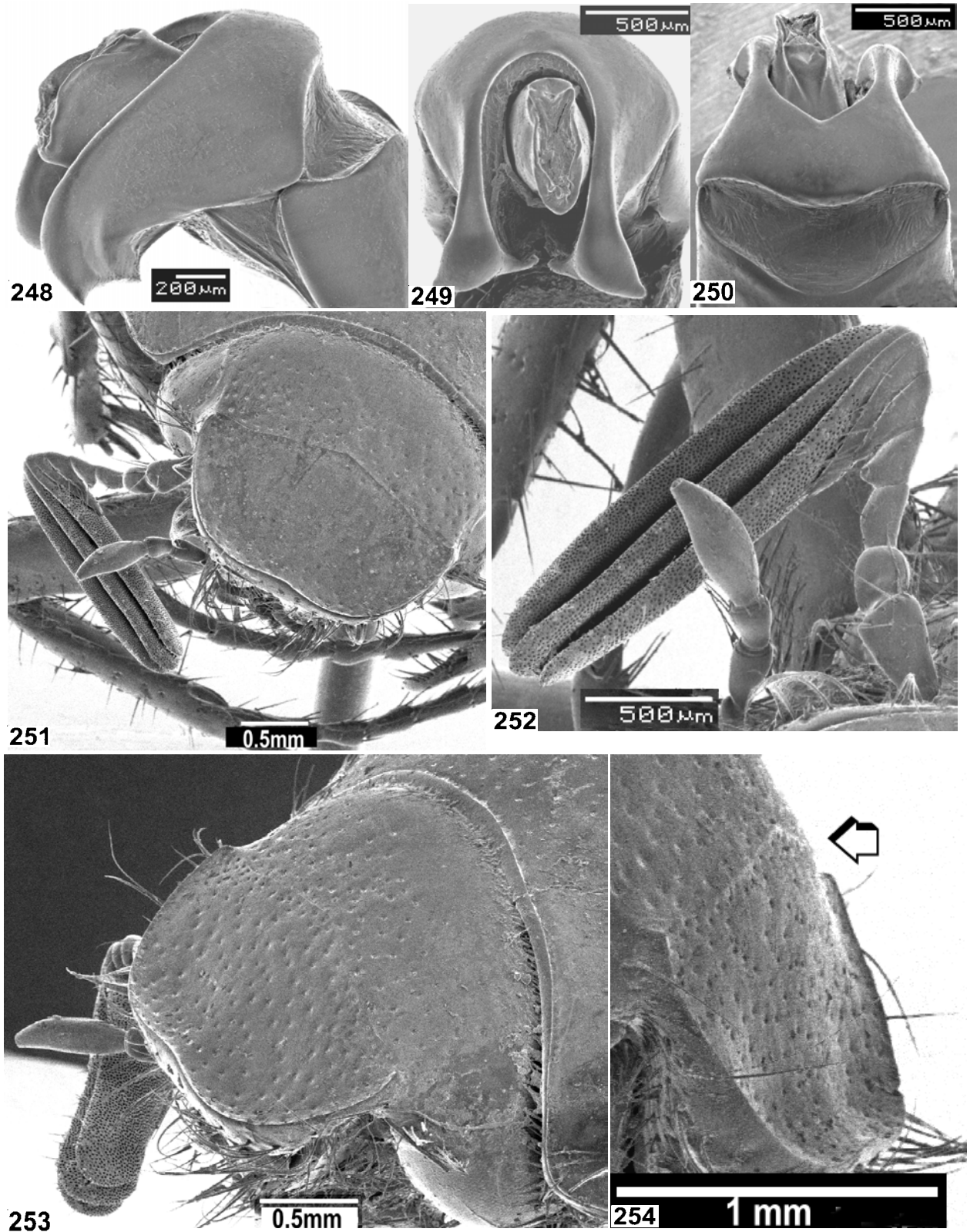


Fig. 248-254. *Phyllophaga costura* Sanderson. 248-250 Male genitalia: 248) lateral; 249) caudal; 250) dorsal; 251-254 head: 251) dorsal; 252) antenna (note antennomere 6 enlarged); 253) dorso/lateral; 254) lateral (note raised clypeal suture, arrow).

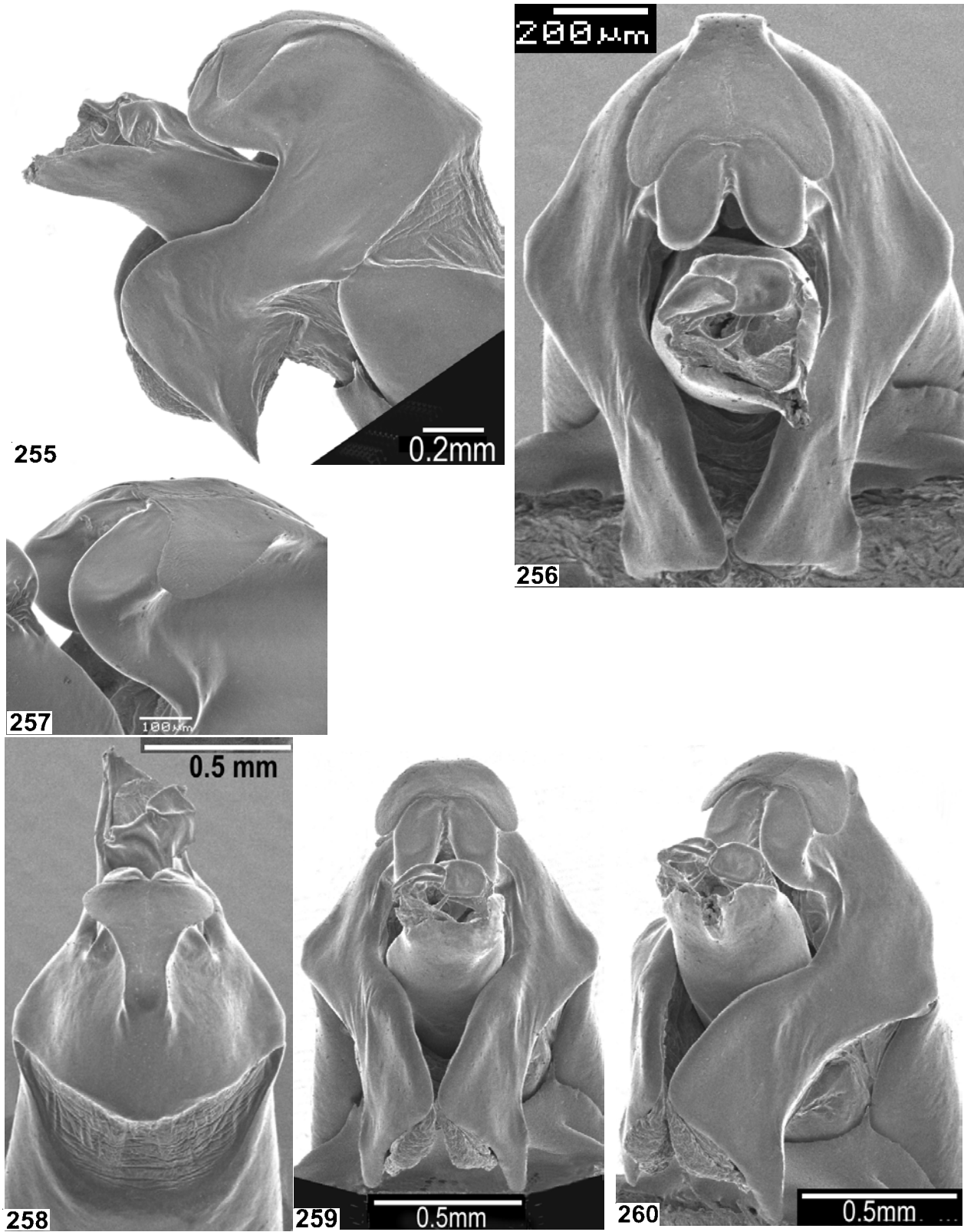


Fig. 255-260. *Phyllophaga davidsoni* Woodruff. Male Genitalia: 255) lateral; 256) caudal; 257) dorsal apex of phallobase; 258) dorsal; 259) caudo/ventral; 260) caudo/lateral.

dull, lightly pruinose, with fine scattered microsetae. Genitalia distinctive, phallobase cap in caudal view (Fig. 256), resembling pollinia of an orchid, aedeagus without large, pointed spines.

Head. Clypeus emarginate, anterior angles rounded, joining frontal suture at nearly right angles, margin highly reflexed, punctation irregular but mostly coalescing, especially in center; frontal suture deeply impressed, slightly emarginate medially, relatively straight across. Frons punctate densely and slightly depressed in medial longitudinal band, punctures coarse and separated by about 1 diameter in most of remainder; posterior band impunctate. Eye canthus carinate with 4-5 long setae. **Antennae** 9-segmented, club 3-segmented, subequal in length to previous 5 antennomeres, 3 and 4 elongate, parallel-sided, 5 slightly produced forward, about as long as wide, 6 reduced, wider than long, club yellowish; receptors noticeable but not large, lamellae nearly equal in length.

Pronotum. Color dark brown, slightly lighter at lateral angles, posterior angles obtuse; lateral angles nearly medial, evenly rounded; anterior angles not produced. Punctation less dense than frons, punctures irregular, denser and coalescing in lateral third, disc with a slight medial depression anteriorly, punctures more elongated; lateral margin with normal long setae, not extending to posterior margin which is indicated by row of punctures with short setae, but not carinate.

Scutellum. Slightly wider than long, barely convex, punctate only on sides, punctures similar to those of elytra but about 1 diameter apart.

Elytra. Surface noticeably pruinose, iridescent, with fine short setae scattered; color darker in central third along sutural margin, likewise on posterior two-thirds of lateral margin. Suture barely carinate except in declivity, not terminating in obvious spine. Punctation fairly regular, denser below humeral angles, otherwise nearly in rows, with costae barely raised, sutural one more so; punctation also denser below scutellum and sutural margin. Elytra terminating truncately; lateral margin with scattered setae, similar to those on pronotum.

Pygidium. Color dark, as in pronotum, relatively flat, punctate coarsely and forming wrinkles in central two-thirds, glabrous except terminal fringe.

Legs. Protibia tridentate, basal tooth well-developed, middle tooth somewhat closer to proximal than basal, anterior spur acuminate, barely reaching base of protarsal segment; dorsal face of protibia noticeably setate and punctate. Protarsal segments 1 through 4 subequal, fifth 1.5X longer than 4th; tarsal claws elongate, terminal tooth sharply pointed, middle tooth directed at right angle and located near middle. Mesotibia with a longitudinal carina, transverse carina not developed, but location indicated by teeth and spines on external margin; terminal spurs acuminate, inner spur two-thirds length of first tarsal segment, outer about half this length; tarsal segments 2, 3, and 4 progressively shorter, fifth 1.5X longer than 4th; claws as in protarsi. Metatibia with distinct longitudinal carina, transverse carina not developed, but location indicated by large teeth and spines on external margin; terminal spurs similar to mesotibial spurs, inner spur barely curved, longer than first tarsal segment, inner face convex, flattened; outer spur subequal in length to first tarsal segment; apical fringe of 12 spines. Metatarsal segments 2, 3, and 4, progressively shorter, fifth slightly shorter than second.

Abdomen. Venter mostly straw colored, sternites uniformly punctate, nearly glabrous except for an elongate pruinose patch at anterior and lateral margin of penultimate sternite, this patch with appressed setae, penultimate and ultimate sternites effeminate, not distinctly modified.

Genitalia, male (Fig. 255-260). Laterally parameres are of a simple type, but phallobase cap distinctly modified unlike any other known species. A hood-like projection extends over aedeagus, with 2 ovate structures below (resembling orchid pollinia in caudal view, Fig. 256). Aedeagus heavily sclerotized, asymmetrically terminating into lateral plates and fingers, but no large spines.

Female. Unknown; known from only 2 male specimens.

Specimens examined. Total 2 (all DOMINICAN REPUBLIC): In addition to the holotype, (1 paratype) Prov. Pedernales, 26 km N. Cabo Rojo, 18-06N, 71-38W, 730 m, 26-27-IX-1991, R. Davidson, C. Young, S. Thompson, J. Rawlins, wet deciduous forest, CMNH 306,658 [CMNH].

Ecology. The type locality (actually Las Abejas, not La Abeja as labeled) is known for many rare and

unusual species, and it was once a pristine cloud forest. Unfortunately it was destroyed by fire several years after the type specimen was collected. It has not been accessible by road for many years, and my attempts to collect there have failed. The single paratype was collected in "wet deciduous forest" on the same road (km 26) above the Alcoa headquarters at 730 m elevation. My collections at km 24 and km 30 have not yielded specimens. The Carnegie expeditions collected many times in this area, but found only a single specimen. There is no label indication that specimens were collected at light. Its rarity, coupled with the receptors on the antennal club, suggest that it is another of the higher altitude diurnal species. It appears to be a "South Island" sister species to *carnegie* of the Sierra de Neiba to the north.

Comparisons. Externally similar to *carnegie*, but genitalia distinct, the differences discussed under that species (compare Fig. 255-260 vs. 235-240).

Etymology. This species is named for Dr. Robert Davidson, who was one of the collectors for many of the Carnegie Museum specimens, and who graciously arranged the loan of that material. It is especially fitting that it is a close relative to *P. carnegie*, named above for his host institution.

Phyllophaga eladio Woodruff, **new species**
(Fig. 77-78, 261-269)

Holotype male. DOMINICAN REPUBLIC: Prov. La Vega, 5 km W. Manabao, Finca Eladio Fernandez, Paso de la Perra, along Rio Yaque del Norte, 15-V-2001, 3050 ft elev., R.E. Woodruff, blacklight trap [FSCA].

General Description. (Habitus, Fig. 78). Exceptionally large (L. 29, W. 15 mm). Dorsally glabrous, elytra pruinose, pronotum densely punctate, but shining, scutellum impunctate; color reddish brown, venter yellow, contrasting to darker dorsum. Body heavy, abdomen large and convex.

Head. Surface glabrous, shiny. Clypeus emarginate, anterior angles rounded, abruptly angled posteriorly to frontal suture (creating a lobed appearance); margin reflexed, more so at anterior angles; densely, coarsely punctate, punctures smaller medially, rarely separated by a diameter; clypeus shorter than frons. Frontal suture deeply impressed, not emarginate, smoothly, gently curved to eye junction. Frons punctate as clypeus, some punctures forming longitu-

dinal wrinkles; posterior band with scattered punctures, posterior area of head with band of smaller punctures, denser at sides near eye. Eye canthus prominent, with 7 reddish setae. **Antenna** 9-segmented, club 3-segmented, orange; antennomeres 3 and 4 elongate, subequal, 5 wider than long, projecting anteriorly, 6 reduced, wider than long; club ovate, outside lamella shorter than inside, receptors not obvious; antenna exceptionally small for such a huge species.

Pronotum. Widest at posterior angles. Surface glabrous, shiny, coarsely punctate, usually more than a diameter apart medially, but coalescing and denser on sides and anterior angles; vestige of a median impunctate longitudinal line. Anterior margin raised, posteriorly with a depressed groove; pronotum narrow in front, broadest behind; lateral margin raised, posterior margin with a row of chevron-shaped punctures except medially; lateral pronotal angles smoothly rounded, slightly anterior of median, anterior angles acutely produced, posterior angle sharply quadrate; lateral margin with short setae, slightly crenulate at setal origin, more so behind median.

Scutellum. Wider than long; surface shiny, glabrous, impunctate, with a slight median longitudinal impression, barely convex.

Elytra. Widest in posterior fourth; uniformly pruinose, except humeral tumosity, surface shallowly, fairly uniformly punctate, with costae slightly raised, including sutural ones; some punctures with tiny microsetae, especially near lateral margin; lateral margin slightly reflexed along entire length. Suture barely impressed for most of length, more carinate in posterior fourth and terminating in a sharp spine; elytral apices nearly truncate, with a slight curve from apical spine.

Pygidium. Surface uniformly punctate, each puncture with a fine straight golden seta, finely alutaceous, but appearing somewhat shiny, color yellowish as remainder of abdomen.

Legs. Protibia tridentate, teeth sharp, basal tooth well-developed, terminal spur acuminate, sharply pointed, extending well beyond base of first tarsal segment; protarsal segments 1-4 subequal, fifth 1.5X longer; interior of each segment terminating in a short spine-like projection; protarsal claws (Fig. 267) C-shaped, teeth very sharp pointed, middle tooth located medially, tip curved slightly posteriorly, reach-

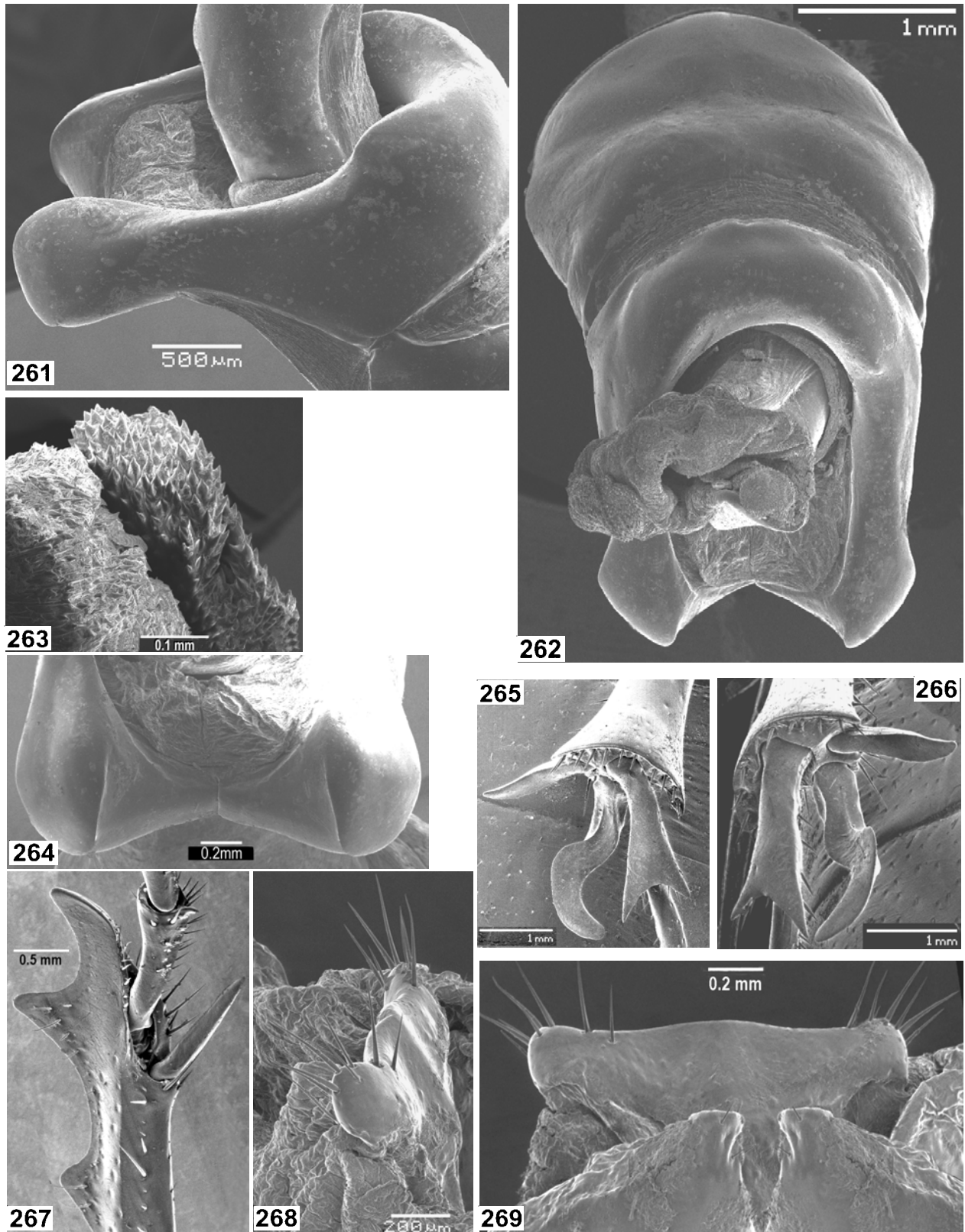


Fig. 261-269. *Phyllophaga eladio* Woodruff. 261-264 Male genitalia: 261) lateral; 262) dorso/caudal; 263) aedeagal tip spines; 264) paramere tips (caudo/ventral); 265-266: Male metatibial apex: 265) right; 266) left; 267) protibia, right, ventral; 268-269: Female genitalia: 268) lateral; 269) ventral.

ing beyond tip of terminal tooth, forming a large U-shaped notch with base. Mesotibia without complete longitudinal carina (vestiges present), transverse carina indicated by teeth in diagonal pattern, but not complete; terminal spurs elongate, narrow, acuminate; inner spur two-thirds length of first tarsal segment; outer spur less than half its length. First mesotarsal segment enlarged, terminal spines obvious, internally and externally; segments 2-4 gradually shorter, fifth 1.5X longer than 4; claws as in protarsi. Metatibia similar to mesotibia, inner terminus of incomplete transverse carina marked by an exceptionally large tooth with 3 setae; tibial apex expanded, outer angles sharp, spine-like; apical fringe with 12 spines; inner spur drastically curved, S-like (Fig. 265-266), longer than first tarsal segment; outer spur narrow, slightly curved, convex, regular. First metatarsal segment sharply spined inside and out, terminus expanded, segments 3 - 5 subequal, fifth slightly longer; tarsal claws as on other legs.

Abdomen. Venter light straw-colored, robust, convex, shiny, setae arising from shallow punctures; second sternite with setae appressed, other sternites with scattered setae; penultimate sternite depressed medially with scattered setae and a group of microtubercles, otherwise little modified.

Genitalia, male (Fig. 261-264). Of simple type near *hogardi*, the parameres appearing fused medially at inner apex. Labia with strong carina or ridge medially. Phallobase dorsally rounded, not notched. Aedeagus a sclerotized tube, ending in spongy, spinose tip (Fig. 263).

Allotype female. DOMINICAN REPUBLIC: same data as holotype, except 23-IV-2000, R.E. Woodruff, T.J. Henry [FSCA]. Similar to male except bulkier (L. 30, W. 15 mm), elytra slightly inflated posteriorly; pronotum broader, more densely punctate, median impunctate line more noticeable. Metatibial apical fringe with 17 spines (12 in male, widely spaced), terminal spurs broad, spatulate-shaped, inner face flat to concave, inner curved, outer nearly straight. Elytral margin nearly as male (not smooth as in *marcano* females), but pruinosity less developed and elytra smoother at apical tumosity.

Genitalia, female (Fig. 268-269). Inferior plates not fused, easily displaced, apex with slight inward direction, with a few fine setae. Superior plate (Fig. 268) large, fused medially, the outline ventrally slightly wavy, barely longer medially, mildly projecting at

lateral tips, with 7 large stiff spines; *marcano* has these tips projecting forward, with the line between recessed, nearly straight (Fig. 478).

Specimens examined. Total 18, including holotype and allotype (all DOMINICAN REPUBLIC): 16 paratypes as follows: (1) same data as holotype; (3) same as allotype; (2) same as holotype, except 19-23-IV-2000, R.E. Woodruff, T.J. Henry; (9) Prov. La Vega, La Cienega de Manabao [Parque Nacional Armando Bermudez], 20-21-IV-2000, 3000 ft, R.E. Woodruff, T.J. Henry [FSCA, MHND, CMNH, INHS, USNM]; (1) Prov. Monseñor Nouel, Rio Blanco Vivero Forestal [Nature Conservancy and Fundación Moscoso Puello], 11-13-V-2001, 613 m, 18-52-40N, 70-30W, R.E. Woodruff, C. and F. Nuñez, blacklight trap [FSCA].

Comparisons. This huge species is similar in external habitus and genitalia to *marcano*. They may be immediately separated by the impunctate scutellum of *eladio*, coarsely punctate in *marcano* (Fig. 474). The male metatibial inner spur in *eladio* is drastically twisted into an S-shape (Fig. 265-266), whereas it is more C-shaped in *marcano* (Fig. 475). Male genitalia are similar, but in *eladio* the ventral, internal gap of labia (caudal view) are a smooth inverted crescent curve (Fig. 264), whereas it is a more inverted V-shape (Fig. 464) in *marcano*. Female genitalia are compared above.

Ecology. All specimens were collected at blacklight at relatively high altitudes (613 m to 3050 ft), in April and May. Many appeared freshly emerged, indicating that the species may be more common later in the season. No information is available on adult host plants. The type locality is in a disturbed setting along the Rio Yaque del Norte, which was flooded during a recent hurricane (Andrew). The area is under consideration for a major hydroelectric plant. The locality at the headquarters of the Parque Nacional Armando Bermudez is also along the Rio Yaque del Norte, several kilometers upstream from the type locality. It is also somewhat modified by activities of the park; especially the guides and mule trains going to Pico Duarte, a popular tourist activity. Perhaps the host trees are associated with large river floodplains.

Etymology. It is my pleasure to name this species for bird photographer and naturalist, Eladio Fernandez, the owner of the finca at the type locality, and who graciously provided accommodations for us on several occasions. Although we have never met, his continued

support for our studies is greatly appreciated. We are also grateful for assistance provided by his staff, Felipe and Ramona, and to Francisco Nuñez who assisted with this contact and for many other favors. Latinizing the name would sound peculiar in Spanish, so it is treated as a noun in apposition.

Phyllophaga espina Sanderson
(Fig. 79, 270-274)

Phyllophaga espina Sanderson (1951: 264-5; Fig. 22-3)

Little can be added to the original description, based on 2 specimens from DOMINICAN REPUBLIC: [Prov. Santiago or La Vega?] "foothills Cordillera Central south of Santiago, June 1938, [P.J.] Darlington" [MCZC]. I have examined the holotype and single paratype (from which the genitalia figures here were made). The female remains unknown, and no additional specimens have been seen.

It is medium sized (L. 15-16, W. 7.5 mm) and resembles *mella* (Fig. 94) superficially, but the long elytral hairs and spinose first metatarsal segment, and genitalia will easily distinguish it. The unique male genitalia (Fig. 270-274), with 2 elongate, flexible projections at the aedeagal tip and the gill-like structures at their base, are unique features, obscuring relationships to any other known Hispaniolan *Phyllophaga*.

Phyllophaga esquinda Sanderson
(Fig. 80, 275-287)

Phyllophaga esquinda Sanderson (1951: 268; Fig. 28,29).

This medium sized species (L. 9.5, W. 4.5 mm) was described from a unique male from HAITI: La Visite and vicinity, La Selle Range, 5000-7000 ft, 16-23-IX-1934, [P.J.] Darlington [MCZC].

Female allotype (here designated). HAITI: Department Sud-Oueste, Parc Nat'l La Visite, Morne de Fe Noire, 17-V-1984, M.C. Thomas [FSCA].

Generally similar to male, except pronotum more convex, shiny, glabrous. Antennal club very small, oval, unlike enlarged lamellae of male (Fig. 283). Metatibial apical spurs exceptionally widened, spatulate-shaped and rounded (Fig. 281); terminal fringe of 14 spines. Pygidium more elongate than male. Genitalia distinct (Fig. 284-286) [lost during SEM preparation,

after illustrations were made]. The only female specimen seen.

Specimens examined. Total 7 (all from HAITI). In addition to the holotype and allotype, I have seen 5 additional males from the same locality (topotypes), except Morne La Visite, 12-V-1984, M.C. Thomas, 2100M. These specimens were collected during studies conducted by the Florida Museum of Natural History under contract with USAID (for additional details see: Sergile, et al., 1992; Woods and Ottenwalder, 1992; Woods, et al., 1992).

Comparisons. The large eyes, deeply concave clypeus, with highly reflexed margin (Fig. 80); exceptionally long antennal club (Fig. 283) equal to all previous 6 antennomeres combined, with obvious receptors on lamellae; short, round, curved inner metatibial spurs in both sexes (Fig. 281-282); wrinkled dorsal elytral surface (Fig. 80), all serve to identify this species. The genitalia are simple, but distinct (Fig. 275-279, 284-286).

Phyllophaga fossoria Sanderson
(Fig. 81, 288-310)

Phyllophaga fossoria Sanderson (1951: 258-259; Fig. 5,6).

Sanderson saw only 3 male specimens (all DOMINICAN REPUBLIC, collected by P.J. Darlington): holotype from "Constanza to Valle Nuevo, 3000-7000 ft, August, 1938 [MCZC, examined]. The paratypes were from Loma Rucillo and mountains north, 5000-8000 ft, June 1938, and vicinity of Valle Nuevo, 6000 ft, cloud forest, August, 1938. [L. 12.5-14, W. 5.5-6 mm].

Allotype female (here designated). (Genitalia Fig. 299-304). DOMINICAN REPUBLIC: Prov. La Vega/ Monseñor Nouel, 6 mi NW (9.2 km) of Rt. 1, on Rd. to Constanza, El Chorro [19°01'59.2"N, 070°29'40.5"W], 27-VI-1998, R.E. Woodruff, R.M. Baranowski, black-light trap, 1034m elev. [FSCA].

