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Phytophagous scarab beetles from the Central Region of Guerrero, Mexico (Coleoptera: Scarabaeidae: Melolonthinae, Rutelinae, Dynastinae, Cetoniinae)

Coleoptera Scarabaeidae fitófagos de la Región Central de Guerrero, México (Melolonthinae, Rutelinae, Dynastinae, Cetoniinae)

CUTBERTO PACHECO F.[1], CUAUHTÉMOC DELOYA[1], PEDRO CORTÉS G.[2]

Abstract. From July 1999 to June 2000, 1.307 specimens of phytophagous Scarabaeidae representing four subfamilies, 11 tribes, and 57 species of the following genera were collected: *Calomacraspis, Macraspis, Pelidnota, Chrysina, Anomala, Strigoderma, Cotinis, Hologymnetis, Euphoria, Golofa, Strategus, Cyclocephala, Tomarus, Bothynus, Phyllophaga, Diplotaxis, Polyphylla*, *Isonychus,* and *Chnaunanthus.* The area surveyed included the Mochitlán, Atlixtac, Chilpancingo, and Tixtla regions located in the central part of the state of Guerrero at an altitude of 840-1.600 m. These regions are characterized by six types of vegetation: pine forest, pine-oak forest, oak forest, tropical deciduous forest, palm groves, riparian forest, and pasture land. The 1307 specimens were captured using fermented fruit traps and by careful examination of herbaceous, brush, and arboreal vegetation in deposits of the detritus produced by ants (*Atta mexicana,* Hymenoptera: Formicidae) in a dead forest as well as by nocturnal collection. Specific richness for Mochitlán is 22 species, Tixtla 23, Chilpancingo 32, and Atlixtac 34; *Phyllophaga* and *Euphoria* make up 66.66% of the species, *Euphoria subtomentosa* being predominant. Central Guerrero has greater specific similarity with species from the high part of the Balsas Basin (southern Morelos 46%, Cuernavaca, Morelos 38%) than with fauna established on the Mexican Pacific slope (Chamela, Jalisco 30%, and Tepic, Nayarit 29%).

Key words: Fauna. Scarab beetles. Balsas Basin. Fruit traps.

Resumen. El presente estudio se realizó entre julio de 1999 y junio del 2000 en Mochitlán, Atlixtac y Chilpancingo en la región centro del estado de Guerrero, México, en altitudes entre los 840 y 1.600 m y caracterizadas por seis tipos de vegetación: bosque de *Pinus*, *Pinus-Quercus*, bosque tropical caducifolio, palmas, vegetación riparia y pastos inducidos. Se obtuvieron 1.307 especímenes que representan 4 subfamilias, 11 tribus y 57 especies de los géneros: *Calomacraspis, Macraspis, Pelidnota, Chrysina, Anomala, Strigoderma, Cotinis, Hologymnetis, Euphoria, Golofa, Strategus, Cyclocephala, Tomarus, Bothynus, Phyllophaga, Diplotaxis, Polyphylla*, *Isonychus,* and *Chnaunanthus*. Los especímenes capturados fueron obtenidos mediante el uso de trampas con fruta fermentada, en la vegetación arbustiva, herbácea y arbórea, en depósitos de detritos de la hormiga *Atta mexicana* (Hymenoptera: Formicidae) y en arbolado muerto y en colectas nocturnas. Chilpancingo presenta la mayor riqueza específica con 32 especies, seguida por Tixtla (23) y Mochitlán (22); *Phyllophaga* y *Euphoria* concentran al 66.66% de las especies y *E. subtomentosa* es la especie predominante. La región central de Guerrero presenta una mayor similitud específica con otras localidades establecidas en la parte alta de la Cuenca del Río Balsas (Sur de Morelos 46%, Cuernavaca, Morelos 38%) que con las establecidas en la vertiente del Pacífico Mexicano (Chamela, Jalisco 30% y Tepic, Nayarit 29%).

Palabras clave: Fauna. Escarabajos. Cuenca del Balsas. Trampas de frutas.