Similar to male, except broader behind and bulkier. Antennal club much shorter, subequal to 4 preceding antennomeres. Clypeal margin less reflexed. Posterior tibial spurs wider, more curved. First metatarsal segment reduced. Metatibial apical fringe of 24 spines (10-18 in males). Elytra wider in posterior third, not subparallel as in male. Protibia with lower spur poorly developed. Tarsal claws all distinctly cleft (Fig. 35). Female genitalia with superior plates joined

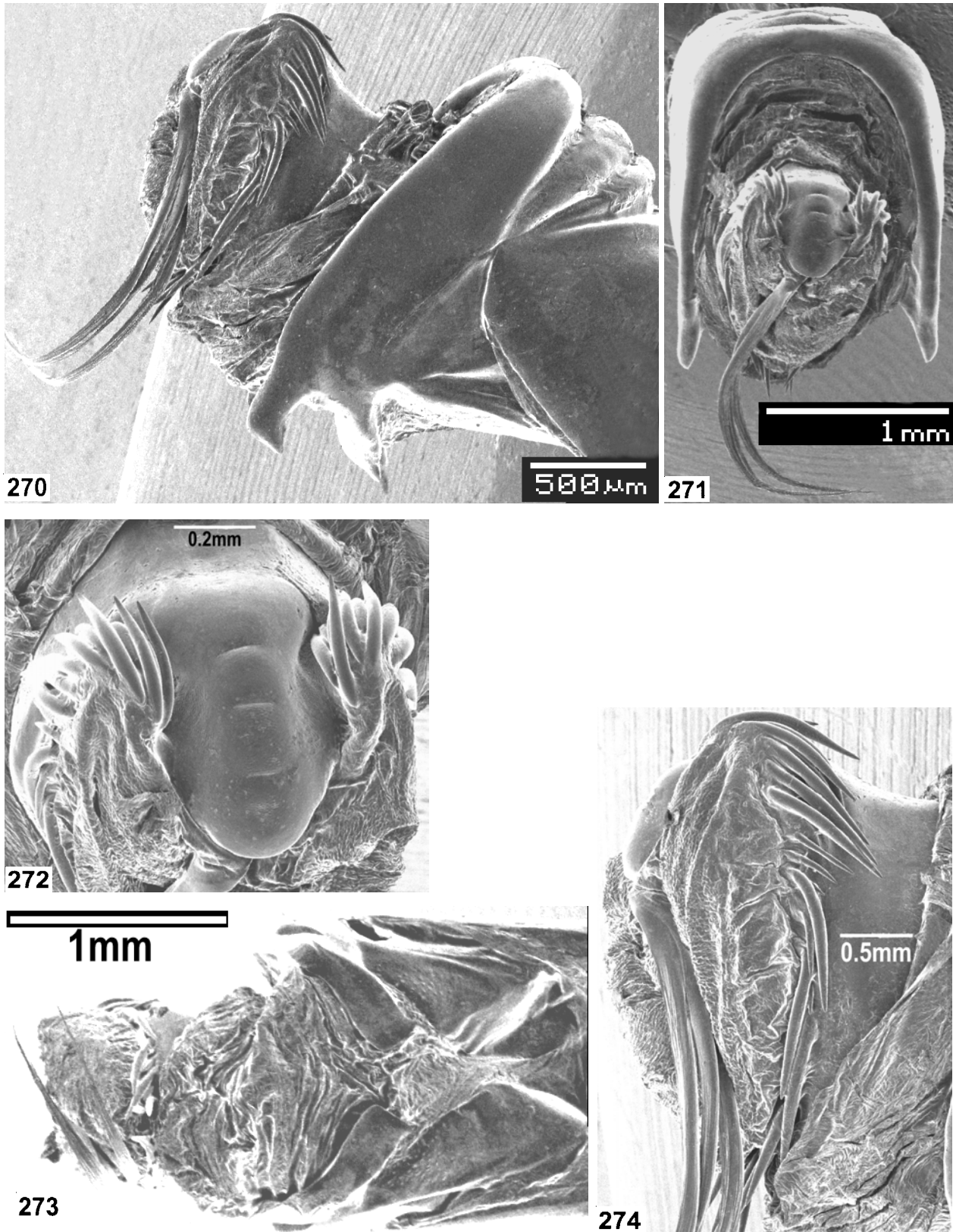


Fig. 270-274. *Phyllophaga espina* Sanderson. Male genitalia: 270) lateral; 271) caudal; 272) aedeagal tip at base of terminal spines, caudal; 273) ventral; 274) aedeagal tip, lateral.

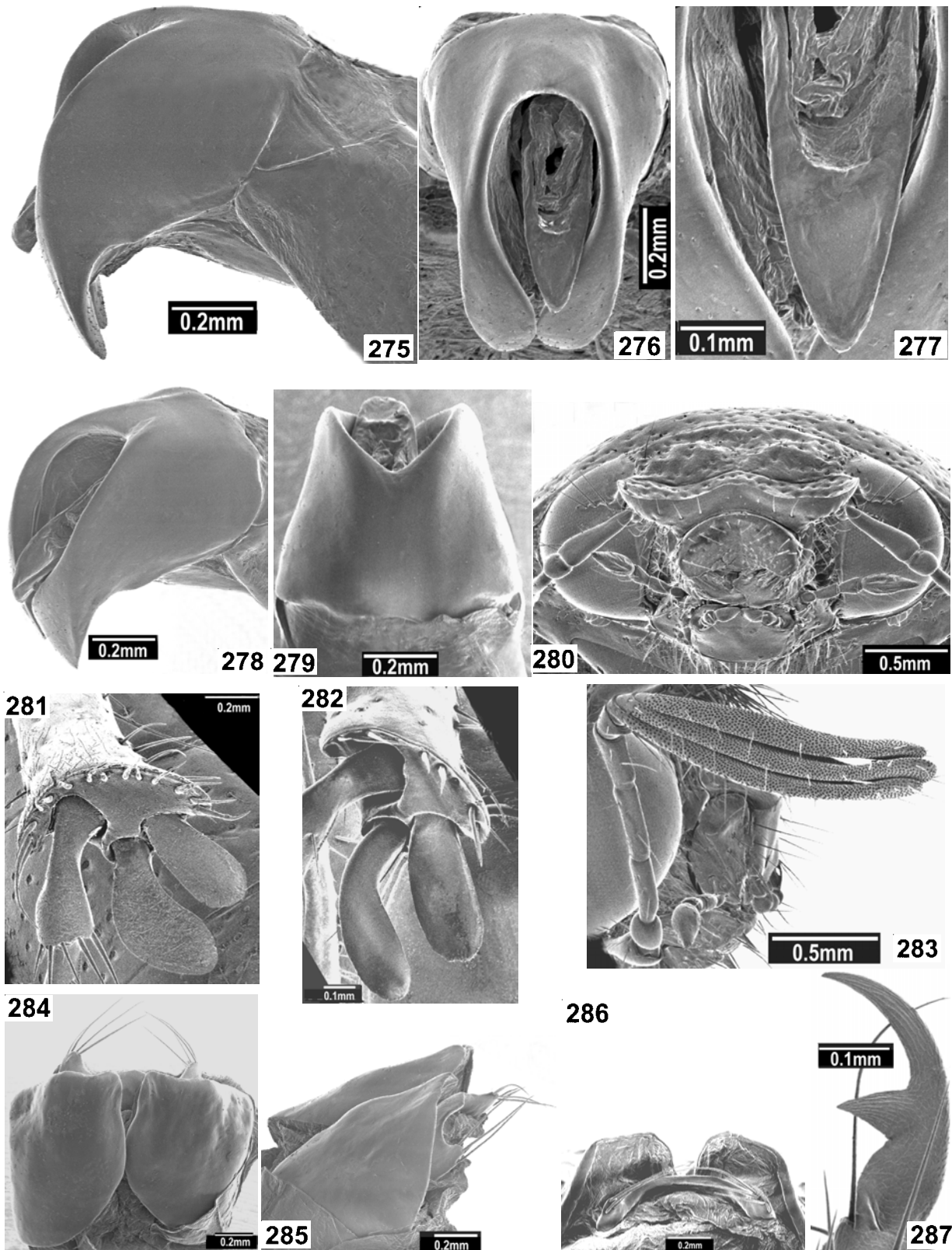


Fig. 275-287. *Phyllophaga esquinada* Sanderson. 275-279 Male genitalia: 275) lateral; 276) caudal; 277) aedeagal tip; 278) caudo/dorsal; 279) dorsal; 280) head, frontal, male; 281-282 metatibial spurs: 281) female; 282) male; 283) antenna, male; 284-286: female genitalia: 284) ventral; 285) lateral; 286) caudo/dorsal; 287) protarsal claw, male.

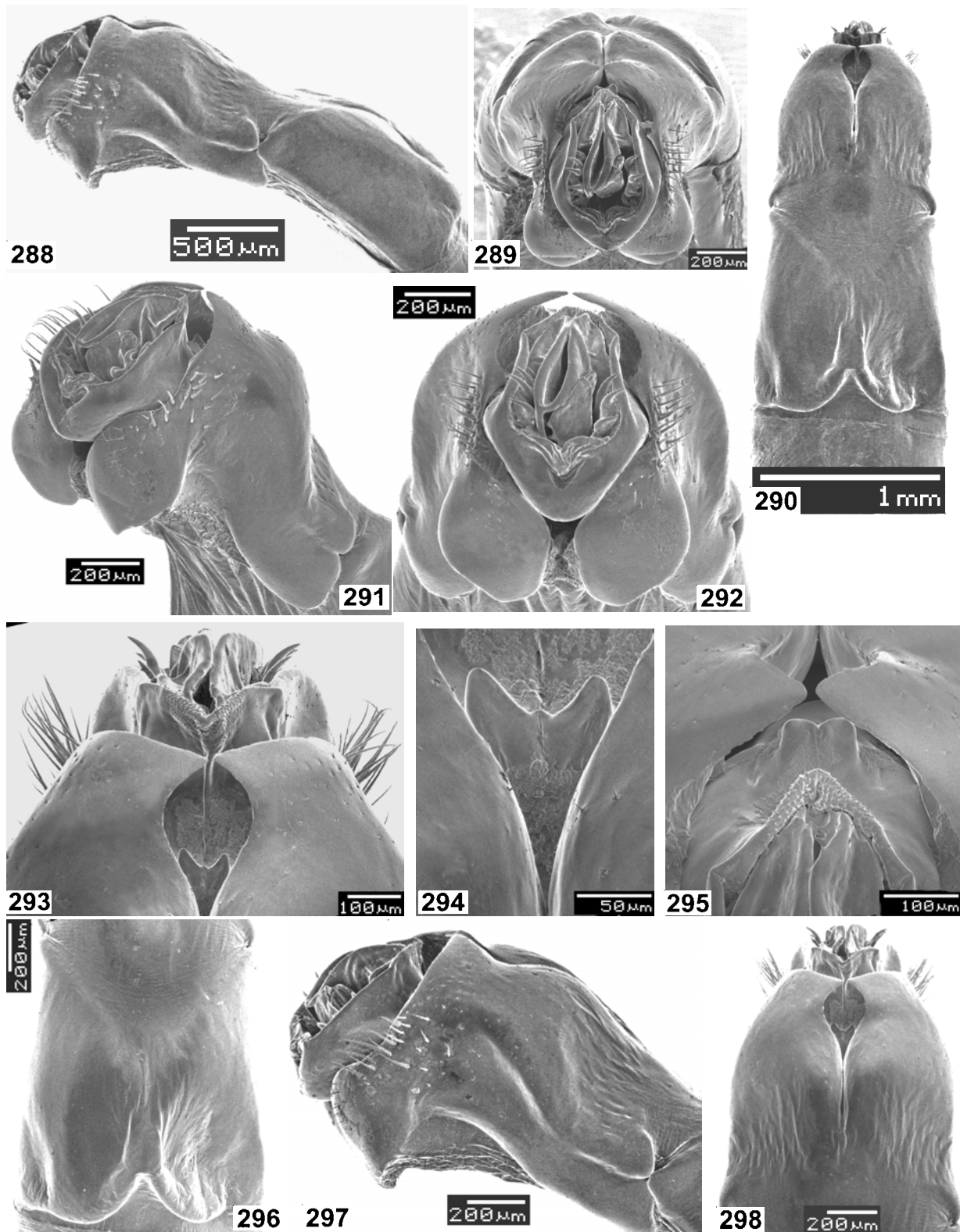


Fig. 288-298. *Phyllophaga fossoria* Sanderson. Male genitalia: 288) lateral; 289) caudal; 290) dorsal [291) caudo/lateral; 292) caudo/ventral; 293) phallobase and aedeagal tip (dorsal); 294) plate at base of phallobase division (dorsal); 295) aedeagal tip; 296) protuberances on tectum, dorsal; 297) phallobase, lateral; 298) phallobase, dorsal. Note setae projecting forward on sides of parameres.

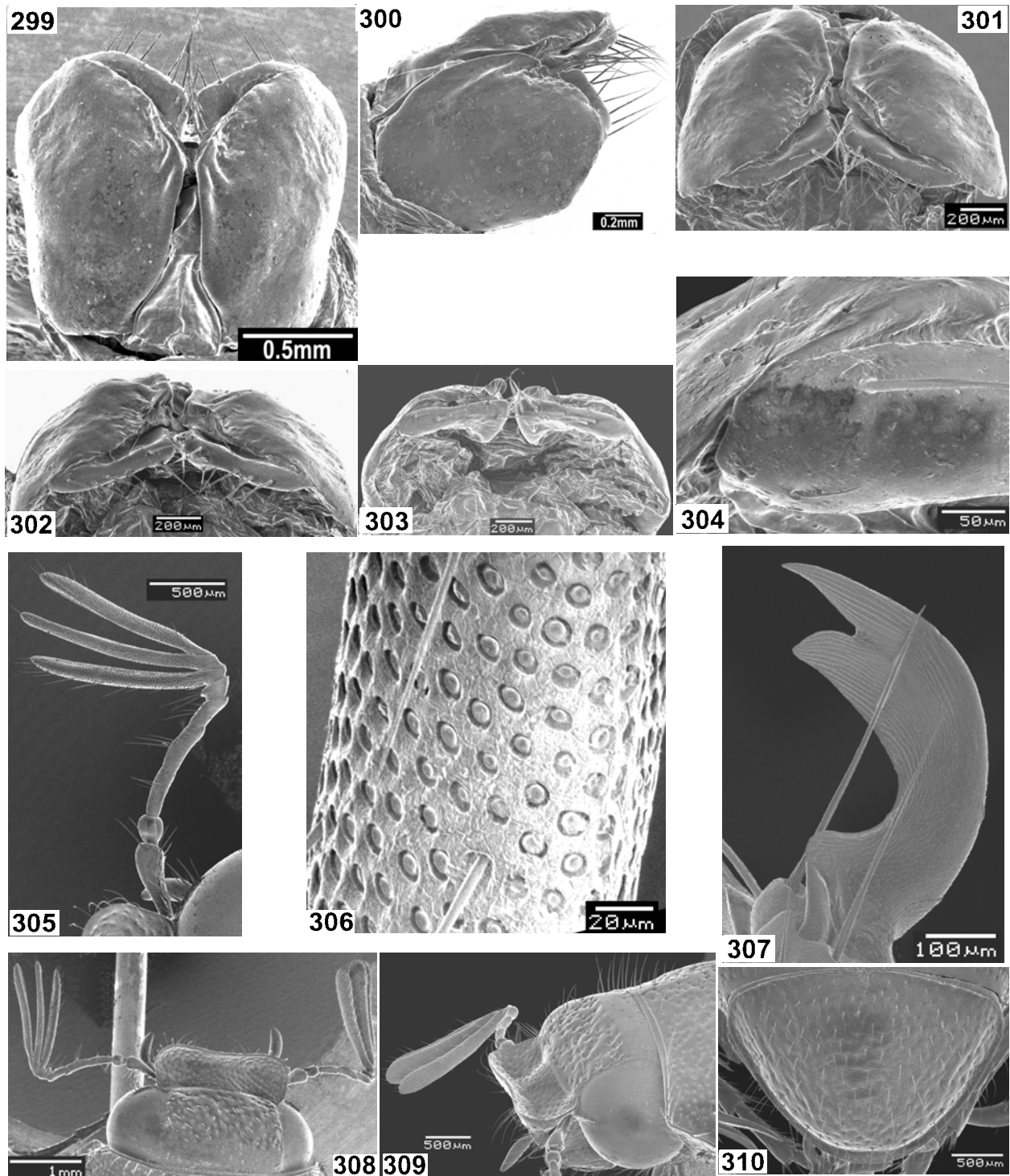


Fig. 299-310. *Phyllophaga fossoria* Sanderson. 299-304 Female genitalia: 299) ventral; 300) lateral; 301) caudo/ventral; 302) caudal; 303) ventral; 304) enlarged junction of superior plate and inferior plates [Note triangular plate dividing inferior plates, and attachment of superior plates]; 305-310 Male: 305) antenna; 306) sensory receptors on lamella; 307) tarsal claw; 308) head and clypeus, dorsal; 309) head and clypeus diagonal/lateral; 310) pygidium.

or fused laterally to inferior plates (Fig. 299-304); similar only to *androw* Woodruff.

Comparisons. Extremely similar to its “sister species”, *androw*, but that species is exceptionally hairy (Fig. 161, 163), has a complete transverse carina on both meso- and metatibiae, whereas *fossoria* has few hairs on pronotum and transverse carina incomplete. Male genitalia are extremely similar, with forward projecting setae on outside of the parameres (see discussion under *androw*; compare Fig. 149-157, 288-298). They occupy separate mountain ranges, *fossoria* in the Cordillera Central and *androw* in the Sierra de Neiba. Sanderson compared it with *aliada* (female only known then) because both had cleft tarsal claws. Several other species have now been discovered with such claws (see key). The dorsal surface of *aliada* is pruinose and matte, whereas *fossoria* is shiny. The genitalia of all the species with cleft tarsal claws are distinct from others in the genus. It is also related to and near the new species following (to be described elsewhere, see text and genitalia Fig. 311-322).

Specimens examined. Total 90. In addition to the holotype and allotype above, I have seen the following (all DOMINICAN REPUBLIC): **Prov. La Vega:** (3) Cazabita [Casabita], Cordill. Centr., 20-VI-1974, 1250m, J. and S. Klapperich [NHMB]; (1) same, except 15-VIII-1972; (39) Loma Casabito, 15.8km NW Bonao, 19-02-12N, 70-31-08W, 28-V-2003, 1455 m, Rawlins, Young, Davidson, Nuñez, Acevedo, evergreen cloud forest, UV light [CMNH]; (19) same, except 15.4km NW Bonao, 19-02-00N, 70-30-58W, 1385 m [CMNH]; (1) same, except 19-03N, 70-13W, 3-IX-2002, 1390m, W.A. Zanol, C. Young, C. Staresinic, J. Rawlins, wet cloud forest [CMNH]; (1) Valle Nuevo, 16-VIII-1972, 2400 m, J. and S. Klapperich [NHMB]. **Prov. Monseñor Nouel:** (6) 1 km E. Paso Alto de Casabito, 7 km NW La Ceiba, 28-VI-1992, 1130m, Davidson, Rawlins, Thompson, Young, cloud forest [CMNH]; (5) 8 km NW La Ceiba, 19-02N, 70-29W, 28-VI-1992, 1280 m, Davidson, Rawlins, Thompson, Young, cloud forest [CMNH]; (1) 9.2 km W. Rt. 1 on Rd. to Constanza, El Chorro [19-01-59.3N, 70-29-40.5W, 1034 m], 28-VI-1999, R.E. Woodruff, R.M. Baranowski, blacklight trap [FSCA].

There are 2 specimens labeled Santo Domingo, 14-VII-1974, J. and S. Klapperich, 30m [NHMB]; because this appears to be a high altitude species (above 1000 m), these records are likely labeling errors.

n.sp., near *fossoria* Sanderson
(Fig. 104, 311-322)

I had given this species a manuscript name, and included in the first draft of this manuscript. However, a request was made by a Dominican graduate student at Montana State University to reserve it for description in her Master's thesis. I have agreed to defer it for that purpose. It is included without name here, solely for recognition purposes, and so that it can be distinguished from others in the *fossoria* group. It is medium sized (L. 10-13 mm), has cleft claws (Fig. 318), quadrate clypeus (Fig. 319) deeply emarginate, exceptionally long antennal club (Fig. 320-32), with noticeable receptors (Fig. 322), and mesotibial transverse carina complete (Fig. 317). It has the external lateral hairs of the parameres exceptionally numerous and long (Fig. 311-313), and the unusual “bumps” on the dorsum of the tectum (Fig. 314-315), also present on *fossoria*.

Specimens examined. Total 9. DOMINICAN REPUBLIC: Prov. La Vega, La Cienega de Manabao, Pk. Hdq. [Parque Nacional Armando Bermudez], (8) on 3-5-VII-1999, (1) on 11-V-2001, R.E. Woodruff, blacklight trap, 3000 ft [FSCA].

Phyllophaga garrota Sanderson
(Fig. 82, 323-332)

Phyllophaga garrota Sanderson (1951: 262-263; Fig. 16-17)

This unusual species was described from the single male holotype: DOMINICAN REPUBLIC: “Loma Rucilla and mountains north, 5000-8000 ft, June, 1938, [P.J.] Darlington” [MCZC, examined]. It is the only known Hispaniolan species with 4 complete lamellae in the antennal club (Fig. 330). The female remains unknown. Along with *costura* and *probaporra* it forms a group, all of which have an enlarged sixth lamella (Fig. 7-9), obvious receptors on the large antennae (Fig. 331), and the clypeus more quadrate, nearly flat with frontal suture raised (Fig. 253-254) or barely impressed (Fig. 329). All occur at high altitudes, are known only from males, and at least *garrota* is sometimes diurnal. Because no females have been seen (even in the large series of males from La Nevera), coupled with the enlarged male antennae, with obvious receptors, and partial extra or full lamella, I believe the female may be flightless. Diurnal flight activity would seem a natural adaptation to low night temperatures at high altitude; the extra sensory pits (Fig. 331) may assist in locating the

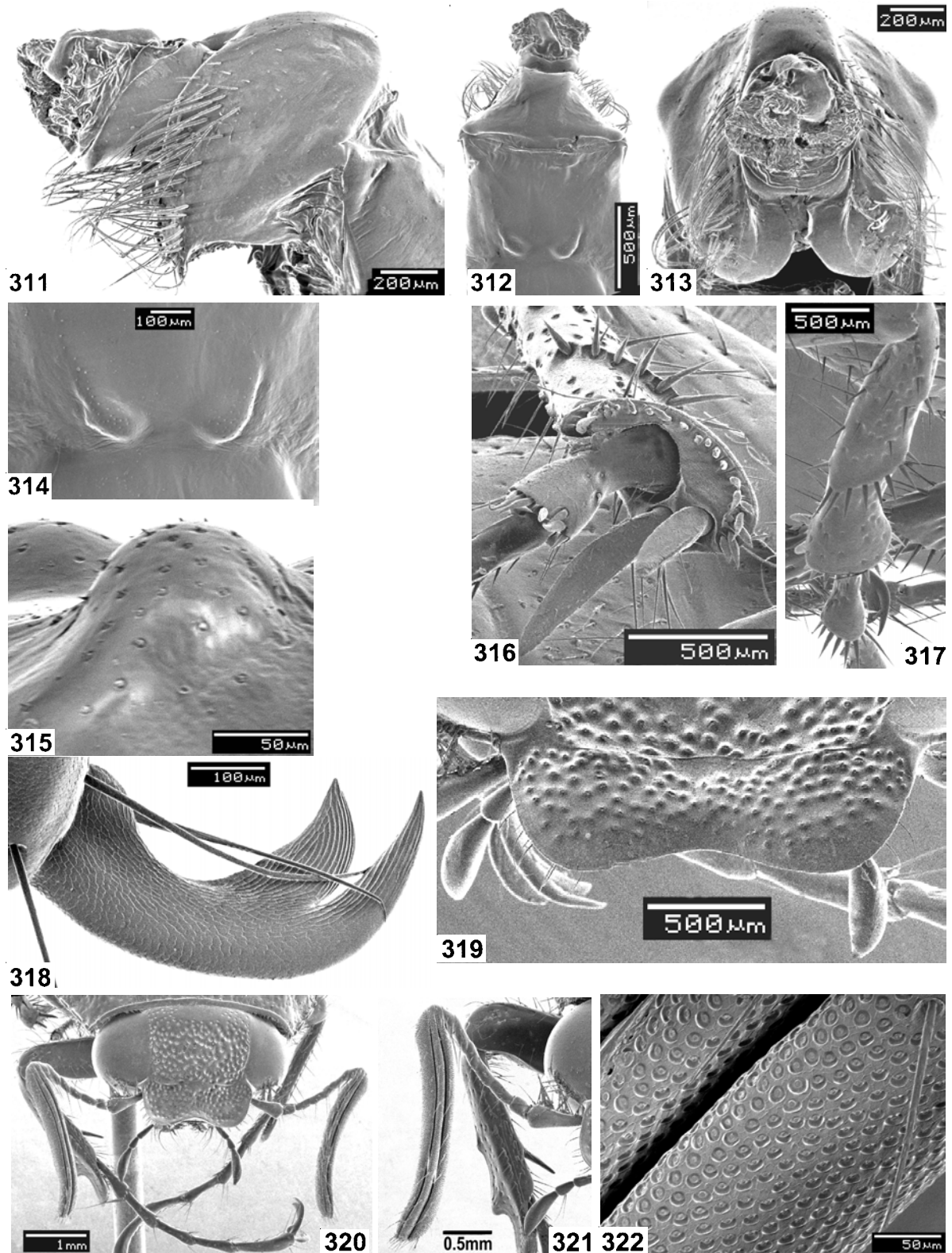


Fig. 311-322. *Phyllophaga n. sp., near fossoria* (see text for explanation). Male. 311-315 Genitalia: 311) lateral; 312) dorsal; 313) caudal; 314) dorsal protuberances of tectum; 315) enlargement of same; 316) metatibial apex; 317) mesotibia, ventral; 318) metatarsal claw, lateral; 319) clypeus, dorsal; 320) head, antennae, and legs, frontal; 321) antenna; 322) sensors of antennal club lamellae.

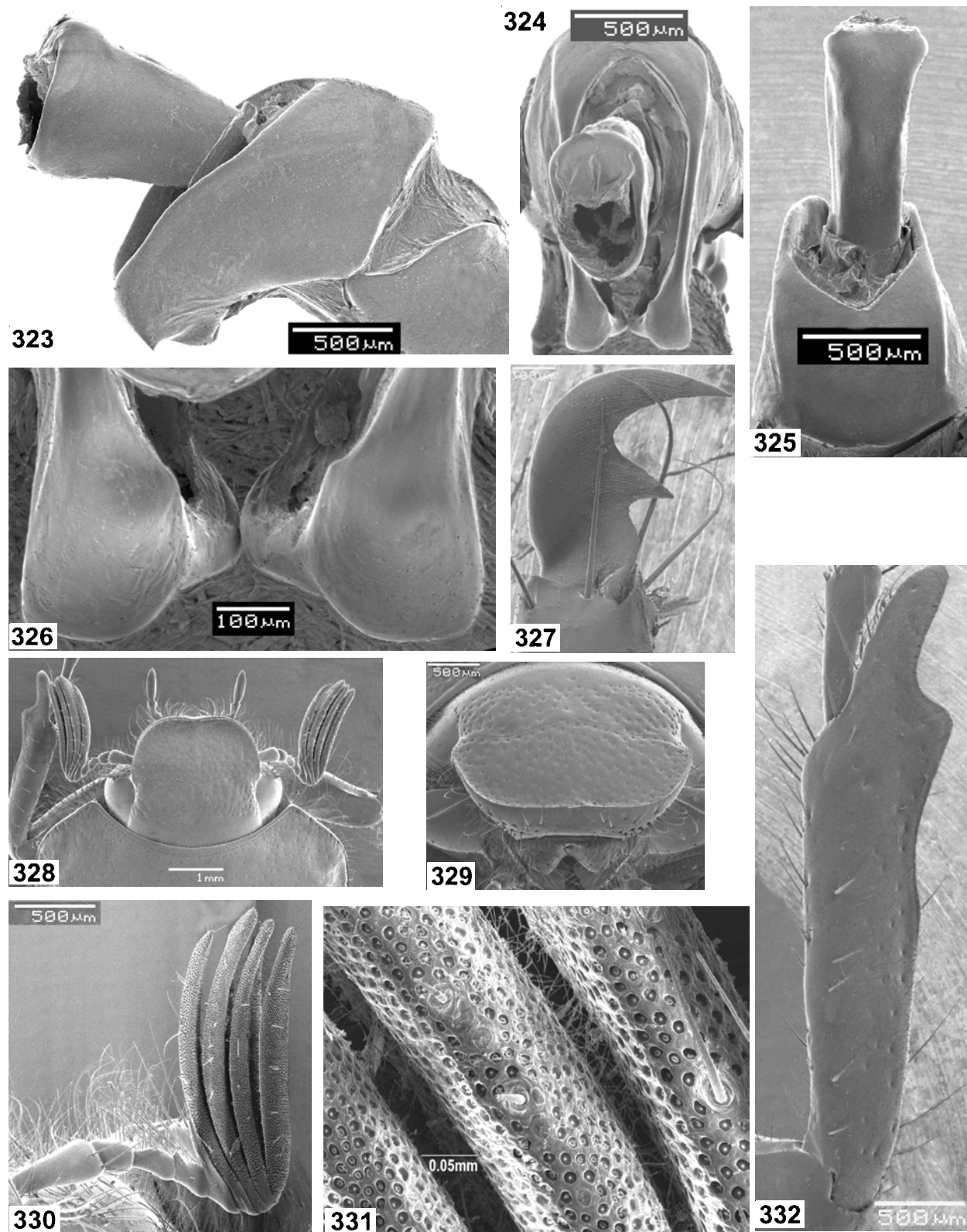


Fig. 323-332. *Phyllophaga garrota* Sanderson. 323-326 Male genitalia: 323) lateral; 324) caudal; 325) dorsal; 326) paramere tips; 327-332: Male: 327) protarsal claw; 328) head and clypeus, dorsal; 329) same, frontal; 330) antenna (note 4 segmented club); 331) enlarged sensory pits on antennal lamellae; 332) protibia, ventral.

female. In species occurring at lower altitudes and normal female flight, such sensory pits are rare, and the sexes congregate on and are attracted to host plants to feed at night.

Specimens examined. Total 33. All DOMINICAN REPUBLIC: **Prov. La Vega:** (6) Valle Nuevo, La Nevera, 4-IV-1965, E.J. Marcano #1079-1081 [FSCA]; (5) same, except 12-IV-1969, Marcano # 5118-5122 [FSCA]; (8) Valle Nuevo, La Pirámide, 24-III-1985, E.J. Marcano, "capturado en dia en vuelo 12-3p.m." [FSCA]; (6) Cordillera Central, Reserva Valle Nuevo, La Nevera, 15.1 km SE Valle Nuevo, 18-41-47N, 70-35-30W, 3-VI-2003, 2252 m, Davidson, Young, Nuñez, Rawlins, Acevedo, De la Cruz, montane meadow in cloud forest, pine, malaise trap (1), UV light (4), hand catch (1) [CMNH]; (14) same, except 15.3 km SE Valle Nuevo, 18-41-39N, 70-35-28W, 25-V-2003, 2244 m, wet montane forest with pine, UV light [CMNH, FSCA].

Taxonomic notes. All specimens were from a very small area around La Nevera (above 6000 ft). Specimens from the latter 2 series are much larger and more similar to the holotype (L.17-22, W. 9-10mm) than those collected by Marcano (L.14-17, W. 7-8mm) from the same area almost 40 years earlier. I have examined them closely, but can find no differences in the genitalia or in external characters, except all structures are enlarged. Obviously larval food and favorable climatic conditions may influence size of adults.

Other characters, not mentioned by Sanderson, are listed here: The pronotum in all my specimens is dull and obviously but not strongly pruinose, the head and elytra are contrastingly shiny and without pruinosity. The anterior tibiae (Fig. 332) have the lower tooth quite reduced, compared with other species (e.g., Fig. 267). The metatibial spurs are straight, acuminate, but with flattened to slightly concave inner surfaces. The fifth antennomere is flattened, extended forward, and compressed to the sixth, resembling a partial fifth lamella. All tarsal claws (Fig. 327) have middle tooth short, nearer base than apex, and there is no obvious notch between it and the base. The transverse carina is usually well developed in both meso- and metatibia, although sometimes not well marked in the metatibia.

Although easily separated from all other Hispaniolan species by the 4-segmented antennal club, it is most similar to *costura*. That species has a partial fourth lamella, the frontal suture is raised, and the genitalia are distinct. Compare genitalia of 3 species

in the group (Fig. in parentheses): *costura* (248-250); *garrota* (323-326); *probaporra* (603-606).

Phyllophaga haitiensis Woodruff, **new species**
(Fig. 83, 333-352)

Holotype male. HAITI: Department du Sud, Ville Formon, 31 km NW les Cayes, S. Slope Morne Formon, Massif de La Hotte, 18-20N, 74-01W, 1405 m, 7-8-IX-1995, R. Davidson, G. Onore, J. Rawlins, disturbed forest and fields, CMNH 305,937 [CMNH].

General Description (Habitus, Fig. 83). Large (L. 24, W.11.5 mm). Color reddish brown, pruinose, iridescent (similar to *mali*). Surface appearing smooth, punctures not obvious. Elytra nearly parallel sided, gently rounded apically and suture not terminating in a spine.

Head (Fig. 343). Clypeus deeply emarginate, somewhat lobed, anterior margin rounded but constricted diagonally to posterior angle at frontal suture, margin reflexed, more so medially. Surface glabrous, pruinose, and lightly, shallowly punctate, punctures irregularly spaced but most 1 to 2 diameters apart. Frontal suture impressed, barely emarginate medially, slightly curved to lateral margin. Frons punctate as head, except finer and denser line above, pruinose as clypeus, posterior band impunctate, except lateral area of head. Eye canthus prominent with 6 long setae. **Antenna** (Fig. 341-342) effeminate, 9-segmented, club 3-segmented, club ovate, sensors not obvious, club subequal to preceding 4 antennomeres, 3 longer than 4, fifth longer than wide, obtusely projected anteriorly, sixth smaller and wider than long.

Pronotum. Wider than long, lateral margin crenulate at origin of long reddish-yellow setae; slightly wider at lateral angles but nearly evenly rounded to rounded posterior angles; anterior angles obtuse, not produced; anterior margin slightly raised impunctate, with a row of very fine punctures behind it. Surface pruinose, reddish, darker in central two thirds, finely punctate, punctures always separated by 2 diameters. Posterior margin barely indicated, except at lateral thirds, not reflexed, barely carinate.

Scutellum (Fig. 340). Slightly wider than long, barely convex, somewhat flattened with translucent edge, punctures shallow, irregular on sides, pruinose as pronotum,

Elytra. Color fairly uniform reddish brown, except for darker apical declivity near suture; sutural margin barely carinate, except beyond apical declivity. Sutural costae barely raised with a few scattered punctures, suture terminating in a very fine microtooth, but barely noticeable, elytra evenly rounded at apex, lateral margin barely reflexed in anterior three-fourths. Elytra especially iridescent or chatoyant, appearing silky.

Pygidium (Fig. 339). Convex, pruinose, iridescent and punctured as elytra, glabrous except for terminal fringe, lighter red-brown than elytra, wider than long,

Legs. Protibia tridentate, basal tooth much smaller than other 2, terminal spine acuminate, extending beyond first tarsal joint; tarsal segments 2-4 subequal, fifth 1.5X longer than 4; tarsal claws C-shaped (Fig. 345), teeth sharp pointed, middle tooth near center, projecting longer than terminal tooth, producing large U-shaped notch at base. Mesotibia with longitudinal carina, transverse carina incomplete but indicated by external teeth and spines; terminal spurs fine, straight, acuminate and pointed, inner spur two-thirds length of first tarsal segment, outer spur half length of first tarsal claw; tarsal segments 1-4 progressively shorter, fifth 1.5X fourth; mesotarsal claws same as protarsus. Metatibia with longitudinal carina well-developed, transverse carina less apparent than on mesotibia, apex expanded into a sharp tooth on external edge (Fig. 344), delimiting terminal fringe of 22 spines; terminal spurs similar in shape to those of mesotibia, inner spur 1.5X longer than first tarsal segment, outer spur subequal length of first tarsal segment; segments 2, 3, 4 gradually shorter, 5 subequal to 2, first tarsal segment wider at apex than others but not greatly expanded to sharp spine-like teeth; tarsal claws similar to other legs.

Abdomen. Venter color light orange to straw colored, all segments with varying degree of golden setae, slightly pruinose to silky, setae appressed throughout. Penultimate sternite convex, ultimate with a horizontal depression, posteriorly edged by carinate demarcation and slightly depressed medially.

Male Genitalia (Fig. 333-338). Totally unlike any other known Hispaniolan *Phyllophaga*, and nearly impossible to describe in words. It is remotely similar to *mali* in the aedeagus with a long central projection, and a bifurcate element below it. The parameres (Fig. 334) are extremely elongated and rounded at their

apex, and their ventral surface with an acute, backward projecting tooth. The phallobase dorsum has a deep median notch or invagination (Fig. 338).

Allotype female. (Fig. 346-352). Data same as holotype, except CMNH 307,340 [CMNH]. Similar to male in most respects, except antennal club shorter, nearly subequal to previous 3 antennomeres; pronotum more convex, massive; metatibial spurs flattened spatulate-shaped and straight, metatarsal first segment reduced, half length of inner spur; apical spinule of 26 spines; pygidium less convex, somewhat wrinkled medially; ultimate abdominal sternite without a horizontal carinate demarcation, but slightly depressed and more densely punctate medially; elytra considerably wider in posterior third. Body bulkier than male, less streamlined. **Genitalia** (Fig. 346-352). Exceptionally hard and sclerotized, convex, and reddish to black. Inferior plates fused entire length, their juncture indicated by obvious suture; basally sealed by a broadly triangular plate medially. Apex crisp, cup shaped, without setae. Superior plates projecting, hardened, fused medially, the outline V-shaped in dorsal view; external projections with crisp edge and about 10 long, stiff setae.

Specimens examined. Only the holotype and allotype are known.

Ecology. Obviously the label data "disturbed forest and fields" reveals little about the habitat. Although much of Haiti's forests have been cut, hopefully the remoteness of the area (1405 m in Massif l'Hotte) will assist in protecting the species, along with its host trees. It is likely that the 2 specimens were a mating pair. It is another of the interesting endemic species restricted to the "South Island".

Comparisons. The reddish brown color and iridescence place this species near *mali*, *neglecta*, *rustica* and *barrosa*. When the male holotype was first examined it was suspected to be the male of *barrosa*, which was described from a unique female. However, when the associated female was examined, with the same data, it was obvious that an undescribed species was involved. Male genitalia of the 4 species are easily distinguished (Fig. in parentheses): *haitiensis* (333-338); *mali* (450-456); *neglecta* (513-518); *rustica* (700-707); [*barrosa* (unknown)]. The largest of the group is *haitiensis*.

Etymology. The name is obviously for the country of origin, but it was chosen because the species may be

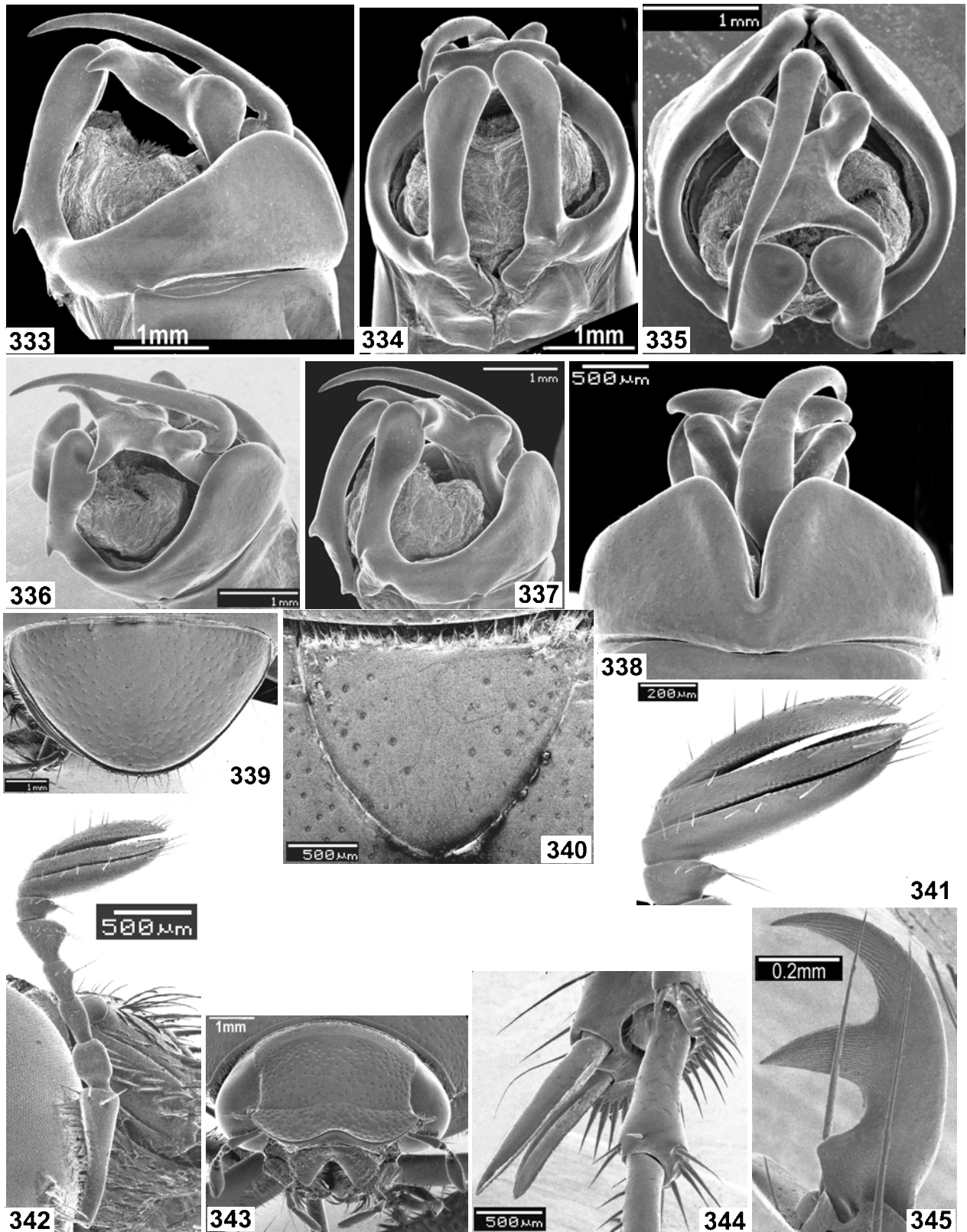


Fig. 333-345. *Phyllophaga haitiensis* Woodruff. Male: 333-338: Male genitalia 333) lateral; 334) ventral; 335) caudal; 336) caudo/lateral; 337) same, more caudal; 338) dorsal; 339) pygidium; 340) scutellum; 341) antennal club; 342) antenna; 343) head, frontal; 344) metatibial apex; 345) mesotarsal claw.

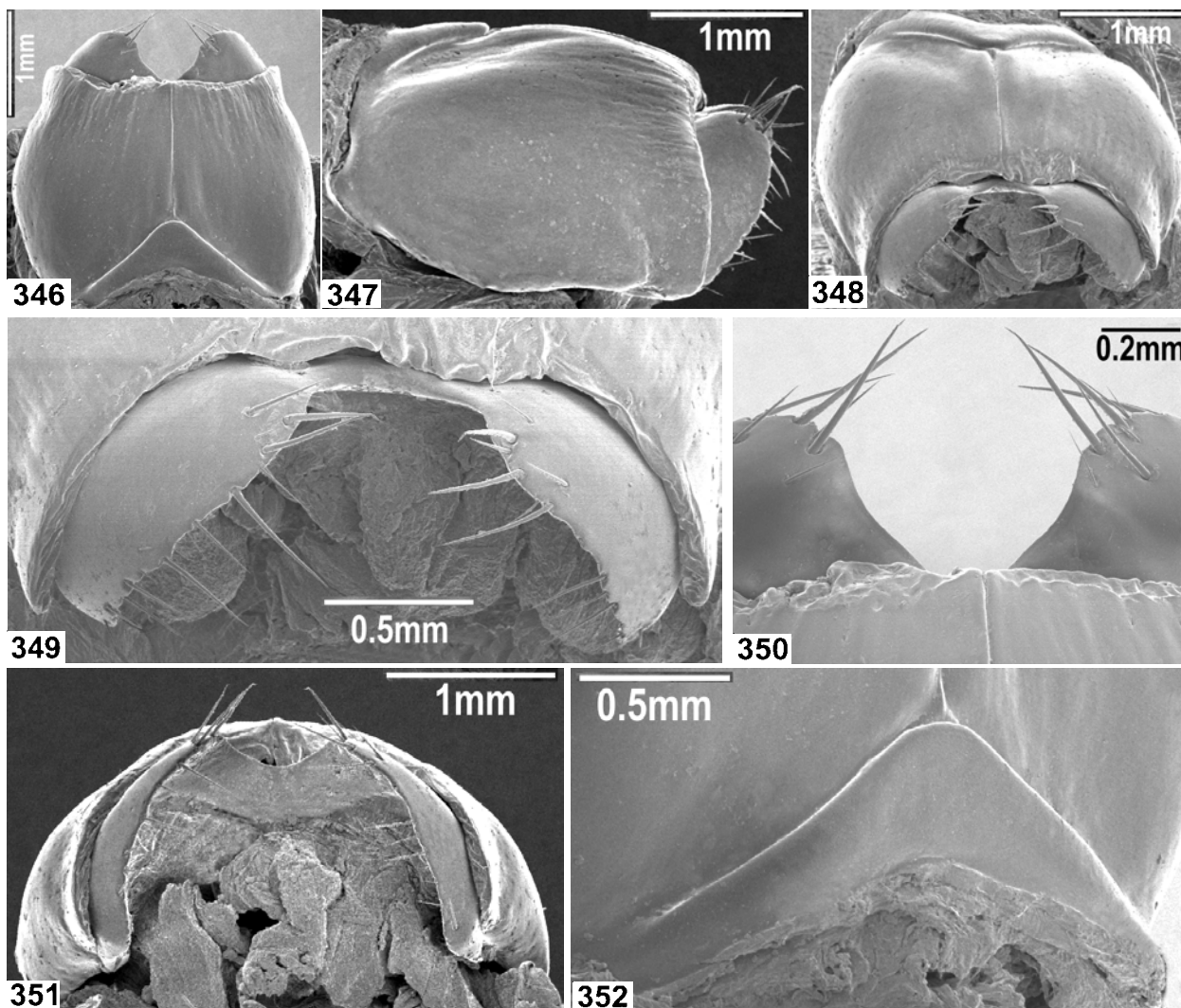


Fig. 346-352. *Phyllophaga haitiensis* Woodruff. Female genitalia: 346) ventral, 347) lateral, 348) caudo/ventral, 349) superior plates, caudo/ventral, 350) pubic process, ventral, 351) caudal, 352) central triangular plate covering base of inferior plates, diagonal/ventral.

restricted to the western mountains of the “South Island”. It is one of the few Hispaniolan species not known from the Dominican Republic as well.

Phyllophaga hogardi (Blanchard)
(Fig. 84, 353-367)

Ancylonycha hogardi Blanchard (1850: 137).

Ancylonycha hogardi Blanchard, Burmeister, 1855: 337.

Phyllophaga hogardi (Blanchard), Wolcott, 1928a: 26.

Phyllophaga hogardi (Blanchard), Sanderson, 1951: 260-1; Fig. 10, 11, 61.

This species and *neglecta* were the earliest *Phyllophaga* described from Hispaniola. It is one of the more common species, especially at lower elevations. Along with *romana*, it is probably one of the 2 species most likely to cause economic damage, because of its abundance in sugarcane growing areas. Wolcott (1927: 227–228; Fig. 77) listed *hogardi* as the most common species in Haiti, and illustrated the adult.

On the basis of the strong spine on the elytral suture apex (Fig. 362), Sanderson placed it in a group with *romana*, *leptosfica*, and *permagna*. In the present study, additional species can be added: *baoruco*, *eladio*, and *toni*. Because of other similarities, including habitus and genitalia, *marcano* also belongs in this group, but the sutural spines are much reduced and not as obvious (Fig. 470). Because *hogardi* is

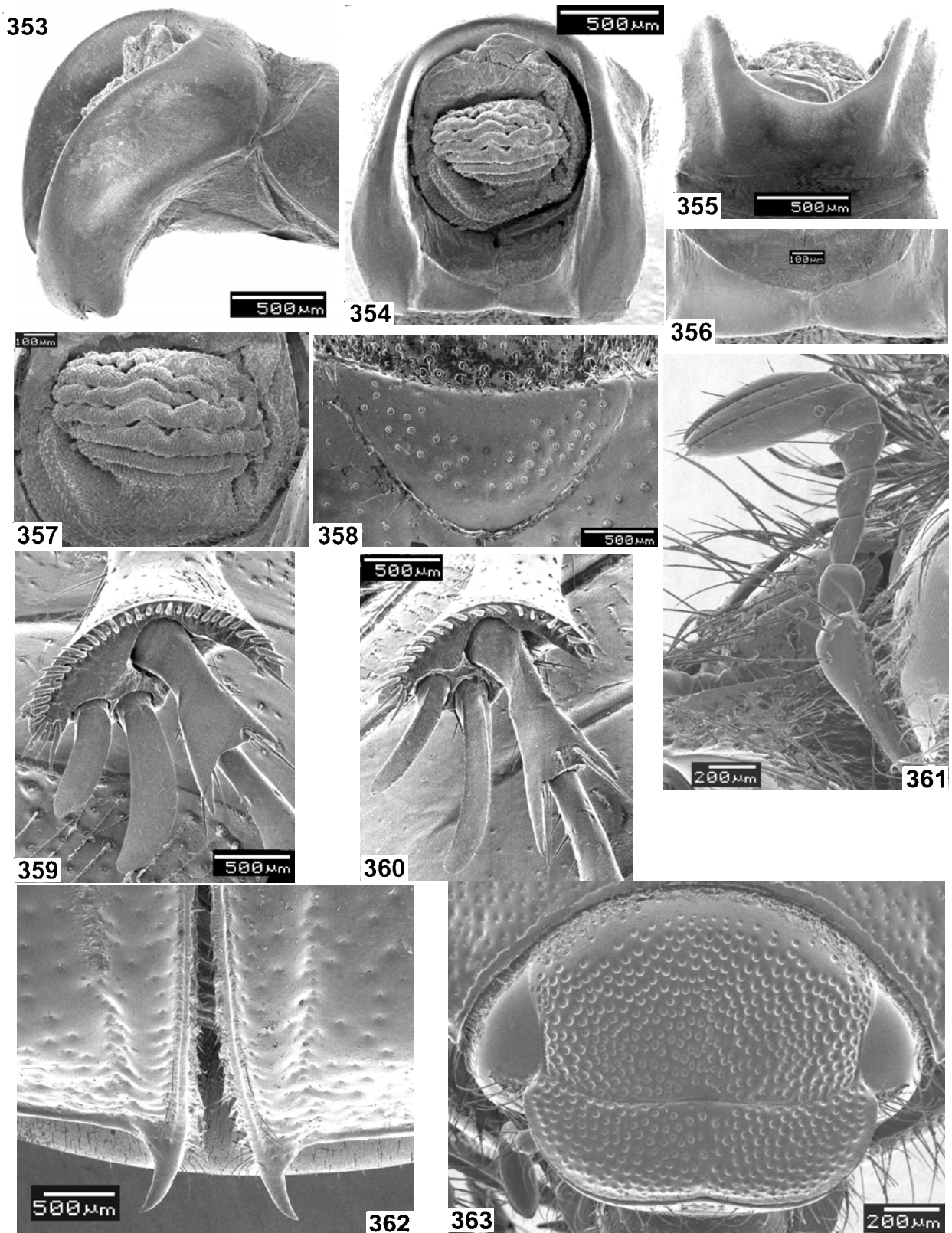


Fig. 353-363. *Phyllophaga hogardi* (Blanchard). 353-357 Male genitalia: 353) lateral; 354) caudal; 355) dorsal; 356) paramere tips; 357) aedeagal tip; 358) scutellum; 359-360 metatibial apex: 359) female; 360) male; 361) antenna, right, male; 362) elytral sutural apex with recurved spines, male; [typical of the *hogardi* species group], 363) head, dorsal.

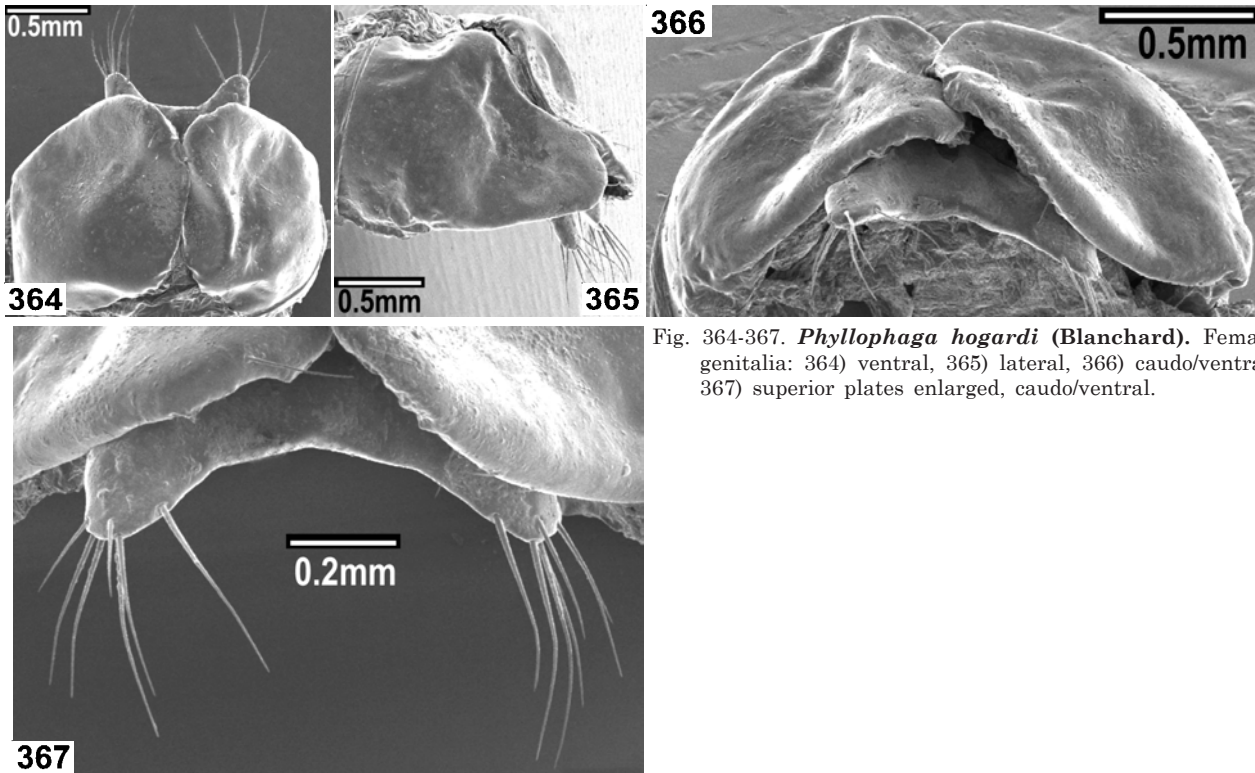


Fig. 364-367. *Phyllophaga hogardi* (Blanchard). Female genitalia: 364) ventral, 365) lateral, 366) caudo/ventral, 367) superior plates enlarged, caudo/ventral.

exceptionally shiny, it is similar in appearance to the female of *canoia*, but that species has no sutural spine and the elytra are more rugosely punctured; the female genitalia (Fig. 364-367 vs. 231-233) are easily distinguished. All of the related species appear to be higher altitude, and perhaps *hogardi* is the ancestral species from the lowlands. It is also variable in size (L. 19-23, W. 9-12 mm) and the degree of shine. Some specimens appear greasy, while others are brilliantly shiny. No genitalic differences were observed to coincide with this variation. Females are often robust and posteriorly swollen, in comparison to males. There is sexual dimorphism in the apical metatibial spines (Fig. 29-30). Sanderson (1951: 261) recorded a male from Puerto Plata with both antennae 8 segmented, but another from the same locality had the normal 9 segments.

Specimens examined. Sanderson (1951) recorded it from HAITI: Petionville and Port-au-Prince; and DOMINICAN REPUBLIC: Santiago, Santo Domingo (=Ciudad Trujillo), and Puerto Plata. I have seen several hundred specimens from the following Dominican Provinces: Barahona, Dajabon, Distrito Nacional, Elias Piña, El Seibo, La Altagracia, La Romana, La Vega, Monte Cristi, Peravia, Puerto Plata, San Cristobal, San Juan, Santiago. Most of these were from low elevations, although 113 were taken at 2400

ft at Rio Limpio (Prov. Elias Piña). However, none was taken at 3300 ft at the Larimar Mine (Prov. Barahona) with the 8 other species taken there. Because of its abundance at lower elevations, it would be an easy one to transport in soil, so its present distribution may be more extensive than before man.

Phyllophaga imprima Sanderson
(Fig. 85, 368-383)

Phyllophaga imprima Sanderson (1951: 276-277; Fig. 52-53).