Scarabaeidae fauna of the Mexican Pacific slope and in the Balsas Basin is composed of 29 to 48 genera and 70 to 120 species (Deloya *et al.* 1993). The location, size, orography, and biogeographical history of the state of Guerrero have created a mosaic of different vegetation associations: xerophilous brush, *Pinus*, *Quercus-Pinus*, *Pinus-Quercus*, and *Abies* forests, mesophilous mountains, tropical deciduous forest, palm groves, riparian forest, and tropical semideciduous forest, among others. These numerous associations, many of which are endemic to the region, combine with the other characteristics of the state to favor the establishment of diverse fauna. Phytophagous Scarabaeidae in Guerrero are represented by five subfamilies (Melolonthinae, Rutelinae, Dynastinae, Cetoninae, and Trichiinae) that include 29 genera with 120 species (Morón *et al*. 1997). The objective of the present study was to perform a preliminary analysis of phytophagous

1 Autor correspondencia Cuauhtémoc Deloya. Departamento de Entomología, Instituto de Ecología, A.C. (CONACYT), Km 2.5 carretera antigua a Coatepec 351, Congregación El Haya, CP 91070, Xalapa, Veracruz, MEXICO. E-mail: cuauhtemoc.deloya@inecol.edu.mx

2 Laboratorio de Fitopatología, Facultad de Ciencias Químico Biológicas, Universidad Autónoma de Guerrero. Av. Lázaro Cárdenas s/n, Ciudad Universitaria, Chilpancingo, Guerrero.

Scarabaeidae fauna inhabiting the central region of the state of Guerrero in order to elaborate a key for the identification of the species and its comparison with other fauna obtained from other localities.

Study areas. The central region of the state of Guerrero, Mexico, is located between 17°30' and 17°39'N and 99°23' and 99°42'W. Climatic characteristics, altitude, annual rainfall, and mean annual temperature for the study areas are shown in Table 1. Vegetation type per region is as follows: a) Chilpancingo: pine forest, pine-oak, oak, tropical deciduous forest, palm grove, riparian forest, and pasture land; b) Mochitlán: tropical semideciduous forest, oak, induced pasture, thorny brush, riparian forest; c) Tixtla: oak, palm grove, tropical deciduous forest, riparian forest, and pasture land; d) Chichihualco: tropical deciduous forest featuring trees less than 15 m high with robust, twisted trunks.

Material and Methods

From July 1999 to June 2000, monthly sampling was done in Chilpancingo, Mochitlán, Tixtla, and Atlixtac (Chichihualco). Samples were collected both day and night from the arboreal, brush, and herbaceous strata as well as from flowers and fruits. Samples were taken from public lighting installations at night and by using fermented fruit traps (banana and pineapple with beer) during the day (Morón 1997). Voucher specimens were deposited in the Entomological Collection (IEXA) of the Instituto de Ecología, A.C. and M. A. Morón (MXAL) in Xalapa, Veracruz, Mexico.

For the data analysis, the number of species obtained was recorded (species richness; S = alpha diversity), as was the total number of specimens (N) for each site. Sørensen's (1948) Similarity Index was used to determine beta diversity QS = 2(c) / a + b, where a is the number of species in community A, b is the number of species in community B and c is the number of species shared by communities A and B. The key was prepared following the taxonomic criteria used by Morón (1984) and Deloya *et al.* (1995).

Results

A total of 1.307 specimens of phytophagous Scarabaeidae were collected, representing 4 subfamilies, 11 tribes, 19 genera, and 57 species (Table 2).

Melolonthinae from the central part of Guerrero were recorded year round except for February and April (Table 3, Fig. 1). Specific richness (S) and abundance (a) throughout the year were as follows: July S=8, a=1.68%; August S=4, a= 0.91%; September S=7, a=1.29%; October S=19, a=37.69%; November S=12, a=8.33%; December S=7, a=1.83%; January S=3, a=0.99%; March S=1, a=0.15%; May S=36, a=29.96%, and June S=25, a =17.12%. As for seasonal richness, 14 species coexisted in summer, 23 in autumn, 4 in winter, and 39 in spring.

The following species constituted 89.15% of the total sampling (N=1307) and were represented by 15 or more specimens: *C. mutabilis* (4.96%), *E. basalis* (8.56%), *E. leucographa* (1.29%), *E. iridescens* (3.28%), *E. biguttata* (1.75%), *E. subtomentosa* (27.9%), *A. inconstans* (3.66%), *Anomala* sp. (2.37%), *S. aloeus* (1.22%), *C. lunulata* (12.69%), *D. atramentaria* (2.29%), *P. ardara* (1.98%), *P. crinalis* (1.6%), *P. integriceps* (1.68%), *P. brevidens* (1.29%), *P. fulviventris* (1.14), *P. crenonycha* (1.75%), *P. obsoleta* (6.11%) and *P. scabripyga* (3.36%), while 38 other species made up only 10.85% of the total with 12 specimens or fewer.