This small species (L. 10-11, W. 6 mm) is pruinose in males, some females partially or wholly shiny. The head is deeply punctate, creating an irregular surface, with vague median division, sometime appearing as if weakly bituberculate. In size (habitus, Fig. 85) and male genitalia (Fig. 368-373) it is similar to *cartaba*, *latiungula*, and *panicula*; the aedeagus has only 2 dorsally projecting parallel spines, whereas all the others have more. The pygidium is shiny medially, but disc encircled by heavily pruinose border (Fig. 374, details 375). The metatibia of this group of small species has the apex more deeply notched dorsally (Fig. 378), enabling the tarsi to be raised almost vertically. Adults of the genus *Serica* often raise their metatarsi while feeding, but there are no observations

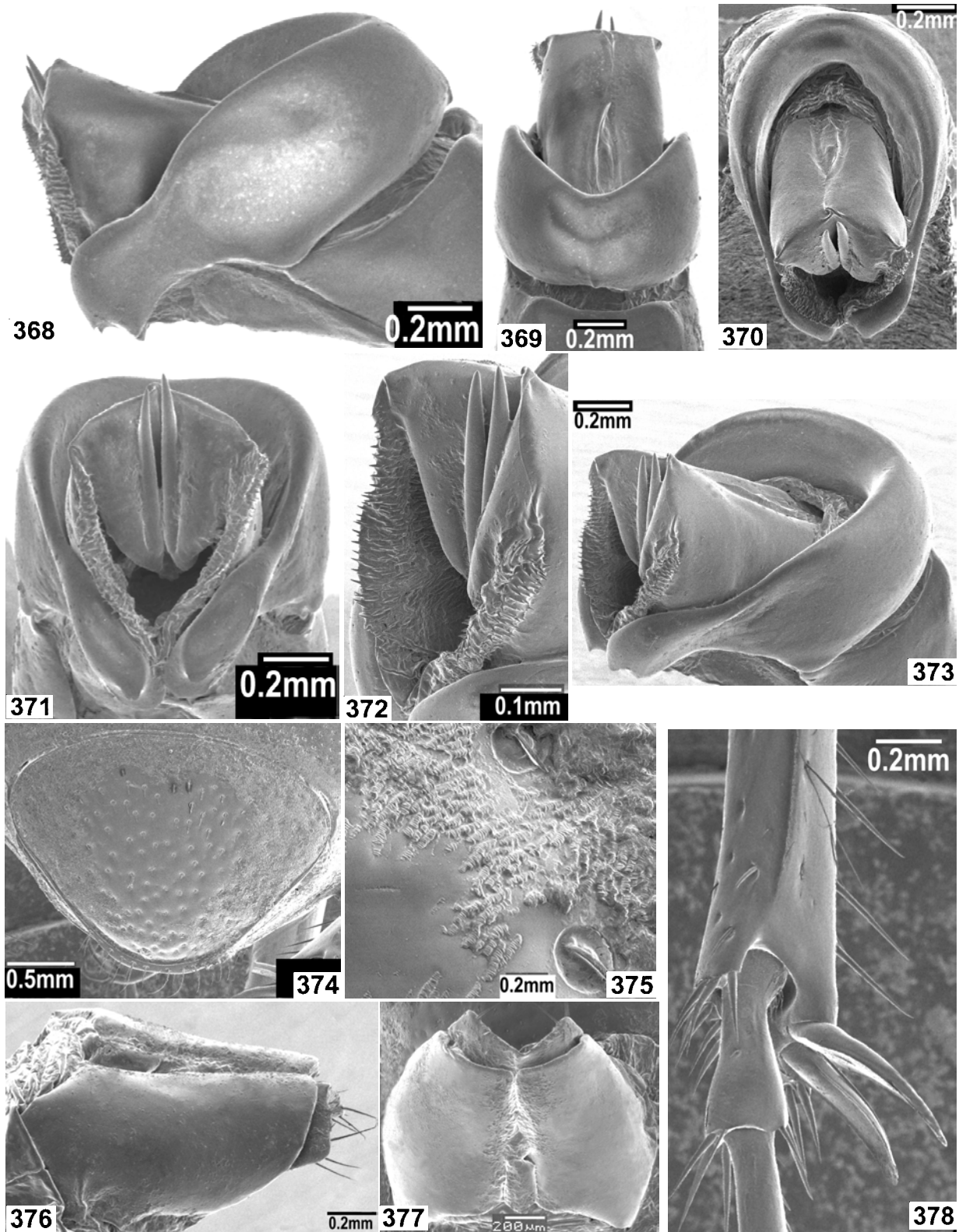


Fig. 368-378. *Phyllophaga imprima* Sanderson. 368-373 Male genitalia: 368) lateral; 369) dorsal; 370) caudal; 371) ventral; 372) aedeagus, lateral; 373) caudo/lateral; 374) male pygidium; 375) same, enlargement of junction between smooth central area and pruinose sides; 376-377 female genitalia: 376) lateral; 377) ventral; 378) metatibial apex, dorsal (note notch in tibia, allowing first tarsal segment to be raised vertically).

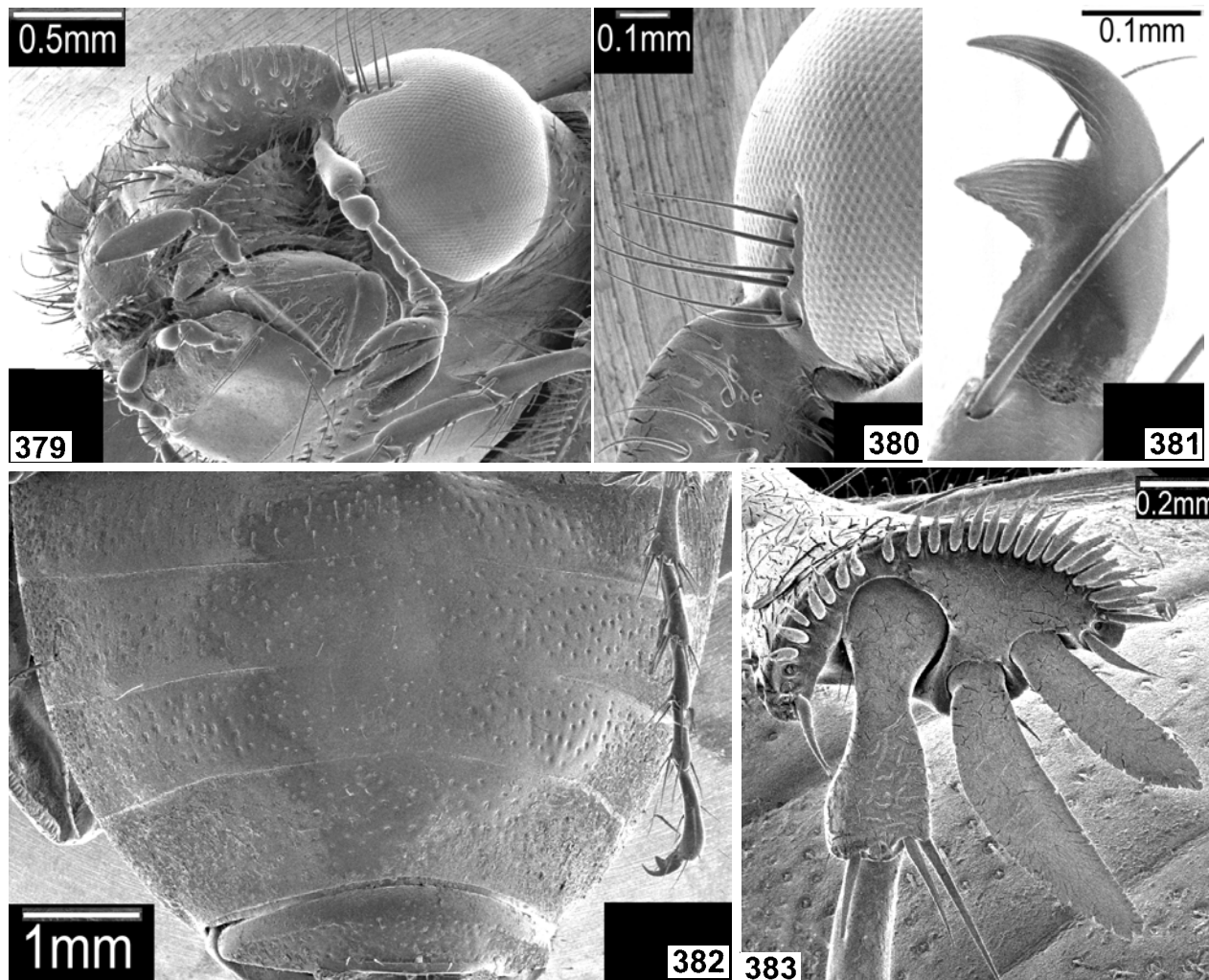


Fig. 379-383. *Phyllophaga imprima* Sanderson. Female: 379) head, diagonal ventral; 380) eye canthus, enlarged [note it is concave; most species have it carinate and raised]; 381) mesotibial claw; 382) abdomen, ventral (note few setae, central area smooth, sides pruinose); 383) metatibial apex, caudal.

on behavior of these *Phyllophaga*. It may also be related to *mella*, which has similar pruinosity on the pygidium, but that species is much larger (L. 13.5-15 mm), and the genitalia (Fig. 484-494) are distinct, especially the female.

Allotype female (here designated; genitalia Fig. 376-377). DOMINICAN REPUBLIC: Prov. Elias Piña, Rio Limpio, 26-27-IV-2000, R.E. Woodruff, T.J. Henry, 2400 ft, blacklight trap [FSCA].

Similar to male, except slightly swollen behind, abdomen more convex. Elytra pruinose only in anterior two-thirds (some female specimens merely shiny, appearing without pruinosity). Pygidium less pruinose laterally. Antennal club smaller, shorter than previous 4 antennomeres (Fig. 389). Head rugosely punctate and lumpy, nearly bituberculate. Metatibial

fringe (Fig. 383) of about 28 spines (male with 13-14). Antennal club with small yellow, linear spots (probably sensors). Eye canthus depressed, with 6 long setae (Fig. 379-380). Abdominal sternites pruinose laterally, shiny medially (Fig. 382). Metatarsal claw (Fig. 381) with median tooth, but no notch or gap formed posteriorly with base.

This species and *canoia* are the only ones in which there is striking sexual dimorphism. In both cases, the difference is less or no pruinosity in females, which are shinier. The female genitalia (Fig. 376-377) have inferior plates convex, fused anteriorly, smooth, without terminal spines or projections; base with elongate plate medially covering (but not sealing) median suture; apex gently rounded to sides. Superior plates fused, interior angles acute, apex with about 5 long setae (some may be broken off).

Specimens examined. Total 90. This species was originally described from 2 male specimens, the holotype from DOMINICAN REPUBLIC: Mt. Quita-Espuela, 2000-3000 ft, July 1938, [P.J.] Darlington [MCZC]. The single paratype was labelled merely "S. Dom.", which was often used as a label for anywhere in Hispaniola, not restricted to the Dominican Republic or the capital city of Santo Domingo.

It appears to be the common small species in the Cordillera Central. Because only 2 specimens were previously known, full data are recorded for our specimens (all DOMINICAN REPUBLIC): **Prov. Dajabon:** (1) 7 km S. Dajabon, Rio Massacre, Balneario Don Miguel 26-V-1973, D. and M. Davis, 40 m [USNM]. **Prov. Elias Piña:** (15) Rio Limpio, 26-27-IV-2000, R.E. Woodruff, T.J. Henry, 2400 ft, blacklight trap [FSCA]. **Prov. La Estrelleta:** (10) 4 km SE Rio Limpio, 24-25-V-1973, D. and M. Davis, ca. 760 m [USNM]. **Prov. La Vega:** (7) Jarabacoa, 11-V-1959, Sanderson and Farr, RD59-18, 19 [INHS]; (1) Jarabacoa, Pinar del Puerto, 14-X-1984, H. Dominguez [FSCA]; (6) La Ciénega de Manabao, [Parque Nacional Armando Bermudez] Pk. Hdqtrs. 3-5-VII-1999, 3000 ft, R.E. Woodruff, blacklight trap [FSCA, MHND]; (1) same, except 20-21-IV-2000. R.E. Woodruff, T.J. Henry [FSCA]; (11) 5 km W. Manabao, Paso de la Perra, Finca Eladio Fernandez, along Rio Yaqui del Norte, 14-16-V-2001, 3050 ft, R.E. Woodruff, blacklight trap [FSCA]; (1) 2 km E. Manabao, 18-VII-1996, M.C. Thomas, R. Turnbow, blacklight trap [FSCA]; (3) 5 km E. Manabao, near mouth Arroyos Dajaos, 19-04N, 70-45W, 9-X-1991, 740 m, Davidson, Young, Rawlins, Thompson, riparian woodland [CMNH]. **Prov. Monseñor Nouel:** (5) Bonao, VI-1989, S. Dunkle [FSCA]; (13) Rio Blanco, Vivero Forestal [Nature Conservancy and Fundacion Moscoso Puello] 11-13-V-2001, R.E. Woodruff, C. Nuñez, 613 m, blacklight trap [FSCA]; (4) same, except Hydroelectric Dam, 13-V-2001. **Prov. San Cristobal:** (1) San Cristobal, 9-V-1974, E.J. Marcano #16343, trampa de luz [FSCA]; (1) Cambite Uribe nr. San Cristobal, 2-V-59, Sanderson and Farr, RD59-2 [INHS]. **Prov. San Juan:** (1) Rio Mijo, 20-22-V-1985, R.E. Woodruff, C. Nuñez, blacklight trap [FSCA]. **Unknown Prov.:** (7) Colonia, III (1), IV (4), V (1), VIII (1), J. and S. Klapperich [NHMB].

Phyllophaga jaragua Woodruff, **new species**
(Fig. 86, 384-392)

Holotype male. DOMINICAN REPUBLIC: Prov. Barahona, 6km S. Cabral, Rd. to Polo, 5-XI-1986, R.E. Woodruff, at night [FSCA].

General Description (Habitus, Fig. 86). Medium sized (L. 16, W. 8mm) dorsally glabrous, head and pronotum shiny, elytra pruinose, widest at posterior fourth, appearing somewhat swollen; base color tan. Genitalia of both sexes distinctive (Fig. 384-389).

Head (Fig. 390-391). Clypeus emarginate, anterior angles rounded, obtusely angled to frontal suture; margin reflexed; clypeus shorter than frons, surface coarsely punctate, punctures irregularly spaced, most separated by one diameter, denser near frontal suture and lateral angles. Frons punctate as clypeus, some punctures more widely spaced, forming a slight depression medially, coalescing above eyes; posterior band impunctate. Eye canthus carinate, with 7 long setae. **Antenna** 9-segmented, club 3-segmented, oval, receptors noticeable only on margin (Fig. 392), club subequal to previous 4 antennomeres, fourth shorter than 3, fifth about as wide as long with forward projection, 6 wider than long, expanded anteriorly, wider than 5.

Pronotum. Wider than long, widest at lateral angles; anterior angles obtuse, not pointed; lateral angles prominent; posterior angles with a notch anterior to posterior margin, lateral margin broken at this point; margin with about 4-5 setae between lateral angle and anterior angle, their origins creating crenulate margin; anterior margin barely raised with a row of dense punctures behind. Surface more coarsely but less densely punctate than frons, punctures denser along anterior margin and anterior angles. Posterior margin with a row of dense punctures paralleling carinate margin, which is nearly obsolete medially; punctures of disc often 2 or more diameters apart, surface shiny and glabrous, reddish.

Scutellum. Nearly flat, punctures as on pronotum, with a small V-shaped impunctate area antero-medially, wider than long, shiny, glabrous, and non-pruinose,

Elytra. Lighter colored than pronotum, pruinose, except for humeral angles and a short distance behind; surface regularly punctate, glabrous, punctures nearly in rows; sutural costa slightly convex, punctures shallow and scattered; 2 elytral costae barely indicated; sutural margin barely raised, slightly more so on apical declivity, carina ending in imperceptible spine. Elytra widest in posterior fourth, apex gently rounded to suture.

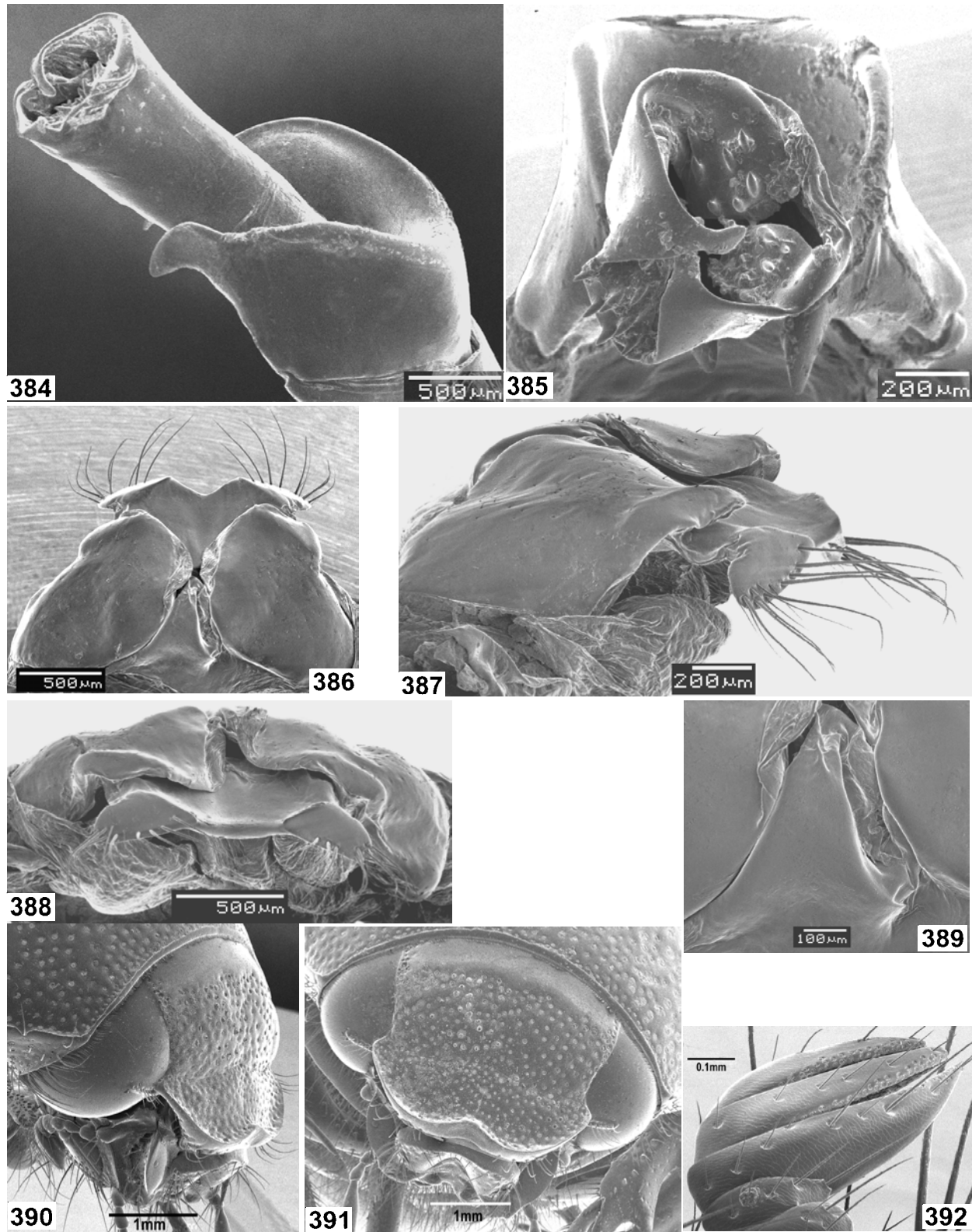


Fig. 384-392. *Phyllophaga jaragua* Woodruff. 384-385 Male genitalia: 384) dorso/lateral; 385) caudal; 386-389 female genitalia: 386) ventral; 387) lateral; 388) caudal; 389) triangular plate separating inferior plates; 390) head, lateral; 391) head, dorsal; 392) antennal club.

Pygidium. Wider than long, glabrous except for apical fringe, coarsely punctate to wrinkled, shiny, minutely alutaceous.

Legs. Protibia shining, tridentate, basal tooth well-developed, middle tooth nearer proximal; apical spine acuminate, reaching beyond base of first tarsal segment; protarsal segments 1-4 sub-equal, fifth 1.5X longer; tarsal claw sharp-pointed, middle tooth broad at base and longer than apical tooth, forming deep notch behind with base. Mesotibial transverse carina incomplete, but indicated by large teeth and spines, longitudinal carina absent; terminal spurs narrow, acuminate, outer barely shorter than inner, about 75% length of first tarsal segment; terminal fringe of 14 spines. Mesotarsal segments 1-4 sub-equal, fifth 1.5X longer than fourth, claws as in protarsi. Metatibia with inner spur elongate, 25% longer than first tarsal segment, narrow, acuminate, inner surface not noticeably concave, gently, slightly curved inward, outer spur narrow, 2/3 length of inner, gently, slightly curved inward also; apical fringe with 18 spines. Tarsal segment 1 with apex slightly expanded more than remainder, sub-equal in length to 2 and 3, fourth slightly smaller, fifth 1.5X fourth; claws as on protarsi.

Abdomen. Venter shining, convex, minutely alutaceous, somewhat pruinose, microsetae on all segments, appressed on all except penultimate, which has a patch of long, curved, fine, golden setae on each side, arising from punctures which are 1 to 2 diameters apart; punctures becoming denser medially, but setae disappearing, slight transverse depression prior to apical margin. Ultimate sternite with a row of setae similar to pygidial fringe, transverse depression densely punctate.

Male genitalia (Fig. 384-385). Laterally with simple parameres pointed ventrally and smoothly rounded dorsally, phallobase median notch evenly rounded. Aedeagus tubular, tip expanded, caudally with 2 overlapping arms, below which arise about 6 dark, heavily sclerotized spines, internally containing 2 additional spine-like clusters.

Allotype female (Fig. 386-398). Data same as holotype. Similar to male, except pronotum redder, elytra with more non-pruinose areas, including apical tumosity, patch of setae on penultimate abdominal sternite less extensive and less noticeable; ultimate sternite with a longitudinal bar medially raised from the transverse depression; abdominal segments fused

and barely indicated medially, convex and shiny; metatibial apical fringe of 20 spines (18 on male), first metatarsal segment much reduced, inner spur nearly as long as first 2 tarsal segments, flatter and more concave on inner surface. Antennal club slightly smaller than male, antennomeres 3 and 4 sub-equal. **Female genitalia** with triangular plate basally inserted between inferior plates (Fig. 389); inferior plates not fused medially, not apically prolonged, without terminal setae (few microsetae behind); superior plates with unique outline terminally (Fig. 386), with a V-shaped median notch, lateral projections diagonally truncated, pointed at lateral angles, with 9-10 exceptionally long (subequal in length to superior plates) setae.

Comparisons. The habitus (Fig. 86) is distinctive, as are the genitalia (Fig. 384-389). It does not appear to be closely related to any other Hispaniola species except perhaps *alcoa*. The latter is larger (L. 18 vs. 16 mm), less convex, elytra somewhat flattened medially, non-pruinose areas of elytra more extensive, and the genitalia are of a completely different type (Fig. 124-134).

Specimens examined. Total 38, including holotype, allotype, and following paratypes (all DOMINICAN REPUBLIC): (2) same data as types [FSCA]. **Prov. Barahona** [should be Pedernales]: (2) Baoruco Mts., 1250 m, 11-IX-1973, T.J. Walker, J.C. Schuster, Coll. # 3 [field note: km 33 above Cabo Rojo, pine forest, grassy understory with few palms, burned 4 years earlier] [FSCA]; (1) 4.5 km S. Barahona, 4 km W. Rt. 2, 17-V-1992, M.C. Thomas [FSCA]. **Prov. Pedernales:** (2) 25 km N. Cabo Rojo, 12-VII-1996, M.C. Thomas, R.H. Turnbow, 700M, MV/ultraviolet [FSCA, RHTC]; (15) 23.5 km N. Cabo Rojo, 18-06N, 71-38W, 26-27-IX-1991, Rawlins, Davidson, Young, Thompson, 540 m, wet deciduous forest [CMNH]; (8) same, except 730M [CMNH]; (3) same, except 20-VII-1990, Rawlins, Young, Thompson [CMNH]; (1) same, except 30 km N., 18-07N, 71-39W, 23-24-VII-1990, 1070 m [CMNH]; (1) same, except 31-VII-1990 [CMNH]; (1) same, except 26 km N, 17-VII-1987, Rawlins, Davidson, 760M [CMNH].

Ecology. Most specimens were taken from 730 to 1250 m elevation in the Baoruco Mountains. The habitat varied from "wet deciduous forest" to open pine grassland. Specimens were collected from May to November, with most in September. Host trees are unknown, and most specimens were attracted to blacklight.

Etymology. The name “jaragua” is a native Taino name; it was chosen also to recognize both the Parque Nacional Jaragua and Grupo Jaragua, the NGO conservation group who continue assisting in its protection. According to information supplied by José Marcano and Padre Julio Cicéro, the name was originally “Xaragua”, and it referred to the Taino kingdom that occupied the southwestern portion of “Española”, including portions of Haiti and the Dominican Republic; it extended east to San Juan de la Maguana, north to Dajabon, and west to the tip of Haiti.

Phyllophaga jimenezi Woodruff and Sanderson,
new species
 (Fig. 87, 393-402)

Holotype male. DOMINICAN REPUBLIC: Prov. La Vega, Jarabacoa, 11-V-1959, [M.W.] Sanderson and [T.H.] Farr, RD59-19(8), mating pair, Acc. #50269 (aedeagus dissected from genital capsule, originally stored in glycerin vial, now mounted on card point below specimen) [INHS].

General description (Habitus, Fig. 87). Large (L. 25, W. 12 mm; varies from 22 to 26, 11 to 14). Color uniformly chestnut brown, dorsal surface shiny, glabrous, somewhat flattened medially. Body nearly parallel sided, barely wider near middle. Elytra faintly pruinose only near lateral margin below humeral angle.

Head. Clypeus weakly, evenly emarginate, margin somewhat reflexed. Posterior angles gently rounded to clypeo-frontal suture. Surface punctate, punctures fairly even and separated by less than their diameter. Frontal suture impressed, but not deeply so. Frons irregularly punctate, punctures larger medially, smaller and coarser near eyes and with a band of smaller punctures near the basal line, which is impunctate. Eye canthus noticeably raised, with 8 or 9 stiff, curved setae. Terminal segment of maxillary palpi expanded toward apex, bearing long terminal sensory area. **Antennae** orange, 9-segmented, club 3-segmented. Lamellae flattened laterally, so that their shape is conical when viewed terminally, subequal in length to preceding 4 antennomeres. Receptors not noticeable. Segment 3 shorter than 2, 4 shorter than 3, 5 as wide as long, slightly projecting forward, 6 short and broad.

Pronotum. Wider than long, lateral margin crenulate on anterior two-thirds where lateral setae arise,

setae present only in anterior two-thirds. Anterior margin raised, lateral margin reflexed posteriorly, posterior margin barely indicated. Punctures shallow, but noticeable, irregularly spaced, but smaller and denser at anterior angles, more widely spaced at lateral angles, mostly 1 to 2 diameters apart. Anterior angles nearly 90 degrees, not sharply pointed. Posterior angles more obtuse, slightly rounded.

Scutellum. Punctured as pronotum, except for slight, smooth, central line. Nearly flat, central line slightly more convex; wider than long.

Elytra. Sutural striae poorly developed, carinate only on apical fourth, terminating in a microtooth. Elytra somewhat flattened medially near suture on anterior half; barely widest at middle, nearly parallel sided. Sutural costae slightly convex, with a very few scattered punctures. Surface mostly punctate more shallowly (finer) than pronotum, fairly evenly spaced, except less dense at humeral angles and denser along elytral margin. Margin barely reflexed, with slight pruinosity on lateral margin below humeral angle; otherwise, elytra shiny, glossy, and glabrous.

Pygidium. Exceptionally convex, punctate as elytra, except punctures more closely spaced, glabrous and shining, no setae except marginal fringe.

Abdomen. Venter very convex, shiny, except for golden setal patches on lateral sternites. Penultimate sternite with a dense area of punctures medially; ultimate sternite transversely grooved, with a narrow, longitudinal, median depression; sternite apically margined by a row of golden setae (shorter than pygidial fringe).