Key for the identification of phytophagous Scarabaeidae species found in the central part of Guerrero

1 Base of antennal scape covered by the anterior angle of front and ocular canthus, not visible from above 2

1' Base of antennal scape visible from above through anteocular indentation. Mesepimeres not covered by base of elytra. Lateral borders of elytra with wide indentation and short, abundant setae. Metatarsus shorter than metatibia .... CETONIINAE 4

2 All tarsal claws equal in length and thickness, dentate, bifid, or entire. 3

2' All tarsal claws differing in length and thickness, the majority grooved and the minority entire .... RUTELINAE 17

3 Claws entire or bifid. Mandible apex hidden under clypeus, not dorsally visible ..... MELOLONTHINAE 34

3' Claws entire or single (at least intermediate and posterior claws). Apex

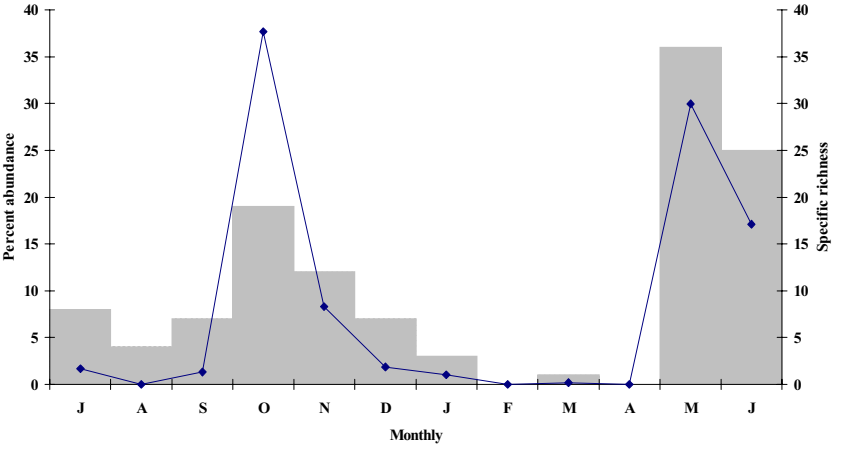

Figura 1. Monthly relation between the percent abundance (Line; N=1307) and specific richness (bars; S= 57 species) of the phytophagous Scarabaeidae (Melolonthinae, Rutelinae, Dynastinae Cetoniinae) from the Central Region of Guerrero, Mexico, July 1999-June 2000.

Table 1. Abiotic factors for study areas in the central region of the State of Guerrero, Mexico (García 1988).

Region	Rainfall mm/year	Temperature °C (annual mean)	Altitude masl	Climate
Mochitlán	1239.0	24.2	840	Aw(w)igw"
Atlixtac	717.5	23.2	1210	BS1(h´)w(w)igw"
Chilpancingo	827.4	21.7	1360	A(C)wo(w)(i´)w"
Tixtla	1014.9	21.5	1600	A(C)w1(w)(i')g

Table 2. Species of Scarabaeidae pleurosticti from the central region of the state of Guerrero, Mexico, captured between July 1999 and June 2000.

1 Melolonthinae
- A) Melolonthini
  - *Phyllophaga (Phyllophaga) ardara* Saylor, 1943
  - *P. (P.) brevidens* (Bates, 1888)
  - *P. (P.) crinalis* (Bates, 1888)
  - *P. (P.) dasypoda* (Bates, 1888)
  - *P. (P.) disca* Saylor, 1943
  - *P. (P.) eniba* Saylor, 1943
  - *P. (P.) fulviventris* (Moser, 1918)
  - *P. (P.) integriceps* (Moser, 1918)
  - *P. (P.) ravida* (Blanchard, 1851)
  - *P. (P.) martinezpalaciosi* Morón, 1988
  - *Phyllophaga (P.)* sp.
  - *P. (P.) setifera* (Burmeister, 1855)
  - *P. (P.) crenonycha* Saylor, 1943
  - *P. (Phytalus) epulara* Sanderson, 1958
  - *P. (Ph.) obsoleta* (Blanchard, 1851)
  - *P. (Listrochelus)* sp.
  - *P. (Chlaenobia) scabripyga* (Bates, 1850)
  - *Diplotaxis atramentaria* Bates, 1888
  - *D. cribriceps* Bates, 1889
  - *D. megapleura* Vaurie, 1960
  - *D. trapezifera* Bates, 1887
  - *Polyphylla petiti* (Guérin-Méneville, 1844)
- B) Macrodactylini
  - *Isonychus ocellatus* Burmeister, 1855
- C) Incerta sedis
  - *Chnaunanthus discolor* Burmeister, 1844