Legs. Protibiae tridentate, basal tooth well developed and only slightly further from middle tooth than from proximal. Anterior spur acuminate, sharp-pointed and reaching base of first tarsal segment. Protarsal segments 2, 3, and 4 subequal, fifth 1.5X length of 4. Protarsal claw C-shaped, middle tooth nearly central with a curve behind forming a notch with quadrate basal piece. Mesotibia without transverse carina, but with longitudinal carina noticeable. Incomplete transverse carina indicated by lateral projections and stiff setae. Mesotibial apical spurs long, narrow, and sharply pointed; outer spur 25% shorter than inner, both spurs about half length of first tarsal segment. Mesotarsal segments 1 through 4 progressively shorter, fifth 1.5X fourth. Metatibia similar to mesotibia; apical spurs with inner about 1.25X length of first

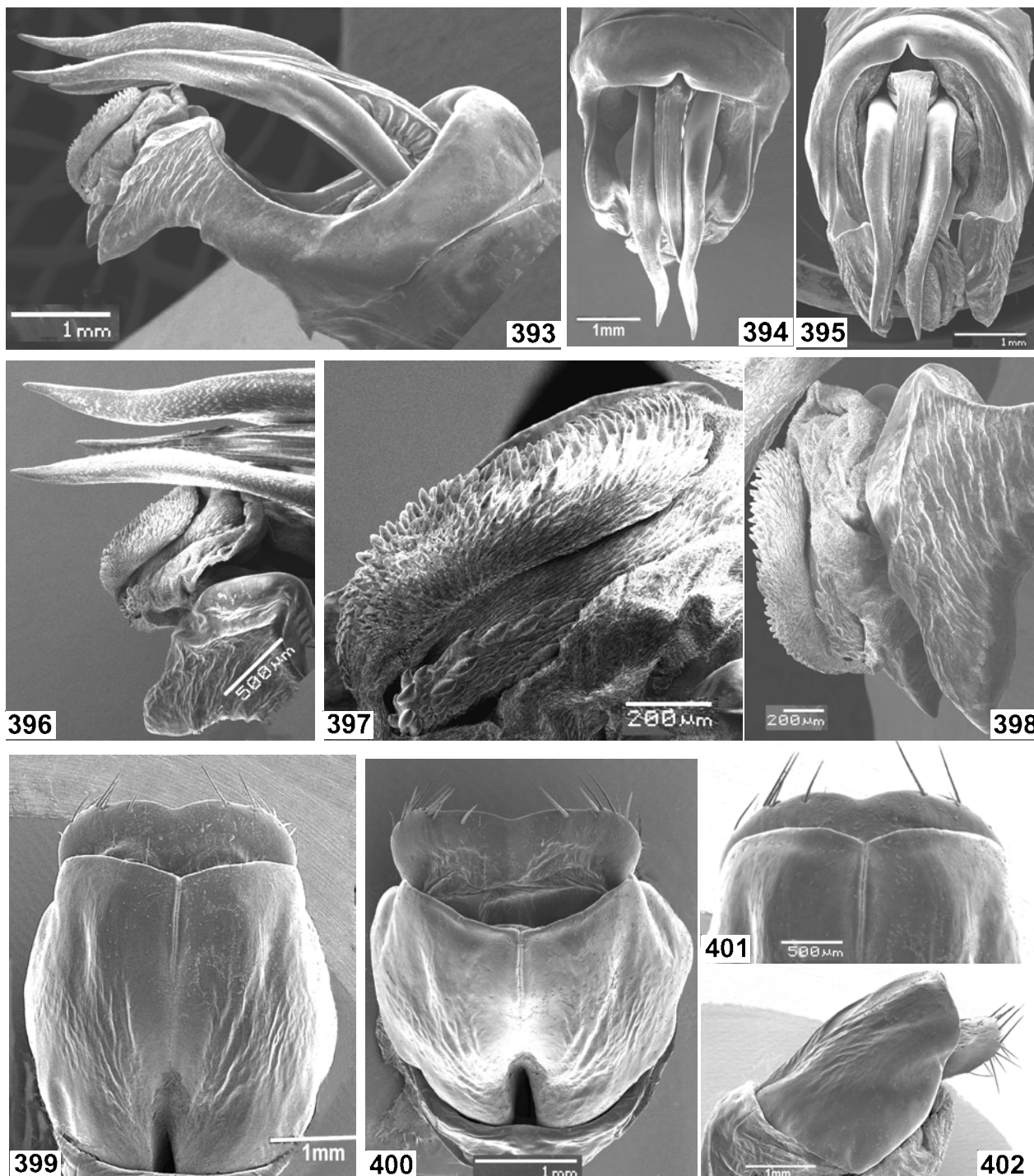


Fig. 393-402. *Phyllophaga jimenezi* Woodruff & Sanderson. 393-398 Male genitalia: 393) lateral; 394) dorsal; 395) caudal; 396) paramere tips and aedeagus; 397) aedeagal tip; 398) enlarged paramere (right, lateral); 399-402 female genitalia: 399) ventral; 400) caudo/ventral; 401) superior plates, ventral; 402) lateral.

tarsal segment; outer spur shorter than first tarsal segment; both concave on inner face, but not expanded, and barely curved; apical fringe about 22 spines; metatarsal segments similar to mesotarsi; tarsal claws subequal on all legs.

Male genitalia. (Fig. 393-398). Exceptionally large, parameres elongate, terminating abruptly into beak-like shape, projecting downward, their outer surface wrinkled (as also in *santachloe*, but smooth in *kenscoffi*); a paired, spongy, setose “cockscomb” at

aedeagal tip between (Fig. 397), others recessed behind; parameres curved in a crescent shape from dorsal apex to phallobase which has a median notch. Aedeagus with heavily sclerotized, trilobed dorsal projection extending beyond parameres; all 3 projections sharply pointed (lateral ones truncate in *kenscoffi* and *santachloe*), median flexible and shorter, without dorsal modification.

Allotype female. DOMINICAN REPUBLIC: La Vega, 5km. W. Manabao, Paso de la Perra, Finca Eladio Fernandez, 19-23-IV-2000, R. E. Woodruff, T.J. Henry, 3050 ft, along Rio Yaque del Norte, blacklight trap [FSCA]. (L. 24 mm). Similar to male, except pronotum and elytra broader in posterior third, not as parallel sided as male. Antennal club shorter than preceding 4 antennomeres. Metatibial fringe of 30 spines closely spaced (22 in male) [counts on 10 tibiae range from 27 to 39 spines], apical spurs flattened, spatulate-shaped. Pygidium less convex, with apex slightly upturned (strongly so in *kenscoffi* (Fig. 414-415)). **Female genitalia** (Fig. 399-402) large and heavily sclerotized, with deep trough medially at base. Inferior plates fused, with a suture indicated medially at anterior third; tips of inferior plates somewhat quadrate, gently curved from suture to lateral angles, non-setate, ridges located at least half plate width from suture (closely paralleling it in *kenscoffi*). Superior plates fused, emarginate medially, tip nearly as broad as apex of inferior plates; tip with about 12 long, stiff setae.

Specimens examined. Total 55, (all DOMINICAN REPUBLIC) including holotype and allotype; paratypes as follows: (19) with same data as holotype [INHS]; **Prov. Elias Piña:** (1) Rio Limpio, 26-27-IV-2000, 2400 ft, R. E. Woodruff, T.J. Henry, blacklight trap [FSCA]. **Prov. Peravia:** (2) San José de Ocoa, 20-24-III-1977, H.L. Dominguez, on coffee [FSCA]. **Prov. Monseñor Nouel:** (2) Rio Blanco Hydroelectric Plant, 12-13-V-2001, 600 m, R. E. Woodruff, C. Nuñez, blacklight trap [FSCA]; (2) Rio Blanco, Vivero Forestal [Nature Conservancy and Fundacion Moscoso Puello], 11-V-2001, 613 m, R. E. Woodruff, C. Nuñez, blacklight trap [FSCA]; (1) Prov. La Vega/Monseñor Nouel [near border of Province, but not marked], El Chorro, 9.2 km W. of Rt. 1 on Rd. to Constanza, 26-IV-1999, R. E. Woodruff, R.M. Baranowski, feeding on *Trema* at night [FSCA]. **Prov. La Vega:** (7) 5 km W Manabao, Paso de la perra, Finca Eladio Fernandez, along Rio Yaqui del Norte, 3050 ft, R. E. Woodruff, blacklight trap [FSCA]; (2) Buena Vista [near Jarabacoa], Hotel Montaña, 19-VII-1996, M.C. Thomas,

R.H. Turnbow [FSCA, RHTC]; (1) 10 km NE Jarabacoa, 4-VI-1994, R.H. Turnbow, mv+bl [RHTC]; (2) Jarabacoa, 30-IV-1977, H.L. Dominguez [MHND]; (3) Jarabacoa, 10-VIII-1980, A. Norrbom, 600M, blacklight trap [CMNH]; Jarabacoa, Pinar del Puerta, 14-X-1984, H.L. Dominguez (1) [FSCA]; (1) 5 km SSE Jarabacoa, 25-VII-1987, J. Rawlins, 640M [CMNH]; (3) La Cienega de Manabao, Parque Nacional Armando Bermudez, 3-5-VII-1999, R. E. Woodruff, blacklight trap, 3000 ft [FSCA]. **Prov. El Seibo:** (4) 6 km N. Pedro Sanchez, 18-55N, 67-07W, 4-VII-1992, Young, Davidson, Thompson, Rawlins, 475m, disturbed field and woodland [CMNH]; (3) 7 km N. Pedro Sanchez, Loma de Chivo, 25-VI-1998, R. E. Woodruff, R.M. Baranowski, 5000 ft [FSCA].

In addition, I have seen 3 specimens which are not made paratypes: **Prov. Hato Mayor,** Parque Los Haitises, 3 km W. Cueva de Arena, 19-04N, 69-29W, 7-9-VIII-1992, Young, Davidson, Thompson, Rawlins, 20 m, mesic lowland forest [CMNH]. These specimens have genitalia similar to *jimenezi*, but the body resembles *santachloe*. Because these are from a low area (20 m), and all other *jimenezi* are from 475 m to 3050 ft, mostly from Jarabacoa in the Cordillera Central, these may not be conspecific.

Ecology. Original notes indicate that the holotype was collected on *Psidium guayava* [sic], along with a series collected on the following plants (numbers in parentheses): *Brysonia crassifolia* (5), *Cupania glabra* (1), *Echites umbellata* (1), *Miconia rubiginosa* (8), *Psidium guayava* (3), and *Pinus* sp. (3). Most other specimens were taken in blacklight traps or attracted to lights. Several specimens were collected near Jarabacoa at the government operated Hotel Montaña, a famous locality for insect collectors. However, this facility has not been operable in the past few years.

Collecting dates range from March (a series was collected as a pest, feeding on coffee) to October, suggesting that it may be found throughout the year. Altitudes range from 475 m to 3050 ft (near Manabao). It appears to be more common in the Jarabacoa region near 600 m elevation in May. It is one of only a few species known to feed on pine.

Comparisons. This species is superficially similar to *kenscoffi* and *santachloe*, with which it forms a species group. Both sexes can be distinguished readily by the distinctive genitalia (Fig. 393-402). In addition, *santachloe* has more noticeable pruinosity (often a violet blush), and it occurs on the coastal plain near the north coast. Because *kenscoffi* was described from Haiti (Kenscoff), it appears to be a species of the

“South Island”, but the 2 species are difficult to distinguish on external characters. On genital characters, *kenscoffi* males (Fig. 403-409) are easier to distinguish by the smooth, rounded parameres (not wrinkled and pointed as in *jimenezii* and *santachloe*, Fig. 398, 710) and the somewhat truncate tips of the aedeagal “parameres”; females of *kenscoffi* (Fig. 410-413) have deep ridges paralleling the fused inferior plates, and *jimenezii* (Fig. 399-402) has no such ridges, but lesser ridges occur away from the fused suture, and the base has a deep groove or depression.

Etymology. This species is named in honor of Dr. José J. de Jiménez, physician and distinguished amateur botanist of Santiago, who assisted Dr. M. W. Sanderson during his field work in the Dominican Republic in 1959.

Phyllophaga kenscoffi Wolcott
(Fig. 88, 403-415)

Phyllophaga kenscoffi Wolcott (1928a: 24; Fig. 1; Sanderson, 1951: 269-271; Fig. 33-34, 66)

This, one of the largest Hispaniolan species (L. 26-31, W. 12-15 mm), was described from 2 pairs from HAITI: Kenscoff, 1400 m, 7-VII-1927, Emanuel Ducasse, on apple [holotype male, NMNH Cat. # 40658 and allotype female, examined]. Sanderson (1951) saw only 1 additional specimen from DOMINICAN REPUBLIC: Mt. Diego de Ocampo, 3000-4000 ft, July, 1938, [P.J.] Darlington [MCZC].

The most striking feature is the upturned apical pygidial margin (Fig. 414-415), which is found to a lesser degree in the other 2 members of this group, *jimenezii* and *santachloe*. The male genitalia are similar, but the latter 2 species have the paramere apices beak-shaped (Fig. 398, 710), with sharp angles, whereas it is rounded and smooth (Fig. 406) in *kenscoffi*; from *jimenezii* it also differs by having lateral aedeagal projections truncated (Fig. 407), not acuminate pointed. Female genitalia are similar, but *kenscoffi* has inferior plates fused, paralleled by broadly carinate ridges (Fig. 410-413), with no deep concavity at base as in *jimenezii* (Fig. 399-400). In addition to genitalic differences, *santachloe* is smaller, slightly pruinose, and occurs only at lower elevations.

Specimens examined. Total 256 (except types, all DOMINICAN REPUBLIC): The following Provinces are represented: (1) Baoruco, (205) Barahona, (12) Dajabon, (37) Elias Piña, (1) La Vega, (1) San Juan.

The largest series of specimens (192) was taken during a 3 week period (6-VI-7-VII, 1992) at the Larimar Mine (Barahona Prov.) in cloud forest at 3300 ft in the Baoruco Mountains. It appears to be an uncommon species elsewhere.

Phyllophaga larimar Woodruff, **new species**
(Fig. 89, 416-428)

Holotype male. DOMINICAN REPUBLIC: Prov. Barahona, nr. Filipinas, Larimar Mine, 3-11-VII-1992, 3300 ft, P. Landolt, F. Skillman, P.E. Skelley, R.E. Woodruff, blacklight trap [FSCA].

General description. (Habitus, Fig. 89). Medium sized (L. 21, W. 10 mm), yellowish brown, glabrous, shiny, head and pronotum more reddish, pygidium with many elongate curved setae (Fig. 425, 428), in addition to apical fringe. Habitus and genitalia similar to *recorta* (compare Fig. 426-427).

Head. Clypeus deeply emarginate, anterior angles smoothly rounded to posterior angles, which extend laterally into base of frontal suture; carinate eye canthus with 7 externally curved setae; clypeal margin reflexed, more so medially; surface coarsely, densely punctate, most punctures about 1 diameter apart. Frontal suture deeply impressed, nearly straight across, slightly curved posteriorly at eye. Frons longer than clypeus, punctures sparse in anterior half, dense in posterior; posterior band with 3 or 4 punctures. **Antenna** 9-segmented, club 3-segmented, antennomeres 3 and 4 sub-equal, 5 wider than long, its anterior projection not sharp, 6 wider than long, club without noticeable receptors, ovate, shorter than previous 4 segments combined, outer lamella short and ovate.

Pronotum. Wider than long, anterior angles obtuse, not pointed, lateral angles obtusely rounded, posterior angles smoothly rounded; anterior margin raised, bordered posteriorly by row of punctures; lateral margin raised, but terminating just above elytral humeral angles; apical margin not well-defined. Surface punctate as frons, punctures denser in anterior third and anterior angles; disc with vague median impression, densely punctate in anterior two-thirds, impunctate in a longitudinal, short line posteriorly; margin anterior to lateral angle with 4 or 5 setae, barely crenulate at their origins.

Scutellum. Wider than long, flat, densely punctate and colored as pronotum.

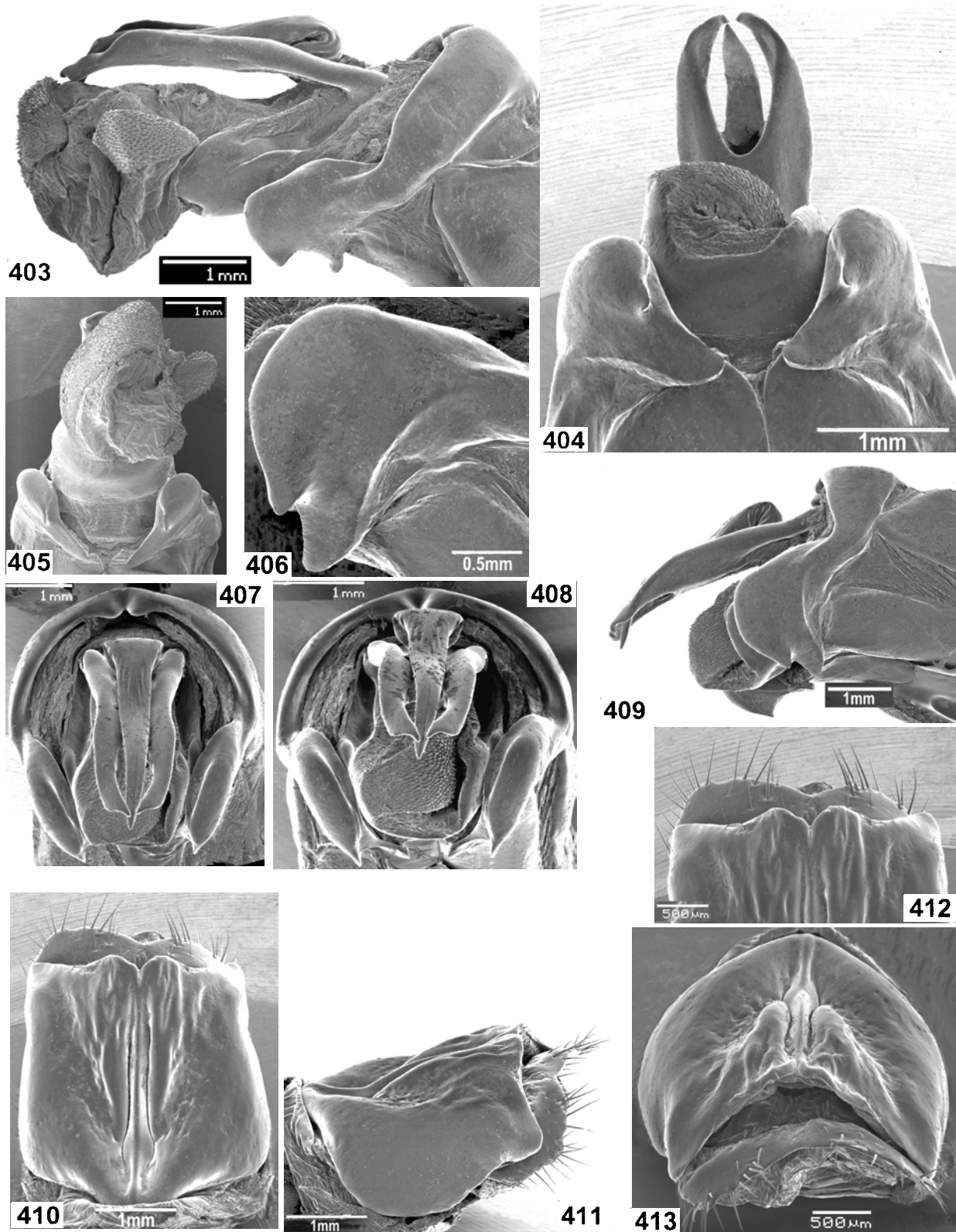


Fig. 403-413. *Phyllophaga kenscoffi* Wolcott. 403-409 Male genitalia: 403) lateral; 404) ventral; 405) ventral, aedeagus extended; 406) parameres, lateral; 407) caudal; 408) caudo/ventral; 409) parameres and aedeagal "parameres"; lateral; 410-413 female genitalia: 410) ventral; 411) lateral; 412) superior plates and inferior plate apices, ventral; 413) caudal.

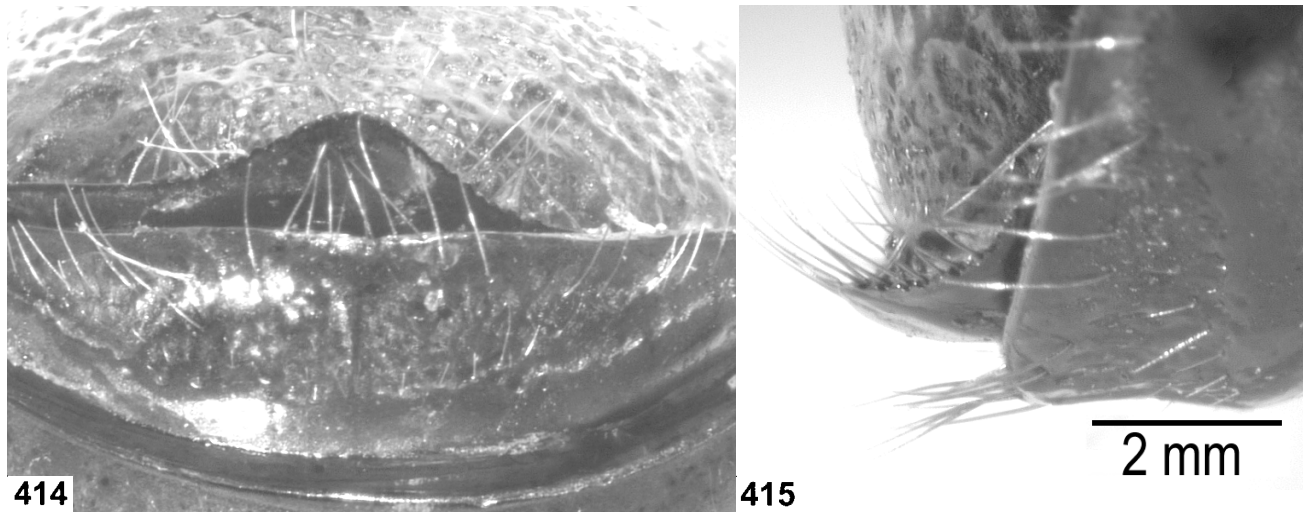


Fig. 414-415. *Phyllophaga kenscoffi* Wolcott. Tip of female pygidium, showing upturned lip: 414) ventral; 415) lateral.

Elytra. Light colored, yellowish-orange, very shiny, punctures shallow and finer than pronotum, costae barely visible except sutural costa slightly convex and punctate as remainder of elytra. Suture slightly carinate from just above apical declivity, not ending in a noticeable spine; elytral apices somewhat truncate, rounded inwardly at sutural apex. Lateral margin barely raised in anterior half.

Pygidium. Wider than long, convex, densely punctate, some punctures coalescing into wrinkles; several scattered, elongate setae, like those on apical fringe (female allotype is covered with such setae).

Legs. Protibia tridentate, basal tooth much nearer middle one and less developed on right leg than on left, middle tooth nearer proximal one; apical spur acuminate, reaching near middle of first tarsal segment. Protarsal segments 2 through 4 sub-equal, fifth 1.5X longer; claws sharp, middle tooth triangular, located near middle, as long as apical tooth and forming notch with base. Mesotibial transverse carina incomplete, marked by teeth and long spines; longitudinal carina noticeable only between 2 teeth on upper side; tibial apex expanded; spurs acuminate, outer one-fifth shorter; mesotarsal segments 1 through 4 progressively shorter, fifth 1.5X fourth; claws as on protarsi. Metatibial transverse carina incomplete as on mesotibia, longitudinal carina same; apical spurs flattened, concave on inner side, slightly wider in apical third, and slightly, gently curved; inner spur extending almost to middle of second tarsal segment; apical fringe about 15 spines.

Abdomen. Ventral surface lightly, uniformly punctate, nearly glabrous, cluster of longer setae laterally in penultimate sternite; ultimate sternite merely grooved, with a few long setae arising from punctures; penultimate sternite, densely, more coarsely punctate medially, with a few setae arising from punctures.

Genitalia, male (Fig. 416-420). Parameres curved downward at tip, pointed, little modified. Aedeagus heavily sclerotized and plug-like; consisting of tubular base with attached lateral lobes (somewhat asymmetrical), from which large hooks arise dorsally, and which are concave on their face, their sides without several large teeth as in *recorta* (Fig. 644-652); below these lies a saw-like process imbedded in softer tissue.

Allotype female. DOMINICAN REPUBLIC: Prov. Pedernales, La Abeja [Las Abejas], 38 km N. Cabo Rojo, 18-09N, 71-38W, 1250 m, 15-VII-1987, J.E. Rawlins, R. L. Davidson, CMNH 307,817 [CMNH]. Similar to male, except much lighter in color, pygidium extensively covered with elongate setae (Fig. 425), tergite above with similar row of golden setae, ultimate sternite more convex without a deep groove; abdomen more convex medially. Frons more densely punctate and depressed, making surface irregular; posterior band convex in its anterior margin. Genitalia (Fig. 421-424) similar to *recorta* (Fig. 655-658), but in *larimar* tips of superior plates with more setae (about 24 vs. 14 total) and the inferior plates have a strong groove paralleling open suture. Both species have exceptionally large triangular plate sealing sutural base (Fig. 422, 655).

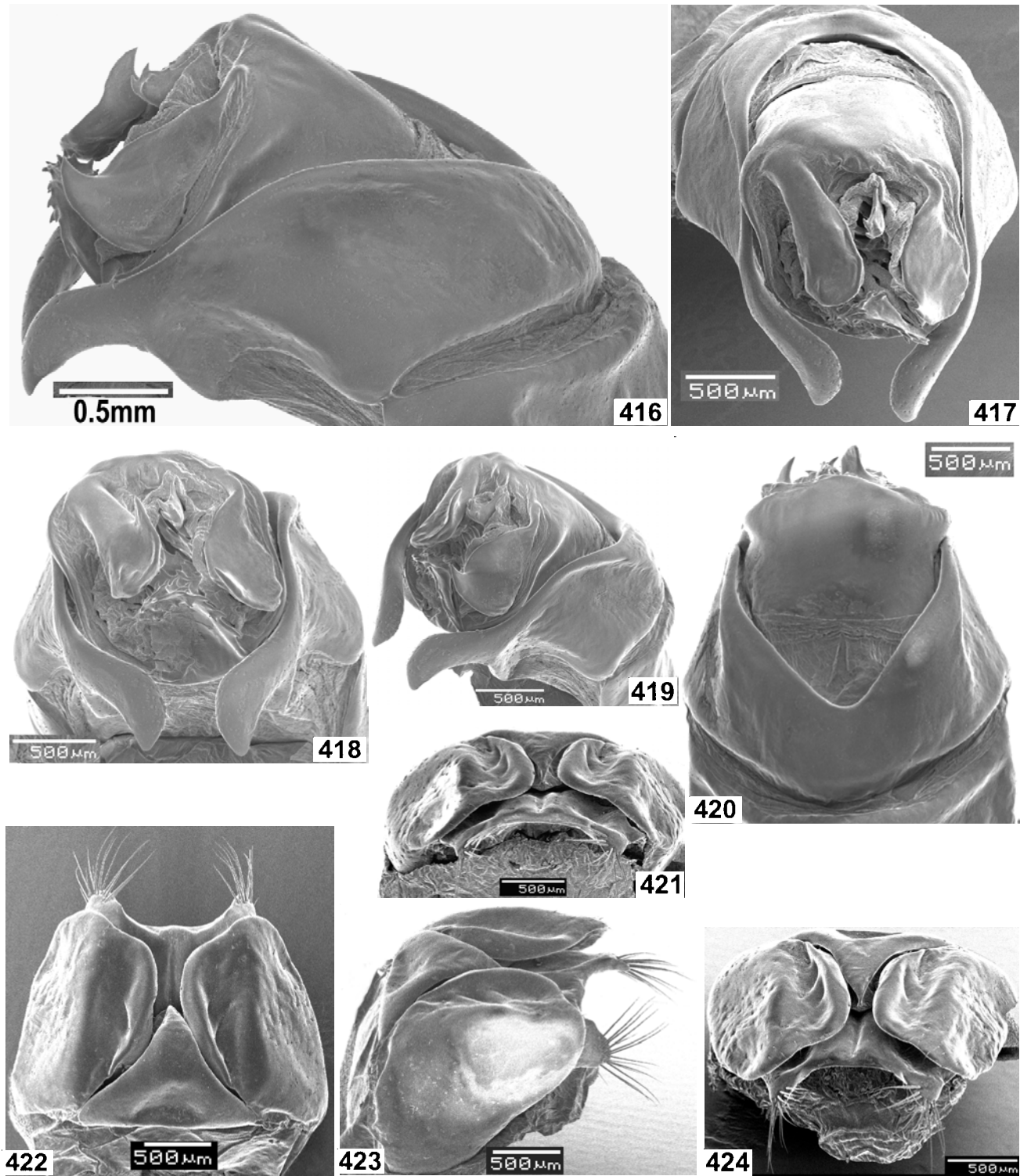


Fig. 416-424. *Phyllophaga larimar* Woodruff. 416-420 Male genitalia: 416) lateral; 417) dorso/caudal; 418) caudo/ventral; 419) caudo/ lateral; 420) dorsal; 421-424 female genitalia: 421) caudal; 422) ventral (note triangular plate separating inferior plates); 423) lateral; 424) caudo/ventral.

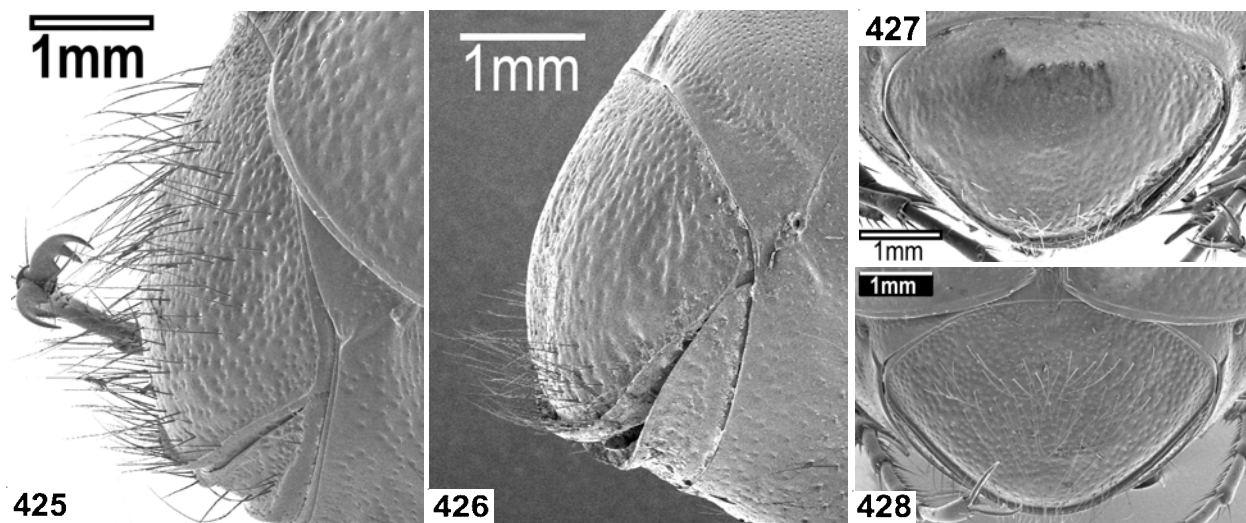


Fig. 425-428. *Phyllophaga larimar* Woodruff. Pygidium: 425 (lateral); 428 (caudal); long setae over nearly entire pygidium, and *P. recorta* Sanderson, 426 (lateral); 427 (caudal); long setae confined to terminal one-third or less, females.

Comparisons. Externally and in genitalic characters this is a “sister species” to *recorta*. It is slightly larger, the female has a completely hairy pygidium (Fig. 425), and the male genitalia have black asymmetrical plates on sides of parameres with hook like tips and non-tooted sides (compare Fig. 416-420 with 644-652). Female genitalia compared above. In *recorta* the female pygidium has only a few setae near apex (Fig. 426-427).

Specimens examined. Total 24, including holotype and allotype. Paratypes as follows: **DOMINICAN REPUBLIC:** (1) same as holotype, except 26-VI-7-VII-1992 [FSCA]. (9) same as allotype, except some 13-14-VII-1987 and some 1160 m [CMNH]. (2) Prov. Pedernales, 25 km N. Cabo Rojo, 12-VII-1996, M.C. Thomas, 700m, MV/ultraviolet light [FSCA]. (2) Prov. Pedernales, 26 km N. Cabo Rojo, 18-06N, 71-38W, 730m, 20-VII-1990, Young, Rawlins, Thompson [CMNH]. (4) same, except 26-27-IX-1991, Young, Rawlins, Thompson, Davidson, wet deciduous forest [CMNH]. **HAITI:** (4) Dept. de l’Ouest, 2 km S. Kenscoff, nr. top of highest mtn., 18-26N, 72-17W, 10-IX-1995, 1790 m, Rawlins, Onore, Davidson [CMNH].

Ecology. This is another of the “South Island” species, found in the southern peninsula of Haiti and the Baoruco mountains of the DR at altitudes from 700 to 1790 m. Most of these localities are cloud forest or “wet deciduous forest”. At the Larimar Mine the site is a prominence above the mine, the light traps drawing from a cloud forest modified for shade grown coffee (presently abandoned). Of the several hundred *Phyllophaga* (including *mali*, *kenscoffi*, *ortizi*, *leptosfica*,

baoruco, *toni*, and *panicula*) collected during a 3 week period, at the same time, only 2 specimens of *larimar* were taken. It appears to be active from June through September, but is scarce.

Etymology. It is named for the type locality. The name “Larimar” was coined by Miguel Mendez for a unique gemstone, found only at a single deposit in the Baoruco Mountains, near Filipinas. It is composed of an abbreviation of his daughter’s name (Larisa) and the Spanish for sea (mar), because of its beautiful blue color. It was my reason for first visiting this unusual locality, publishing the first article on this stone (Woodruff, 1986), in which photos of the area can be found.

This volcanic deposit is dated as Cretaceous in age and was a part of the “South Island”, now being subducted beneath the plate of the “North Island” (De Leon, 1989; Donnelley, 1989). Fossil trees and molluscs (not yet studied), found in the deposit and partially replaced by Larimar, may be significant markers to elucidate the zoogeography of the Caribbean. Microtektites and shocked quartz (in situ) were found in a deposit a short distance away in Haiti at the K-T boundary; these are believed to be the result of the meteorite that created the Chicxulub Crater off Yucatan or a similar depression called the Colombian Basin Crater, which ended the Cretaceous (Hildebrand and Boynton, 1991).

Because of the antiquity of this unique area, and its former isolation as a separate island, it is extremely rich and diverse in endemic species, including many reptiles, butterflies, and other insects. The 8 species of *Phyllophaga* collected here, including 4 new

species (2 of them known from no other locality), is additional evidence of its importance. A concerted effort should be made by the Dominican government to address conservation efforts for the entire Baoruocos. I initiated a cooperative project to build a biological station (Bio-Eco-Dom) at this site, through the Center for Systematic Entomology (Gainesville, Florida) and the Museo Nacional de Historia Natural (Santo Domingo). It has been delayed because of political problems, but it still has great potential for future studies there.

Phyllophaga latiungula Wolcott
(Fig. 90, 429-439)

Phyllophaga latiungula Wolcott (1928a: 28; Sanderson, 1951: 277; Fig. 49-50, 69, 71)

The original description of this species was based on a single female: HAITI: Hotel Mon Repos, Carrefour (near Port-au-Prince), 2-IV-1925 [Type USNM# 40662, examined]. The brief description was not accompanied by an illustration of the female genitalia, but it was easily distinguished from the few small species known then (*minutissima* and *audanti*) because of its pruinose coating ("plumbeus bloom" of Wolcott). Sanderson (1951) described 4 additional small species in this group (*cartaba*, *imprima*, *mella*, *panicula*), all of which are pruinose.

It is most similar to *cartaba* in external and genitalic characters. The male genitalia are distinctive; the parameres are elongate, projecting downward in *cartaba* (Fig. 241-245), whereas they are apically rounded, but projecting posteriorly in *latiungula* (Fig. 431). The aedeagus in *cartaba* is cylindrical, terminating in an evagination containing 3 or 4 spines imbedded deeply within (Fig. 242, 247); that of *latiungula* is lyre-shaped (Fig. 430, 432), with several spines (Sanderson says 12-13, presumably from cleared specimens) imbedded in soft tissue, 3 or 4 pointing forward and 8 pointing backward. In addition to distinctive genitalia, it is smaller (L. 8.5, W. 4-4.5 mm) than *mella* (L. 13.5-15, W. 6.5-7 mm), *imprima* (L. 10.5-12, W. 6 mm), and *panicula* (L. 11.5, W. 5 mm). It is now known only from the area around Port-au-Prince, Haiti.

The male antennal club is oval (Fig. 433, 435), the outer lamellae bun-shaped, with middle lamella flattened on both sides, and sandwiched between. The lamellae have large receptors on most of surfaces (Fig. 435), which presumably play a role in locating the females.

Specimens examined. Total 21, all from HAITI: In addition to the holotype female, I have seen the following: (7) Port-au-Prince, R.J. Crew [MCZC, INHS]; (13) Petionville, 29-III-1972, B.K. Dozier [FSCA].

Phyllophaga leptospica Sanderson
(Fig. 91, 440-449)

Phyllophaga leptospica Sanderson (1951: 262; Fig. 13, 14, 64)

This large species (L. 19 mm) was briefly characterized by Sanderson (1951), from the male holotype and an "imperfect" female allotype. As he suspected, the female superior plates are provided with setae (not shown in his Fig. 64, but shown here in Fig. 446-449). These were merely labeled "Hayti" [MCZC]. No additional specimens have been reported for over 50 years. It now appears that it is another of the "South Island" species, found in both southern Haiti and the Dominican Republic.

Generally *leptospica* is slightly larger (L. 18-19 mm) than *romana* (L. 16-19 mm), and somewhat more convex (Fig. 91 vs. 108). The male genitalia (Fig. 440-445) are similar to its "sister species" *romana*, but that species has the ridge or carina (often a line of darker color) incomplete on the face of parameres (Fig. 691, 693), and the dorsum of the phallobase gently rounded, not parallel (in lateral view, Fig. 690) with the paramere apical margin as it is in *leptospica* (Fig. 444). The female genitalia (Fig. 446-449 vs. 697-699) are similar and variable, so males are needed for confirmation. Both species are pruinose, but related to *hogardi* because of the enlarged apical spine of the elytral suture. That species is non-pruinose, extremely shiny, and the male genitalia have the parameres fused ventrally.

Specimens examined. Total 170. HAITI: (3) Dept. du Sud, Ville Formon, 31km NW Les Cayes, S. slope of Morne Formon, Massif de la Hotte, 18-20N, 70-01W, 7-8-IX-1995, 1405 m, R. Davidson, G. Onore, J. Rawlins, disturbed forests and fields [CMNH]. DOMINICAN REPUBLIC (new country records): (151) Prov. Barahona, nr. Filipinas, Larimar Mine, 26-VI-7-VII-1992, R.E. Woodruff, P.E. Skelley, 3300 ft, blacklight trap [FSCA, USNM, MHND, INHS, NHMB, MCZC]; (11) same, except 3-11-VII-1993, R.E. Woodruff [FSCA]; (5) same, except 26-VI-1999, mercury vapor light [FSCA].

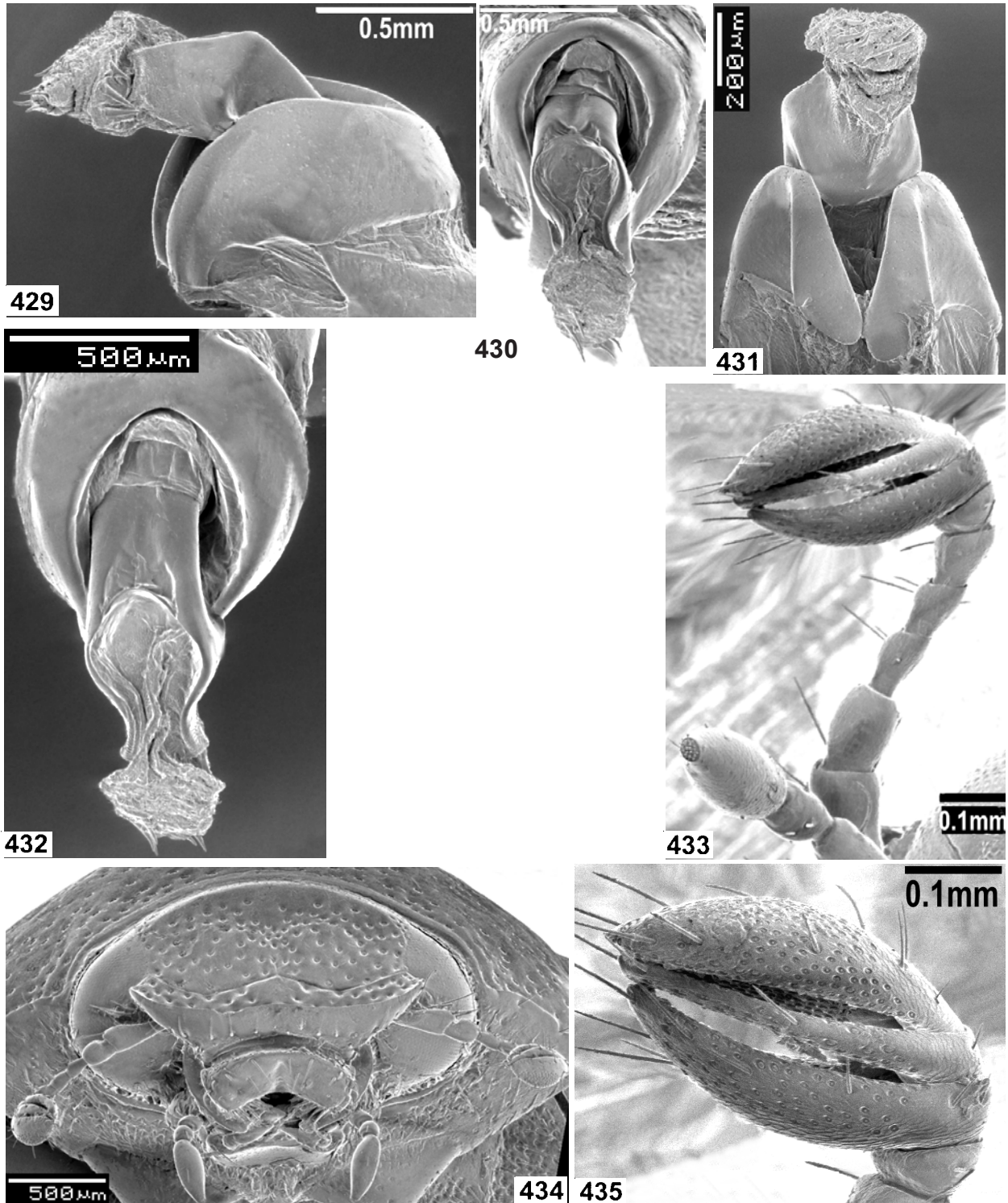


Fig. 429-435. *Phyllophaga latiungula* Wolcott. Male. 429-432 genitalia: 429) lateral; 430) caudal; 431) ventral; 432) dorso/caudal; 433) antenna; 434) head, frontal; 435) antennal club [note enlarged sensors, except on lamellar base].

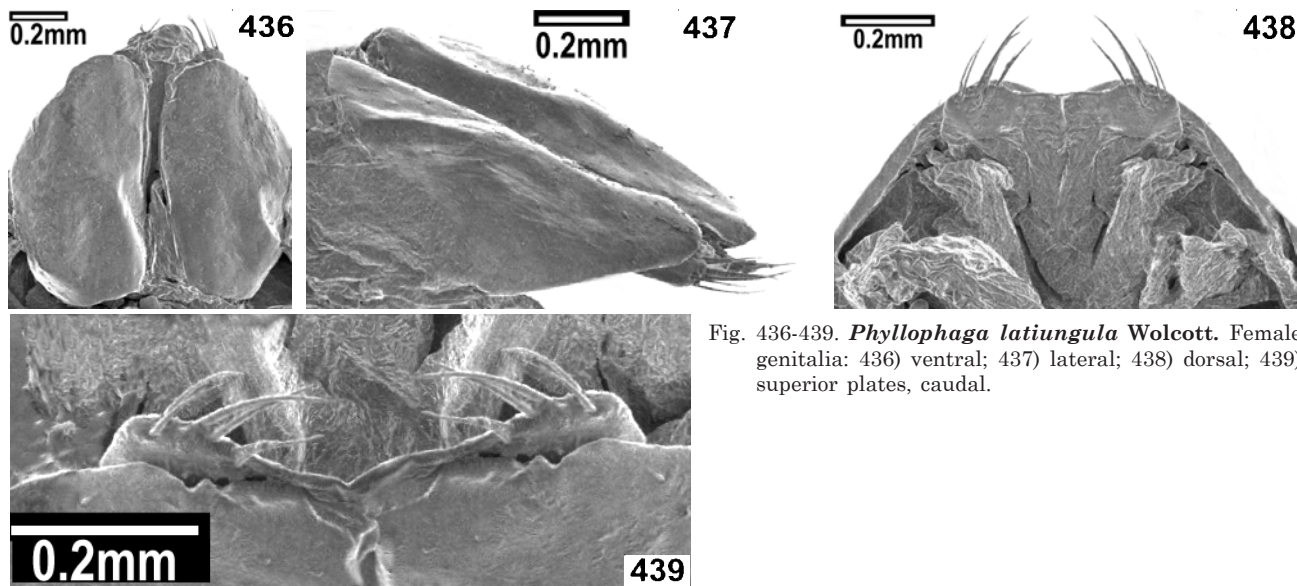


Fig. 436-439. *Phyllophaga latiungula* Wolcott. Female genitalia: 436) ventral; 437) lateral; 438) dorsal; 439) superior plates, caudal.

Phyllophaga mali Wolcott
(Fig. 92, 450-460)

Phyllophaga mali Wolcott (1928: 25; Fig. 2; Sanderson, 1951: 272-273; Fig. 4-42, 77)

This is probably the most common and widespread species, and it is also quite variable in the shape of the aedeagal processes. As Sanderson (1951) said "This is one of the most variable of all known Hispaniolan *Phyllophaga* if all the individuals studied actually constitute one species." However, this variation does not seem to be correlated with geographic or altitudinal distribution. The aedeagal median projection normally terminates in a distinctive "nail puller or crowbar head". This head is the most variable portion (Fig. 453-455), the tip only slightly expanded in the holotype.

The holotype was from Kenscoff, Haiti [USNM# 40659, examined], feeding on apple and rose [presumably foliage]. Although Wolcott gave no etymology for the name, it is an appropriate double entendre, the Spanish "mal" meaning bad (pest) and the generic name for apple being "*Malus*". Several species are similar externally and probably related to *mali*, and all have the reddish (ferrugineous), pruinose dorsum. The male genitalia are very complicated and nearly indescribable, so illustrations here for those in the group should be consulted: *neglecta* (Fig. 513-522) is smaller, but the most similar in male and female genitalia; *barrosa* (Fig. 199-209) is known from a unique female; *haitiensis* (Fig. 333-352) is slightly larger, more iridescent, complicated male genitalia,

and unique female genitalia; *rustica* (Fig. 700-709) is known from 2 males only, is larger, and the lower median aedeagal projection is not present, only a dorsal and 2 lower acuminate projections.

Specimens examined. Data were recorded for the nearly 700 specimens seen (only 5 from Haiti, including the holotype), but space limitations prohibit listing them here. Dominican Republic Provinces represented: Baoruco, Barahona, Dajabon, Distrito Nacional, Elias Piña, El Seibo, Hato Mayor, La Altagracia, La Vega, Monseñor Nouel, Pedernales, Puerto Plata, San Cristobal, San Juan, Santiago.

Ecology. Because it is so abundant and widespread, it is probably one of the species which causes economic damage as larvae. Although most specimens have been collected at blacklight, it has been recorded from semiarid regions, deciduous forest to high elevation, and pine forest. Elevations range from 30 ft to 1973 m, and seasonally from April to November. Serious efforts should be made to rear larvae to adults, so that the most economically important stage can be identified to species. Currently no Hispaniolan white grubs can be identified.

Phyllophaga marciano Woodruff, **new species**
(Fig. 93, 112-113, 461-483)

Holotype male. DOMINICAN REPUBLIC: Prov. Elias Piña, Rio Limpio, 26-27-IV-2000, 2400 ft, R.E. Woodruff, T.J. Henry, blacklight trap [FSCA].

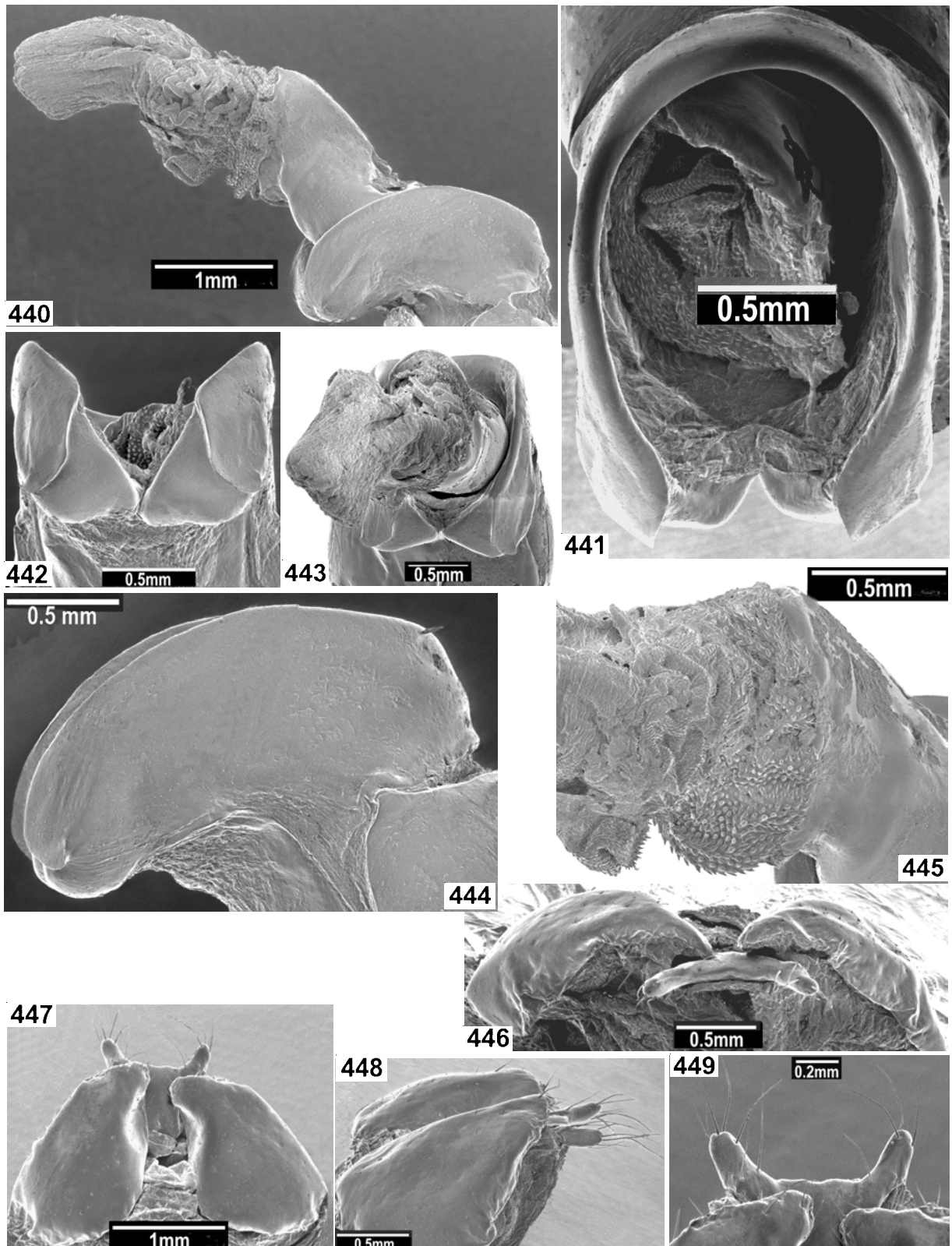


Fig. 440-449. *Phyllophaga leptospica* Sanderson. 440-445 Male genitalia: 440) lateral; 441) caudal (aedeagus removed); 442) ventral; 443) caudo/ventral; 444) parameres, lateral; 445) spiny area of aedeagus; 446-449 female genitalia: 446) caudal; 447) ventral; 448) lateral; 449) superior plates.

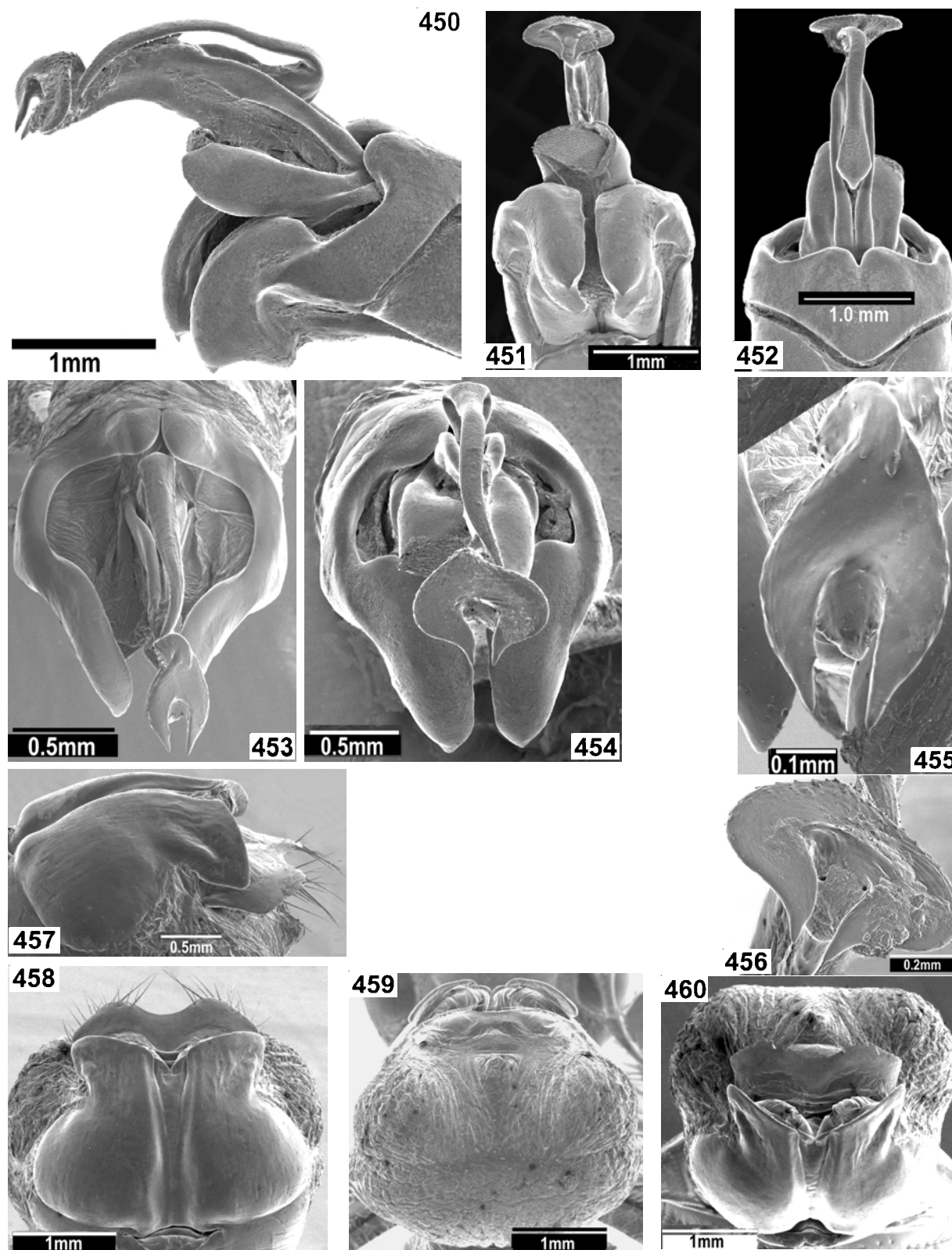


Fig. 450-460. *Phyllophaga mali* Wolcott. 450-456 Male genitalia: 450) lateral; 451) ventral; 452) dorsal; 453-454) caudal (2 different specimens); 455-456) same, aedeagal tip enlargement; 457-460 female genitalia: 457) lateral; 458) ventral; 459) dorsal; 460) caudal.

General description. (Habitus, Fig. 93). Exceptionally large (L. 30, W. 15 mm). Dark grey-brown above, light yellow below, heavy bodied, head and pronotum densely punctate, glabrous, scutellum densely punctate, elytra pruinose, silky; antennae exceptionally small for size of beetle.

Head. (Fig. 472). Clypeus emarginate, anterior angles obtuse, appearing lobed, gently curved to posterior angles which are abruptly curved to frontal suture. Surface densely, often contiguously punctured throughout. Margin reflexed, especially at posterior angles, frontal suture deeply impressed. Frons longer than clypeus, densely and coarsely punctate as clypeus, posterior band with a few punctures, broken longitudinally at side by band of punctures above eye (Fig. 482). Eye canthus carinate, with about 7 long, reddish setae and a few shorter ones. **Antenna** (Fig. 473) exceptionally small, compared to beetle size, club oval, receptors not noticeable, sub-equal to previous 4 antennomeres, antennomeres 3 shorter than 4, sub-equal to 5, which is longer than wide, slightly projecting anteriorly, 6 much reduced, wider than long.

Pronotum. Nearly twice as wide as long at widest point. Glabrous, shiny between dense punctures, medially with vestige of impunctate longitudinal line on posterior half; punctures often coalescing, especially on sides, rarely separated by more than 1 diameter and often much less. Anterior margin slightly raised, with a groove behind medially, more punctate groove toward anterior angles. Anterior angles projecting, pointed, acute (Fig. 93); lateral angles nearly median, not prominent, pronotum widest at posterior angles. Lateral margin with a few long setae, crenulate in anterior half, margin slightly reflexed to posterior angles, which are nearly 90 degrees; posterior margin marked by chevron shaped punctures, but marginal line obsolete medially.

Scutellum. (Fig. 474). Punctate as pronotum (compare impunctate scutellum of *eladio*, Fig. 77-78).

Elytra. Widest at posterior third, appearing swollen. Beautifully pruinose (the "plumbeus bloom" of Wolcott) except for top of humeral angles and lateral margin just below; surface matte, due to "fingerprint-like" sculpture (Fig. 469). Surface glabrous, fairly evenly punctate, punctures much shallower and sparser than head and pronotum. Elytral suture carinate only at apical declivity and beyond, ending in a very tiny straight spine (Fig. 470). Elytral apices smoothly

rounded, slightly indented near apical spine, costae slightly convex, sutural one more so, sutural costae with punctures scattered and less dense. Lateral margin weakly carinate from humeral angles to suture, area below humerus depressed, surface more densely punctate, margin slightly dimpled, with a blue/grey sheen.

Pygidium. Glabrous except for terminal fringe, wider than long, punctures dense, many coalescing into wrinkles, but relatively shallow, pygidium barely convex. Tergite above extending beyond elytra, quite convex, swollen, with a crescent-shaped slight depression anteromedially (as a darker line).

Legs. Protibiae reddish, basal tooth well-developed, middle tooth nearer proximal than basal, terminal spur acuminate, sharp, extending beyond base of first tarsal segment. Protarsal segments 2, 3, and 4 becoming progressively longer, fifth 1.5X fourth; claws sharp, middle tooth longer than apical, tip slightly projected posteriorly; forming notch with quadrate base. Mesotibial transverse carina incomplete, marked by teeth and spines; longitudinal carina noticeable for most of tibial length; apical spurs acuminate, sharp pointed, nearly straight; tibial apex appearing toothed, surrounding apical fringe of about 8 widely separated setae with large sockets. First mesotarsal segment expanded apically on both sides, segments 1-4 progressively shorter, fifth 1.5X fourth; tarsal claws as in protibia. Metatibial transverse carina with gap more prominent, but marked with teeth and spines as in mesotibia; longitudinal carina nearly complete; tibial apex not toothed as in mesotibia; apical fringe with 11 spines, widely spaced and short; apical spurs elongate, inner face concave, inner spur curved toward body and extending to middle of second tarsal segment, outer spur shorter and barely curved (Fig. 475). Metatarsal segments 1 and 2 both expanded at apex with large spines on inside and out; segments 2 and 3 subequal, 3 with enlarged spine only on inner face, 4 shorter, fifth 1.1X third.

Abdomen. Venter extremely convex, swollen, sternites fused medially, punctures scattered, shallow, nearly glabrous, with scattered elongate setae on penultimate sternite which is depressed apically and slightly more densely punctate; ultimate sternite with typical transverse, shallow groove, slightly punctate with a few scattered setae. Little sexual modification of sternum, male appearing effeminate.

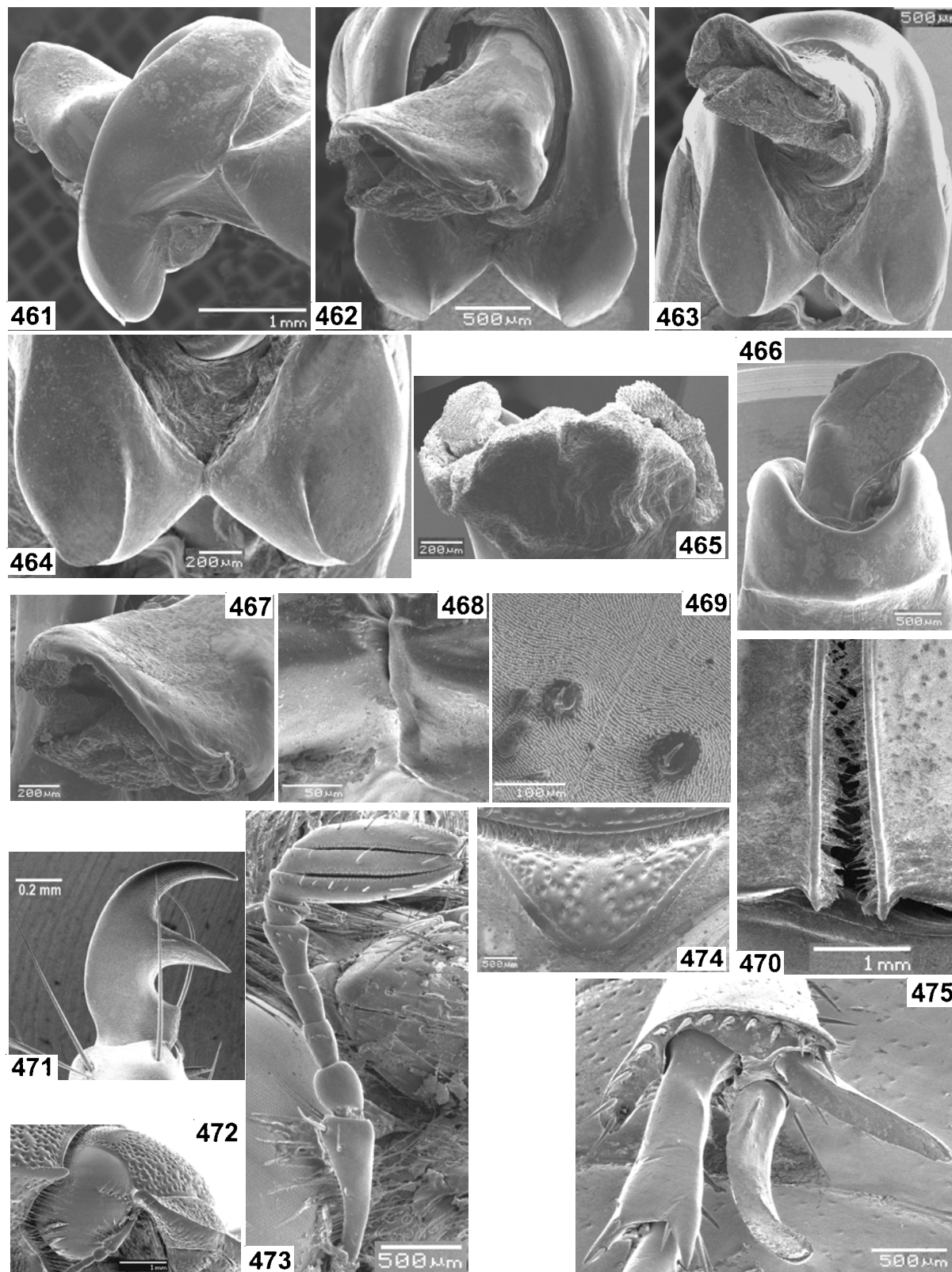


Fig. 461-475. *Phyllophaga marceno* Woodruff. 461-468 Male genitalia: 461) lateral; 462) caudal; 463) caudo/ventral; 464) paramere tips; 465) aedeagal tip; 466) dorsal; 467) spinose aedeagal tip; 468) paramere junction; 469) elytral sculpture; 470) elytral tips; 471) protarsal claw; 472) head, lateral; 473) antenna; 474) scutellum; 475) metatibial apex.

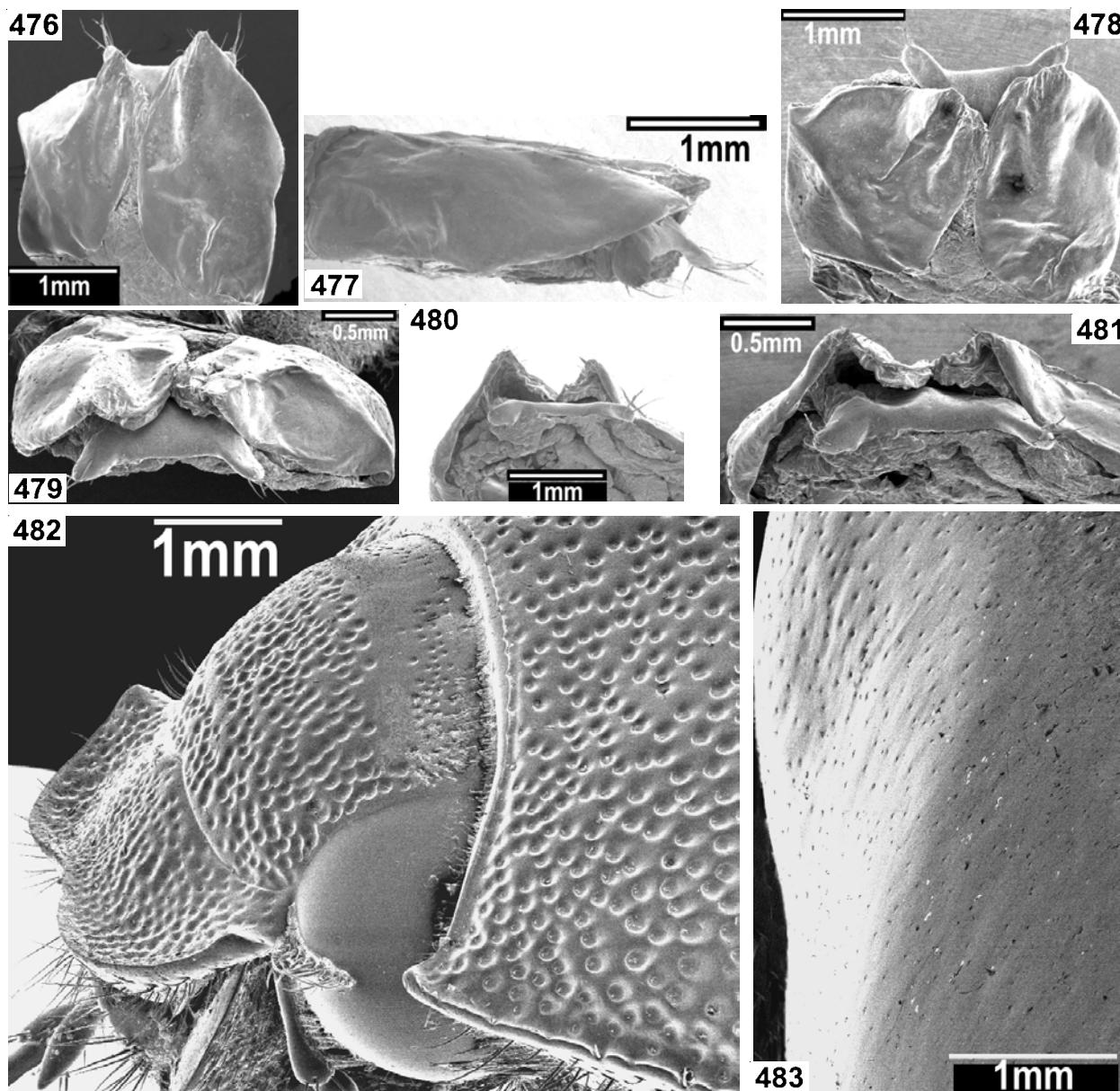


Fig. 476-483. *Phyllophaga marcana* Woodruff. Female. 476-481 Genitalia: 476) ventral; 477) lateral; 478) caudo/ventral; 479) caudal; 480) dorsal; 481) same, different angle; 482) head dorso/lateral; 483) smooth area above lateral margin of elytron.

Genitalia, male (Fig. 461-468). Relatively simple, of the *hogardi* type and most similar to *eladio*. Paramere gently rounded in lateral view, with barely indicated apical carina of face pointing down and back; tips fused internally (Fig. 464), as in *hogardi* and *eladio*; carina on labial face incomplete, similar to *romana*. Aedeagus dorsally heavily sclerotized, projecting as a foot (Fig. 462), tip rounded, its lower surface spongy and setose, evaginated (Fig. 465).

Allotype female (Fig. 476-481). Same data as holotype [FSCA]. Similar to male, antennae nearly equal

in size. Elytral margin below humerus smooth for 2/3 length, shiny, and less pruinose compared to remainder of elytra (Fig. 112-113, 483); scutellum with a vestige of median pronotal line impunctate. Elytral tumosities less pruinose, somewhat shiny, pygidium more convex, slightly more elongate than male. Posterior tibial spurs broader, more spatulate-shaped, first tarsal segment much expanded inside and out as a spur, but second with spur only on inside. All legs reddish, metafemur bicolored yellow and red. Abdomen more convex, ultimate segment without noticeable transverse groove. **Female genitalia** similar to

that of *eladio*; superior plates fused, margin between lateral angles recessed, angles prolonged, teat-like (in *eladio* nearly in same line with median, not projecting). Only 2 females of *marcano* available, so little can be said about variation.

Comparisons. This huge species is similar only to *eladio*, and the 2 are obviously “sister species”. Although the genitalia are distinct (Fig. 461-467 vs. 261-264) they are similar and their internally fused parameres tie them to the *hogardi* group. They may be separated externally by the impunctate scutellum of *eladio*, densely punctate in *marcano* (Fig. 474); male metatibial spur with an S-shaped twist in *eladio* (Fig. 265-266), whereas it is only curved in *marcano* (Fig. 475); and the pygidium is glabrous in *marcano*, but covered with short, stiff setae in *eladio*. It appears that, in some cases when external differences abound, genitalic differences are minimal; certainly true in these 2 “sister species”.

Specimens examined. Total 12, including holotype and allotype (all **DOMINICAN REPUBLIC**). Paratypes are designated as follows: (2 males, 1 female) with same data as holotype [FSCA]. (5) Prov. La Estrelleta, 4 km SE Rio Limpio, 24-25-V-1973, D. and M. Davis, ca. 760 m [USNM]. Both collections were probably made very near the same location.

Note: Two additional specimens have been identified as this species but are not made paratypes, because the genitalia differ slightly. Only a single pair is known, so the extent of variation is not certain. They are larger, the male being 33 mm long and 17 mm wide, whereas the female is 30 mm long and 17 mm wide. They were collected on the “South Island”: Prov. Pedernales, El Banano, Rio el Mulito, [21km N. Pedernales, 18°09.3'N, 71°45.6'W, 280 m], 14-V-1995, K. Guerrero, O. Flint [MHND]. This area has produced several new species of Trichoptera, recently described by Flint and Sykora (2004).

Ecology. All my specimens were collected at blacklight in a disturbed area, but near a small stream with dense trees. This area is a few kilometers from the town of Rio Limpio, at an altitude of 2400 ft, in the shadow of Nalga de Maco. This is the far western end of the Cordillera Central, the peak being 1960 m. The few specimens of *marcano* were taken in April and May. Near the type locality, another localized endemic scarab (*Mimeoma nigra* Endrödi, 1997), was collected. The type series of that species was collected by

D. and M. Davis at 4 km SE Rio Limpio. No other species in the genus is known from the Caribbean.

When the female specimens were collected, the smoother lateral elytral border (Fig. 483) appeared as broad stripes and fluoresced under the standard BL (long wavelength) blacklight, very distinct from the males. These huge *Phyllophaga* fly well, but were apparently confined to the forested area along the stream. None was taken in a trap, set 100 ft away in the open.

Etymology. The name Marcano is perhaps the best known one in Hispaniola in the Natural Sciences. Rather than Latinizing it, I have chosen to use the species name as the original spelling of the surname (as a noun in apposition) partly for the sake of euphony in Spanish. For more than 30 years, and 46 trips, the late Professor Eugenio de Jesus Marcano was always available to me and my colleagues. While Director of the Museo Nacional de Historia Natural, he was instrumental in developing the insect collections, and his collecting has provided a great legacy for future taxonomists. As a professor at Universidad Autónoma de Santo Domingo he trained and stimulated untold young naturalists. He excelled as a botanist and published several major works, including “Plantas venenosas en la Republica Dominicana” and “Ruta ecológica de la Provincia Monseñor Nouel”. He was recognized with 2 honorary doctoral degrees. His friendship and camaraderie in the field will never be forgotten.

Additionally the species is named to honor his entire family, especially his son, José Marcano, who is a well known naturalist and conservationist in his own right. He accompanied Dr. Thomas Henry (Smithsonian) and me to the type locality in 2000; without his knowledge and assistance, this species may not have been described. We also fondly recall, and still savor, the fabulous *san cocho*, with herbs collected by Eugenio, served by Mrs. Marcano to huge groups of visitors. We know that spouses rarely get proper recognition for their support, but we know that Eugenio and José were blessed with the best. We therefore wish to dedicate this species to the entire Marcano family.

Phyllophaga mella Sanderson
(Fig. 94, 484-500)

Phyllophaga mella Sanderson (1951: 278-9; Fig. 54-56, 74)

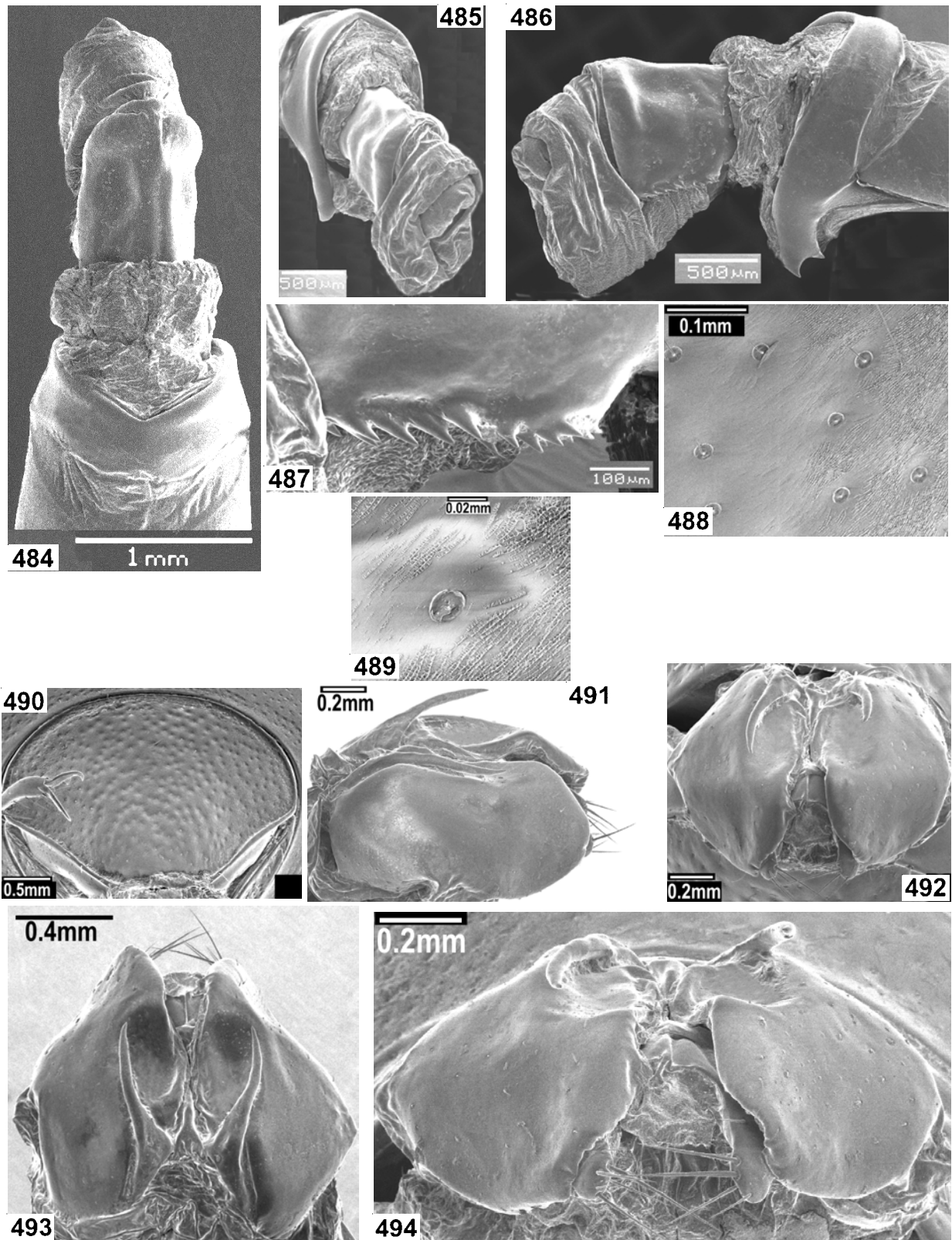


Fig. 484-494. *Phyllophaga mella* Sanderson. 484-487 Male genitalia: 484) dorsal; 485) caudo/lateral; 486) lateral; 487) aedeagus lateral margin; 488-490 female pygidium: 488) junction of smooth central area and pruinose sides; 489) enlarged single puncture in 488); 490) caudal, entire; 491-494 female genitalia: 491) lateral; 492) caudo/ventral; 493) ventral; 494) caudal.

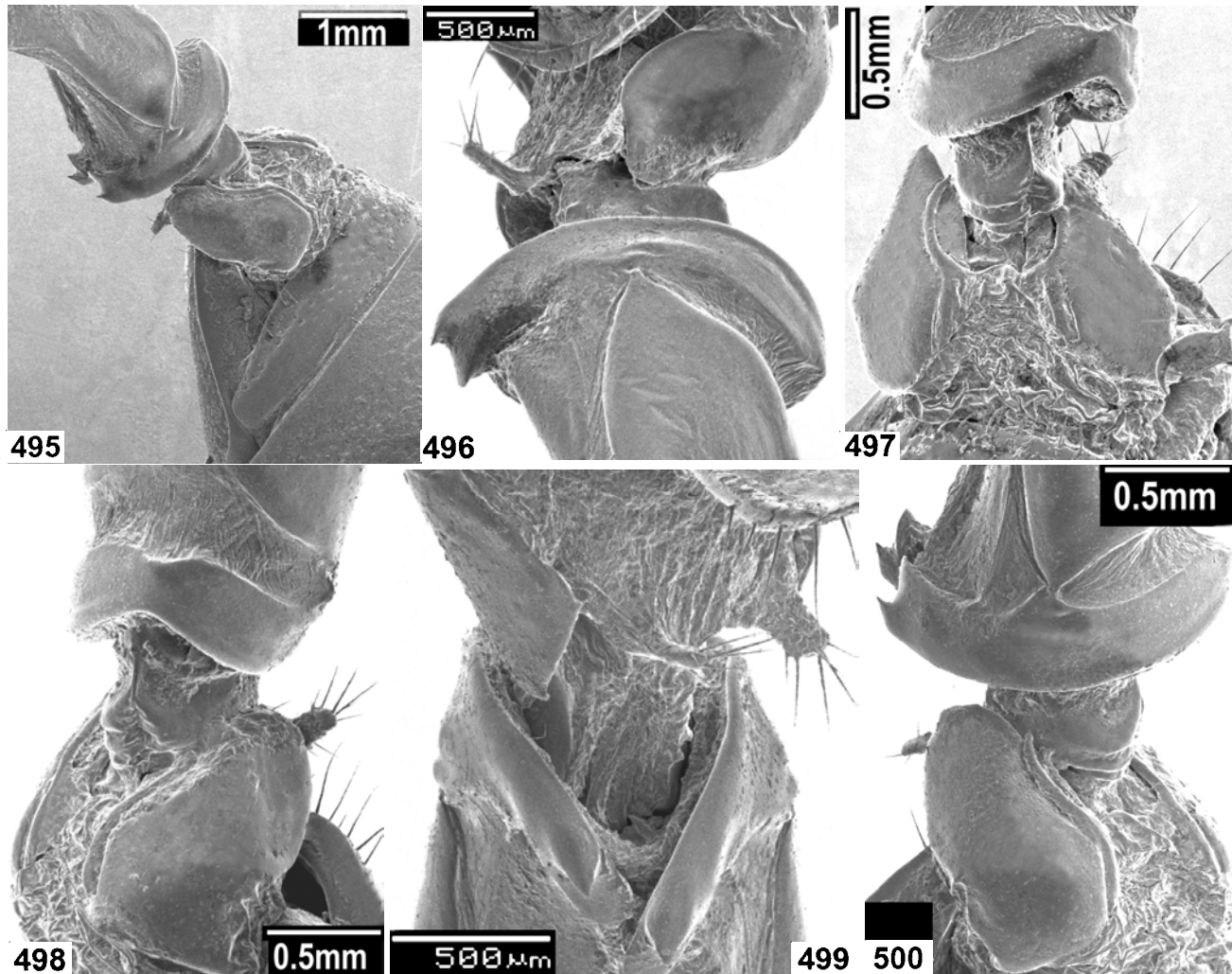


Fig. 495-500. *Phyllophaga mella* Sanderson. Mating pair. The female apparently applied the specialized hooks, holding the male genitalia, which was extracted and remained attached to the female when collected. No other female *Phyllophaga* are known with such hooks. 495) ventral female abdomen, in coitus; 496-500: various views of copulation. Note that the male parameres are external, and only the aedeagus actually penetrates the female between the inferior and superior plates. Although the parameres, because of their various modifications, must play an important part in mating behavior, in this case they are not involved in the “lock & key” mechanism previously surmised for these structures.

This medium sized, pruinose species (L. 13.5-16, W. 6.5-7 mm) is one of the easiest to identify from its habitus (Fig. 94). It was described from 7 specimens, all from DOMINICAN REPUBLIC and collected by [P.J.] Darlington, [Prov. Santiago?], foothills Cordillera Central, south of Santiago, June 1938, [holotype and 2 paratypes MCZC, INHS, examined]; Mt. Diego de Ocampo, 3000-4000 ft, July, 1938, [allotype, MCZC]; [Prov. Santiago] San José de las Matas, 1000-2000 ft, June, 1938 [2 paratypes, MCZC, INHS]; Prov. La Vega, Constanza, 3000-4000 ft, August, 1938 [1 paratype, MCZC].

The male and female genitalia are also very distinctive (Fig. 484-494). The male has simple clasp-

ers, but the aedeagus has the lower lateral edge serrate, the teeth sharp, pointing backward (Fig. 487). The female is unique in having inferior plates with 2 apically projecting, moveable large spines (“ice-tongs”) arising from base (Fig. 491-494); plates themselves concave behind these; normally these spines are appressed in pinned specimens, but they can be moved easily in alcoholic or fresh specimens. No other known *Phyllophaga* has such structures.

Fortunately a single female was collected which had the male genital capsule (without the beetle) hanging from its abdomen. When these were later retrieved from alcohol, they were still in place (Fig. 495-500) and illustrate the use that these structures

may serve. They can be seen hooked into the integument of the male aedeagus and holding it in place; it must be a rare occurrence to completely extract it from the male's body! Although the old "lock and key" theory for the magnificently modified male genitalia may be involved sometimes, it appears that the female is in control with these moveable spines. Additional ideas about female selections have been discussed by Eberhard (1987, 1990).

Specimens examined. Total 260, all DOMINICAN REPUBLIC: **Prov. Dajabon:** (2) 13 km S. Loma de Cabrera, 20-22-V-1973, D. and M. Davis, ca. 400 m [USNM]. **Prov. Elias Piña:** (56) Rio Limpio, 26-27-IV-2000, R.E. Woodruff, T.J. Henry, 2400 ft, blacklight trap [FSCA, MHND, INHS]. **Prov. La Estrelleta:** (1) 4 km SE Rio Limpio, 24-25-V-1973, D. and M. Davis, ca. 760 m [USNM]. **Prov. La Vega:** (2) Constanza, 2-6-VI-1969, Flint and Gomez [USNM]; (4) Constanza, 10-V-1972, J. and S. Klapperich, 1250 m [NHMB]; (1) Jarabacoa, 21-VII-1980, A. Norrbom, 600 m [CMNH]; (1) Convento, 12 km S. Constanza, Flint and Gomez [USNM]; (2) Cordillera Central, 4.1 km SW El Convento, 18-50-30N, 70-42-48W, and 18-50-33N, 70-42-44W, 31-V-2003, Rawlins, Davidson, Young, Nuñez, Acevedo, 1730 m, dense secondary evergreen forest with pine, UV light [CMNH]; (9) Cordillera Central, Loma Casabito, 15.8 km W. Bonaó, 19-02-12N, 70-31-08W, 28-V-2003, Rawlins, Davidson, Young, Nuñez, Acevedo, 1455 m, evergreen cloud forest, east slope, hand collected [CMNH]; (1) 15 km. N. Jarabacoa, 21-VII-1987, J. Rawlins, R. Davidson, 240 m [CMNH]; (57) 5 km. W. Manabao, Paso de la Perra, Finca Eladio Fernandez, 19-23-IV-2000, R.E. Woodruff, T.J. Henry, 3050 ft, blacklight trap [FSCA]; (6) same, except 14-16-V-2001, R.E. Woodruff [FSCA]; (18) La Cienega de Manabao, [Parque Nacional Armando Bermudez], Pk. Hdqtrs. 3-5-VII-1999, R.E. Woodruff, 3000 ft [FSCA]; (1) same, except 11-V-2001 [FSCA]; (59) same, except 20-21-IV-2000, R.E. Woodruff, T.J. Henry [FSCA]. **Prov. Puerto Plata:** (1) La Cumbre, 25-IV-1978, R.E. Woodruff, G.B. Fairchild, 1300 m, blacklight trap [FSCA]. **Prov. San Juan:** (33) Sierra de Neiba, 9.4 km SSW El Cercado, 18-39-18N, 71-32-51W, 22-VI-2003, 1974 m, Rawlins, Davidson, Young, Nuñez, Acevedo, de la Cruz, meadow near mature pine forest, hand collected [CMNH]; (1) same, except 18-39-15N, 71-32-52W, 1974 m, mature pine forest, malaise trap [CMNH]; same, except Sabana de Silencio, 10 km SSW El Cercado, 18-39-07N, 71-33-21W, 2009M, cloud forest along Dantonia savannah, UV light [CMNH]. **Prov. Santia-**

go: (1) Mata Grande, 4-IV-1970, E.J. Marcano #6889 [FSCA].

Taxonomic notes. The pruinosity of the elytra of *mella* is characteristic, because the irregular surface refracts light in such a way as to vaguely resemble spots. This phenomenon is noticeable on the male of *canoá*, and to a lesser degree on *imprima* (smaller, L. 10.5-12 mm) and *espina* (male aedeagus with long flexible filaments). As mentioned above, the genitalia of both sexes are unique and easily distinguished from all others by our SEM photographs.

Ecology. Although it has been collected in good numbers, little is known of its habits or food plants. It has been taken from 400 to 1974 m elevation, in evergreen cloud forest, dense evergreen forest with pine, and broad leaved forest in the Cordillera Central, the Sierra de Neiba, and one record for the Cordillera Septentrional. Few higher altitude species have such wide distribution. It has been collected by hand, in Malaise traps, and blacklight traps.

Phyllophaga minutissima Wolcott
(Fig. 95, 501-512)

Phyllophaga minutissima Wolcott, Wolcott 1928b: 76
(corrected genitalia figure).

Cnemarachis minutissima (Wolcott), Blackwelder,
1944: 223.

Phyllophaga minutissima Wolcott, Sanderson, 1951:
266-7; Fig. 26, 27, 71; Evans, 2003: 125.

As the name implies, this is an extremely small species (L. 6-7, W. 3 mm) that can be recognized from all others in Hispaniola by its size. Unfortunately, Saylor (1943) also used the same name in *Phyllophaga* (*Phytalus*) for a Mexican species. For this homonym, Evans (2003: 91) created the replacement name *diminuta*. Wolcott described his species "...from an abundance of males and a few females collected at light at Port-au-Prince, Haiti, March 17 to May 5, and only males September 21 to 31, 1927". The holotype (examined) and allotype are deposited in USNM. Unfortunately, the illustration (Fig. 5, p. 29) of the male genitalia was incorrectly labeled, and represented *hogardi*. Later, in another issue of the same journal, Wolcott (1928b: 76) corrected this mistake and provided a new illustration.

Specimens examined. In addition to the holotype and 2 paratypes, I have seen only 2 additional specimens: HAITI: (1) Petionville, 29-III-1972, B.K. Dozier

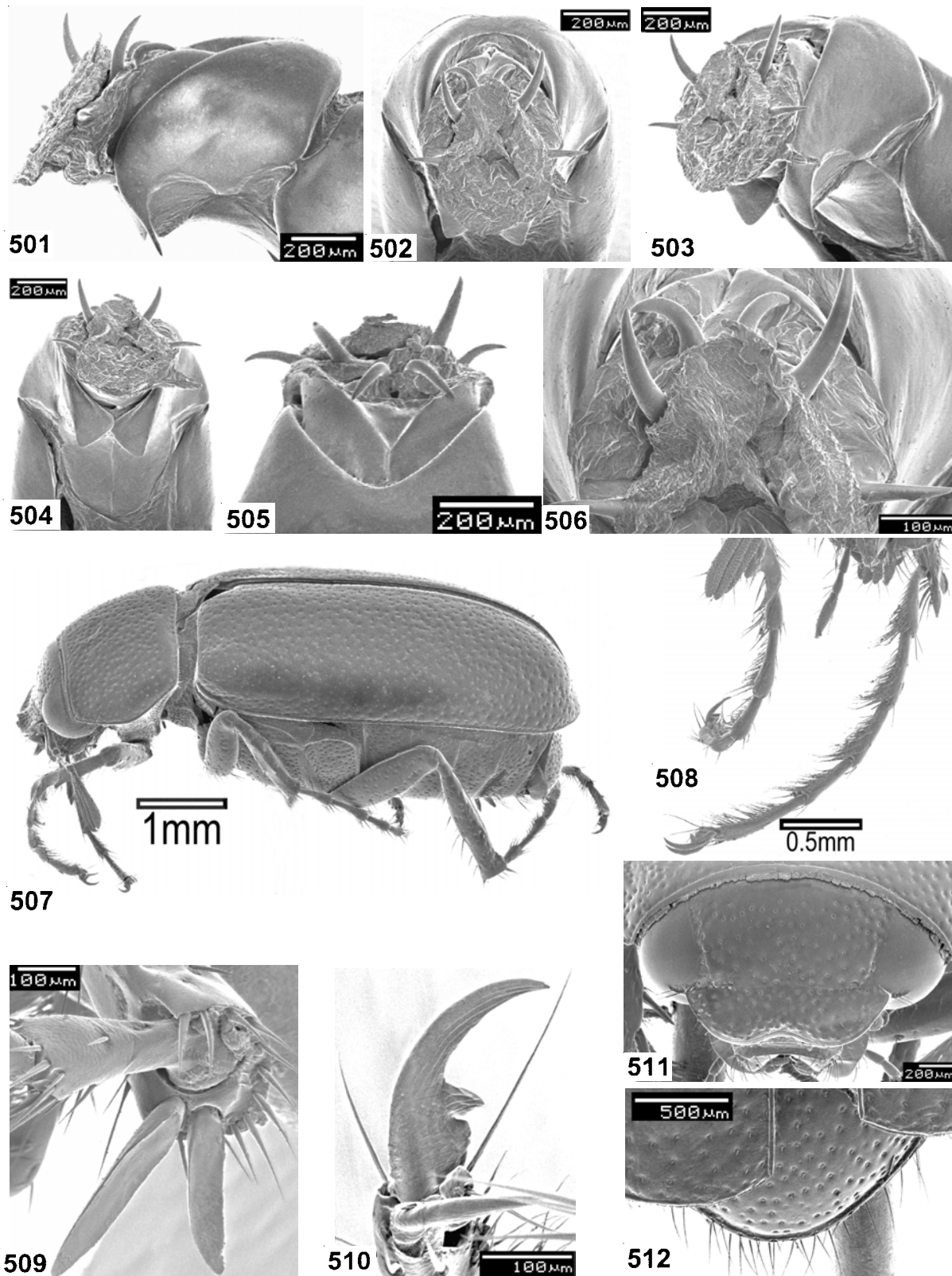


Fig. 501-512. *Phyllophaga minutissima* Wolcott. Male. 501-506 Genitalia: 501) lateral; 502) caudal; 503) caudo/lateral; 504) ventral; 505) dorsal; 506) aedeagal tip, caudal; 507) beetle, lateral; 508) protarsi (note long setae); 509) metatibial apex; 510) protarsal claw; 511) head, dorsal; 512) pygidium and elytral apices.

[FSCA]. DOMINICAN REPUBLIC (**new country record**): Prov. Dajabon, Rio Massacre, Balneario Don Miguel, 7 km SW Dajabon, 26-V-1973, D. and M. Davis, 40 m [USNM]. Sanderson (1951) saw only 2 paratypes and 10 additional specimens, all from Port-au-Prince. It would be interesting to learn whether the species is still as abundant at Port-au-Prince as it was nearly 80 years ago.

Taxonomic notes. Although recognizable by its small size, other characters include the glabrous surface, shiny, parallel sided, protarsi with exceptional brush of setae ventrally (Fig. 508), the elytra are pale straw-colored with darker border, tarsal claws with middle tooth short, arrow-shaped, neared base and the notch behind is uniquely narrow, constricted (Fig. 510), metatibial spurs (Fig. 509) nearly straight, face flattened, and the distinctive genitalia (Fig. 501-506). The male genitalia have paramere tips directed posteriorly, the face flattened and triangular, the aedeagus with 6 exceptionally large, slightly curved spines, nearly evenly spaced, arranged like a crown. No females were available for SEM photographs; reference is made to the illustration in Sanderson (1951: Fig. 71) which has inferior plates separated, rounded internally, the superior plates fused, nearly straight or truncate apically, the lateral angles barely produced, with 4 long setae. He compared it to *cartaba* (his Fig. 70), which has the superior plates emarginate medially, the lateral angles more produced, with 5 setae.

Phyllophaga neglecta (Blanchard)
(Fig. 96, 513-522)

Ancylonycha neglecta Blanchard 1850: 137.

Ancylonycha neglecta Blanchard, Burmeister 1855: 336.

Phyllophaga neglecta (Blanchard), Wolcott (1928a: 27).

Cnemarachis neglecta (Blanchard), Saylor 1942: 159.

Phyllophaga neglecta (Blanchard), Sanderson, 1951: 271-272, Fig. 37-39, 75.

Superficially and in genital characters, this species resembles *mali*, but it is usually smaller. Sanderson (1951: 271-272) gave measurements as follows: *mali* (L. 17.5-22, W. 9-11 mm); *neglecta* (L. 15-19, W. 7-9 mm). Both are pruinose and ferruginous, with *mali* often more reddish and *neglecta* more yellow brown. The male genitalia (Fig. 513-518) are as indescribable as those of *mali*, but the aedeagus in *neglecta* does not terminate in a bifurcate ("nail

puller") projection (Fig. 453-456), and the median projection is not long, acuminate, and pointed; paramere apices (caudally) truncate in *neglecta*, teat-like in *mali*. Female genitalia are similar, but in *neglecta* inferior plates (Fig. 519-522 vs. 458-460) are basally separated (usually for most of entire sutural length), the constriction on lateral margins not deep or rounded below, and more truncate at apices ("subquadrate" *vide* Wolcott, 1928a).

Although there seems little doubt of the correct association of this name, neither Wolcott nor Sanderson mention examination of Blanchard types; I did not locate or see them either. The original identifications for Haitian specimens of Wolcott (1928a) were provided by G.J. Arrow and E.A. Chapin. At that time only Blanchard's 2 species (*hogardi* and *neglecta*) were known from Haiti.

Specimens examined. Total 150, from Haiti and Dominican Republic. Sanderson (1951: 272) listed the following localities in Haiti: Port-au-Prince, Petionville, Ennery, Mannville, Diquini, and Grand Riviere. Wolcott (1928a: 27) listed only Port-au-Prince, and I can add only Dept. du Nord, Pignon, 5-VI-1969, R.L. Armistead [FSCA]. For the Dominican Republic, Sanderson listed only Constanza, the following being new records: **Prov. Azua:** (12) 8 km NE Padre las Casas, Rio las Cuevas, 18-46N, 70-53W, 7-VIII-1990, Rawlins, Thompson, 580 m [CMNH]; (1) Azua, 29-VIII-1985, C. Nuñez, at light [FSCA]. **Prov. Independencia:** (54) 4 km S. Los Pinos, Loma de Vientos, 18-35N, 71-46W, 23-VII-1992, Davidson, Rawlins, Thompson, Young, 455 m, semiarid deciduous forest w/pastures; (4) same, except 12-X-1991, 475 m. [CMNH]; (2) Sierra de Neiba, nr. crest, 5.5 km NNW Angel Feliz, 18-41N, 71-47W, 21-22-VII-1992, Davidson, Rawlins, Thompson, Young, 1750 m, dense cloud forest [CMNH]. **Prov. San Juan:** (34) El Capá, 1 km off Rd. to Vallejuelo, 21-V-1985, R.E. Woodruff, C. Nuñez, blacklight trap [FSCA]; (9) 8 km NE Vallejuelo, 18-42N, 71-16W, 8-IX-1973, Rawlins, Onore, Davidson, arid thorn scrub/woodland [CMNH].

Ecology. As can be seen from the above records, it has been found from sea level to 1750 m elevation, although much more common at lower altitudes, and in arid landscapes. It may be another "South Island" species, although the Sierra de Neiba records negate this. Sanderson's single record from Constanza should be re-examined; it has not been duplicated, and the specimen was not in the INHS. It does appear to be common at times and has been recorded from March to October.

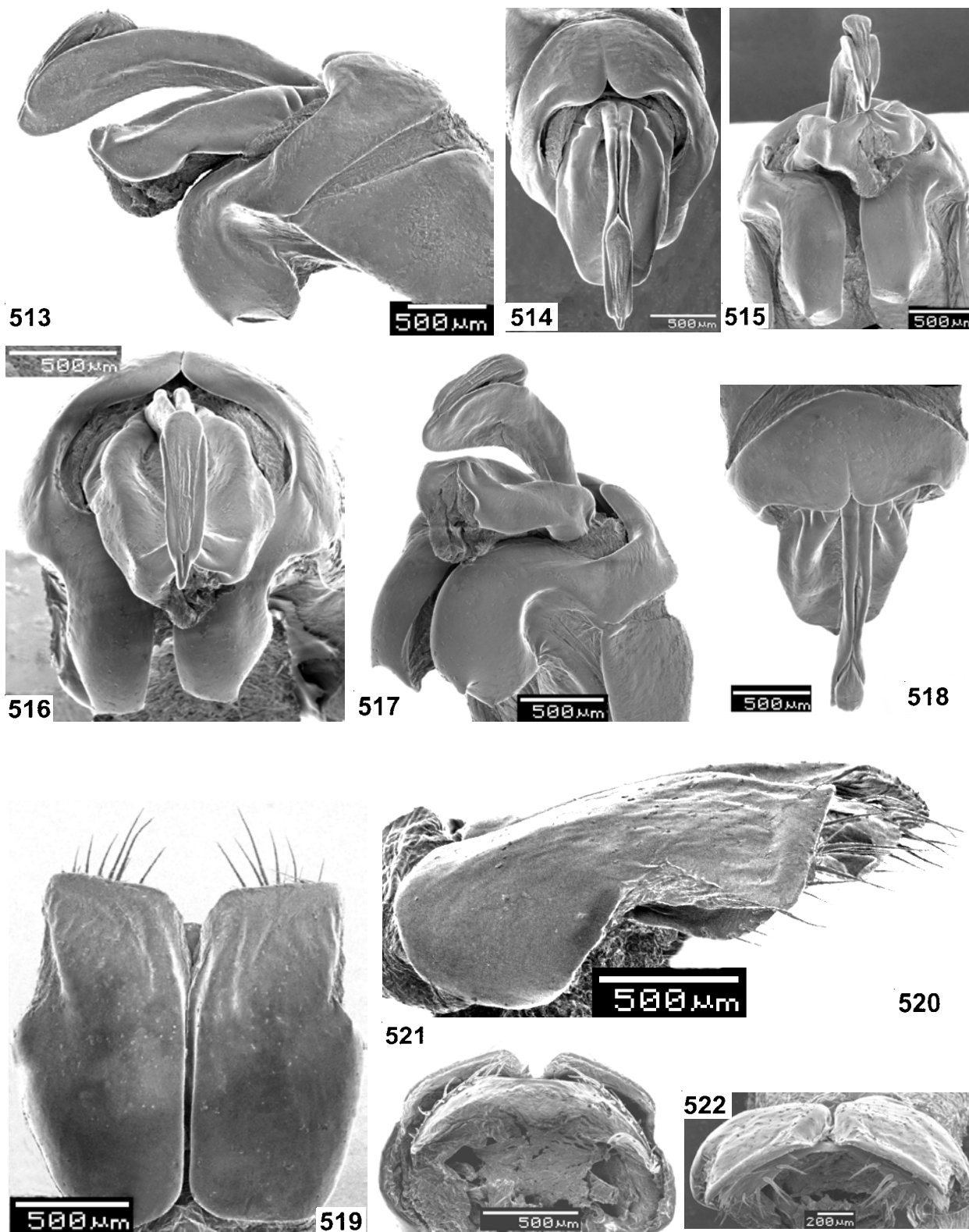


Fig. 513-522. *Phyllophaga neglecta* (Blanchard). 513-518 Male genitalia: 513) lateral; 514) caudo/dorsal; 515) ventral; 516) caudal; 517) caudo/lateral; 518) dorsal; 519-522 female genitalia: 519) ventral; 520) lateral; 521) dorsal; 522) caudal.

Immatures. Although no larvae or pupae have been positively identified, Böving (1942a: 170) curiously mentioned larvae of *neglecta* from Puerto Rico, as being indistinguishable from *vandinei*. I have found no other records of *neglecta* from Puerto Rico and believe these represent misidentifications.

Phyllophaga nunezi Woodruff, **new species**
(Fig. 97, 523-537)

Holotype male. DOMINICAN REPUBLIC: Prov. Monseñor Nouel, Rio Blanco, Muro del Embalse, 600 m, 12-V-2001, 18°53' 11.1"N, 070° 33' 38.1"W, R. E. Woodruff, C. Nuñez, H. Matzusawa, blacklight trap [FSCA]

General description (Habitus, Fig. 97). Small (L. 8, W. 4 mm). Dorsum and legs exceptionally hirsute, antennae large, head and pronotum reddish brown, elytra bi-colored, base color yellowish with sutural margin red-brown and dark areas resembling spots on apical tumosities. Tarsal claws extremely cleft, middle tooth larger than apical one (Fig. 528).

Head (Fig. 529). Clypeus barely emarginate, anterior angles broadly rounded, barely noticeable, obtusely angled to juncture of eye and frontal suture; lateral angle continuous with eye canthus, which is weakly carinate, with 5 or 6 long setae; posterior angles prominent. Clypeus much shorter than frons (about 1/3), margin reflexed its entire length, surface densely, coarsely, punctate, many punctures coalescing, glabrous. Frontal suture impressed, more so at sides. Frons somewhat flattened, densely pubescent, setae arising from dense, coarse punctures; posteriorly margined by convexity before posterior band. Color of head with a metallic sheen, base color dark. **Antenna** (Fig. 530) exceptionally long, 9-segmented, club 3-segmented. Lamellae somewhat flattened, 7th more convex on outer surface, receptors noticeable, antennomeres 3, 4, 5 elongate, subparallel, 3 and 4 subequal in length, 5 longer than wide, 2/3 length of fourth, sixth reduced slightly, produced internally, wider than long, middle lamella of club as long as combined antennomeres 2 through 6; club length subequal to clypeus between anterior angles.

Pronotum (Fig. 529, 533). Longer than wide, anterior margin slightly raised, gently curved, glabrous, shiny. Surface densely pubescent with long yellowish setae, base color dark with metallic reflections, densely, coarsely punctate, more so anteriorly and at sides;

anterior angles not produced; lateral angles not prominent, nearly parallel to posterior angles, which are nearly quadrate; lateral margin crenulate at origin of lateral setae; posterior margin carinate for its entire length, less pronounced medially.

Scutellum (Fig. 523, female). Barely wider than long, punctures dense in 2 lateral sections but margin, posterior, and medial area impunctate, translucent.

Elytra. Nearly parallel sided, base color light yellow-orange, densely pubescent, setae often going in opposite directions, but some arranged in rows. Sutural costa barely raised, but darker in color, more so posteriorly to declivity. Elytral punctures coarse, less dense than pronotum, but denser along lateral and apical margin, appearing more alutaceous also. Color pattern of elytra producing "eye-like spots" at tumosity just anterior to declivity, elytral suture weakly carinate on posterior fourth at declivity, not terminating in a spine. Elytral apices broadly rounded, barely curved before sutural apex; elytral margin barely reflexed, more so on anterior half.

Pygidium. (Fig. 531-532). Hirsute with some hairs pointing posteriorly and some ventral, arising from coarse, contiguous punctures, some forming wrinkles. Color darker than light elytra and similar to abdomen.

Legs. Protibiae tridentate, teeth nearly equally spaced, basal tooth pointing more proximal than usual, tibial face with a long linear carina, with light colored parallel setae; anterior spur acuminate, pointed, but short, barely reaching base of first tarsal segment. First protarsal segment longer than each of the next 3, which are subequal, fifth 1.5X longer. Claws distinctly cleft (Fig. 528), cleft very narrow, lower tooth broader and nearly same length as apical tooth. Mesotibial transverse carina nearly complete, legs heavily sculptured and clothed with setae; longitudinal carina present, from which a row of long golden setae arise; apical spurs acuminate, outer longer than inner (unusual), longest about half length of first tarsal segment. Apical fringe of 8 spines; tibial apex less expanded than many species. Mesotarsal segments 1 through 4 progressively shorter, fifth subequal to 1. Claws as in protibia. Metatibial transverse carina not noticeable, obscured by sculpture and setae; longitudinal carina indicated by long row of setae, but weakly indicated otherwise; apical spinule of 7 or 8, short, widely spaced spines; apical spurs flattened and curved but narrow and acuminate, interior face

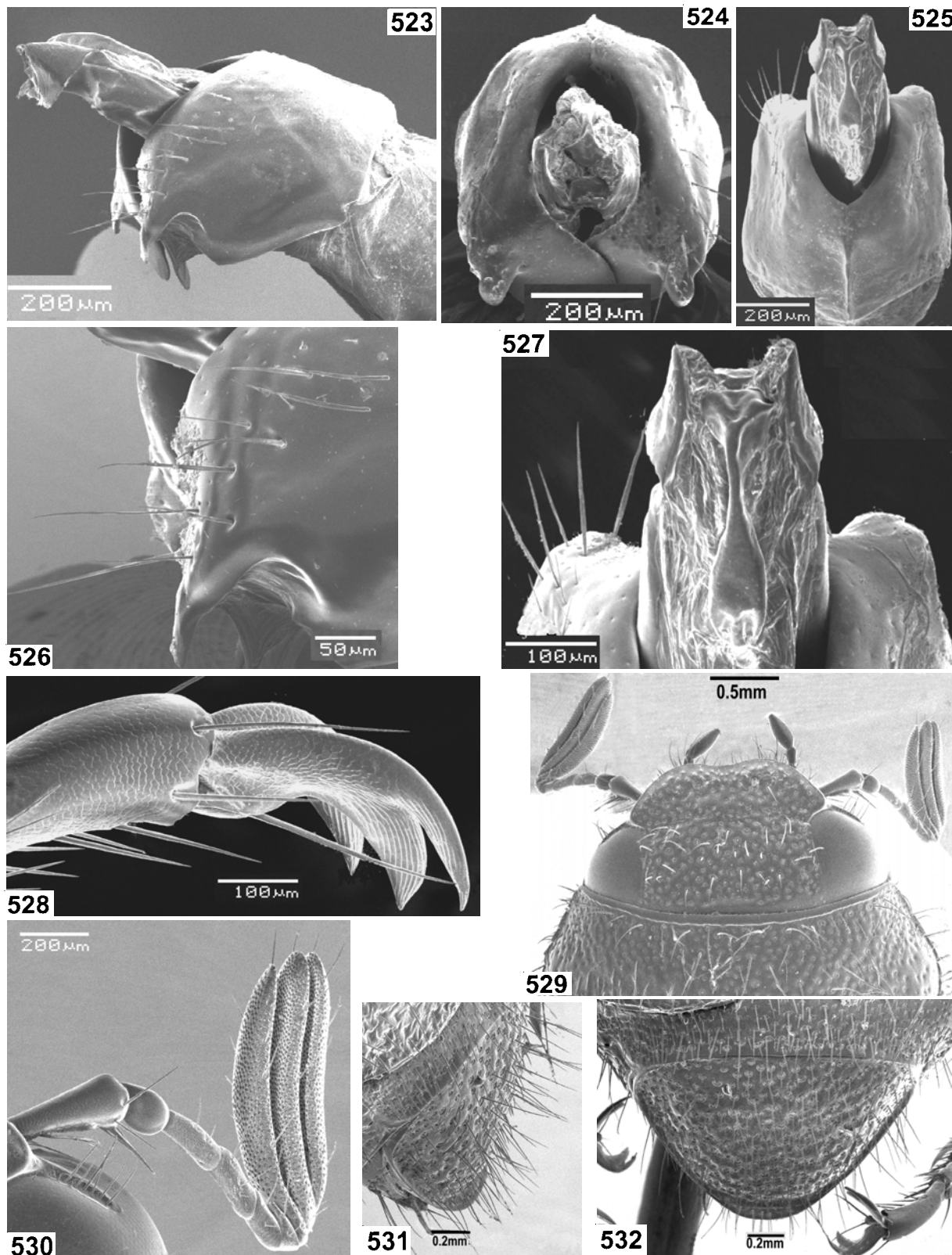


Fig. 523-532. *Phyllophaga nunezi* Woodruff. Male. 523-527 Genitalia: 523) lateral; 524) caudal; 525) dorsal; 526) paramere tip, lateral; 527) aedeagal tip, dorsal; 528) protarsal claw; 529) head, dorsal; 530) antenna; 531) pygidium, lateral (note long setae and coarse punctures); 532) pygidium, caudo/dorsal.

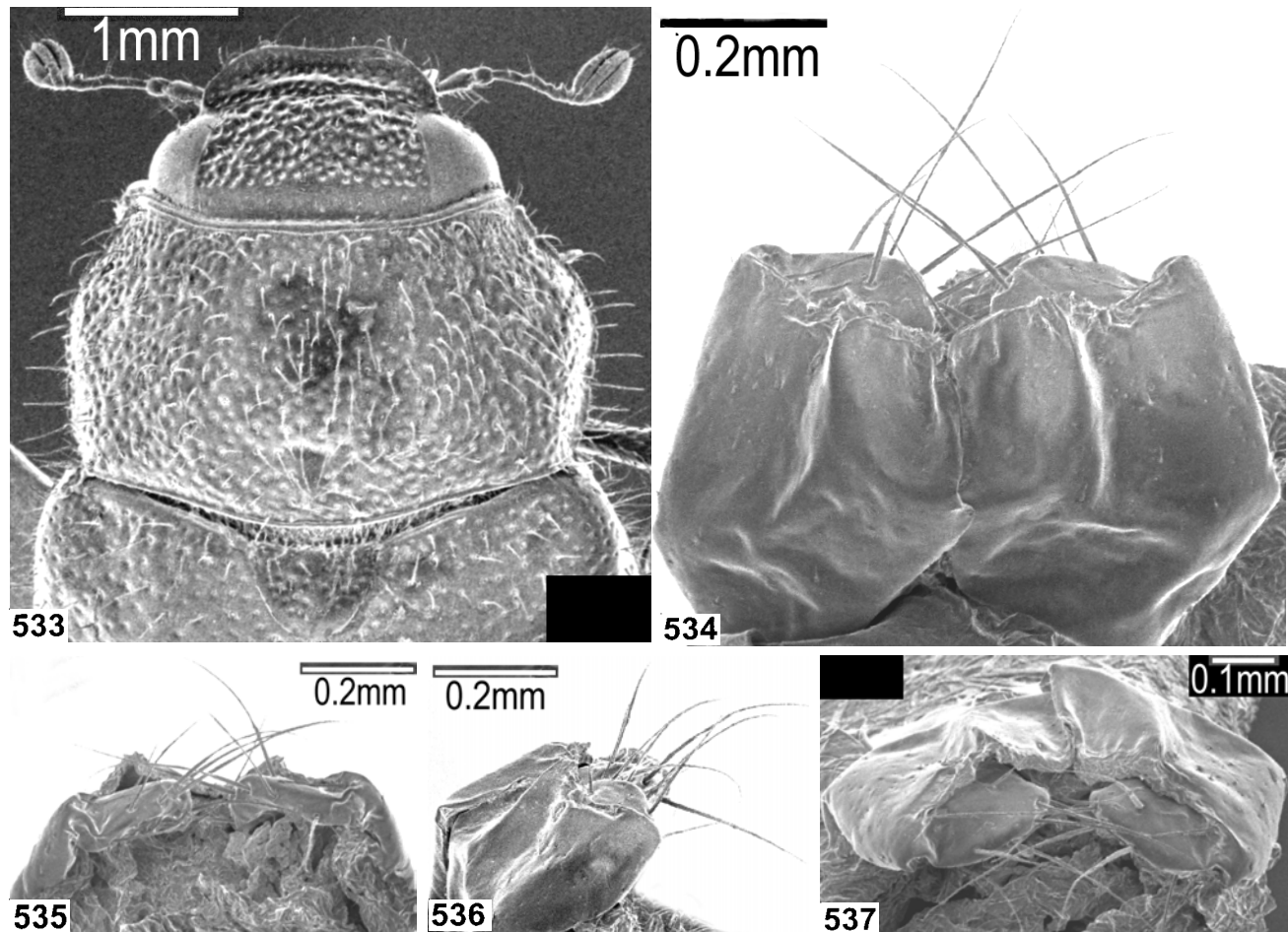


Fig. 533-537. *Phyllophaga nunezi* Woodruff. Allotype female: 533) Head, antennae, pronotum, and scutellum, dorsal; 534-537 female genitalia: 534) ventral; 535) dorsal; 536) lateral; 537) caudal.

flattened, barely concave; inner spur reaching middle of second tarsal segment, outer spur slightly longer than first tarsal segment; first tarsal segment reduced and expanded at tip, but not prolonged into spines; segments 3 and 4 subequal, 2 and 5 subequal in length. Metatarsal claws as in protibiae.

Abdomen. Venter of each sternite heavily clothed with several rows of golden, elongate setae, longest on penultimate and ultimate sternites. Median area of most sternites without setae, shiny. Venter somewhat alutaceous, but heavily punctured on all sternites, color darker than dorsum; penultimate sternite medially with more setae and a band of denser punctures, ultimate barely modified.

Genitalia, male (Fig. 523-527). Generally similar to the *fossoria* type, with numerous setae on phallobase and parameres; aedeagus weakly sclerotized, but dorsally with a unique structure (Fig. 527).

Allotype female (Fig. 533-537). DOMINICAN REPUBLIC: Prov. La Vega, Jarabacoa, 3-4-VI-1969, Flint and Gomez [USNM]. The only female known is similar to the male, except antennal club much smaller (Fig. 529, 533); metatibial apical fringe of 15 spines (7-8 in male), apical spurs nearly equal in length, flattened and gently curved inward. **Female genitalia** (Fig. 534-537) with about 5 (each side) exceptionally long hairs on superior plates which appear to be fused laterally to inferior plates (as they are in *fossoria* and relatives). Inferior plates nearly fused, with prominent longitudinal ridge middle of each plate; no triangular plate sealing sutural base.

Comparisons. The small size (L. 8 mm), exceptionally hairy body, and color pattern provide a unique habitus (Fig. 97). It shares the cleft tarsal claws (Fig. 528) with *aliada*, *fossoria*, *androw*, and *n. sp. near fossoria* (to be described elsewhere; see text). Genitalia are distinctive, including lateral fusion of superior and inferior plates in the female (Fig. 534).