2 Rutelinae
- A) Rutelini
  - *Calomacraspis splendens* (Burmeister, 1844)
  - *Macraspis aterrima* (Waterhouse, 1881)
  - *Pelidnota virescens* Burmeister, 1844
  - *Chrysina macropus* (Francillon, 1795)
- B) Anomalini
  - *Anomala cincta* Say, 1835
  - *A. foraminosa* Bates, 1888
  - *A. forreri* Bates, 1888
  - *A. inconstans* Burmeister, 1847
  - *Anomala* sp.
  - *Strigoderma sulcipennis* Burmeister, 1844
  - *Strigoderma tomentosa* Bates, 1888

3 Dynastinae
- A) Dynastini
  - *Golofa imperialis* Thomson, 1858
- B) Oryctini
  - *Strategus aloeus* (Linné, 1758)
- C) Cyclocephalini
  - *Cyclocephala lunulata* Burmeister, 1847
  - *C. stictica* Burmeister, 1847
  - *C. sexpuctata* Laporte, 1840
- D) Pentodontini
  - *Tomarus nasutus* (Burmeister, 1847)
  - *T. sallei* (Bates, 1888)
  - *Bothynus complanus* (Burmeister, 1847)

4 Cetoniinae
- A) Gymnetini
  - *Cotinis mutabilis* (Gory & Percheron, 1833)
  - *C. pauperula* Burmeister,1847
  - *Hologymnetis cinerea* (Gory & Percheron, 1833)
- B) Cetoniini
  - *Euphoria basalis* (Gory & Percheron 1833)
  - *E. biguttata* (Gory & Percheron, 1833)
  - *E. canescens* (Gory & Percheron, 1833)
  - *E. dimidiata* (Gory & Percheron, 1833)
  - *E. iridescens* Schaum, 1841
  - *E. lineoligera* Blanchard, 1850
  - *E. pulchella* (Gory & Percheron, 1833)
  - *E. sepulcralis leucographa* (Gory & Percheron, 1833)
  - *E. subtomentosa* Mannerheim, 1837
  - *E. vestita* (Gory & Percheron, 1833)
  - *E. westermanni* (Gory & Percheron, 1833)

of mandible visible from dorsum .. .. DYNASTINAE 27

4 Scutellum covered by the basal lobe of pronotum. Gymnetini 5

4’ Scutellum exposed from above Cetoniini .... *Euphoria* 7

5 Head with frontal projection fused or partially free *Cotinis* Burmeister 6

5’ Head lacking frontal projection. Anterior margin of clypeus highly marginate. Mesometasternal projection with sharp apex internally projected .... *Hologymnetis cinerea*

6 Frontal projection free, less than 50% of length. Apically enlarged in dorsal view. Projection of clypeus variable. Coloration opaque, black, greenish, and velvety. Total length 22-30 mm .... *Cotinis mutabilis*

6’ Frontal projection fused for 65% of its length from vertex to clypeus. Dorsal coloration dark green. Mesometasternal projection rounded. Total length 19-22.5 mm .... *Cotinis pauperula*

7 Species longer than 15 mm 8

7’ Species shorter than 15 mm 11

8 Clypeus square with rounded lateral margins 9

8’ Clypeus trapezoidal 10

9 Dorsal surface with long setae. Antennal club shorter than rest of antennomeres. Pronotum with two pairs of longitudinal bands and dark parallels; each pair with anterior convergence. Total length 18 mm. .... *Euphoria iridescens*

9’ Dorsal surface with short setae. Antennal club much longer than the rest of the antennomeres. Pronotum with one pair of dark longitudinal bands in a “db” shape; each pair with anterior convergence. Total length 18 mm .... *Euphoria vestita*

10 Anterior tibia externally tridentate, all teeth equidistant and basal tooth smaller. Dorsal coloration green, elytra with whitish sculpture. Total length 21.0-21.5 mm .... *Euphoria westermani*

10’ Anterior tibia externally tridentate, with two anterior teeth close together and basal tooth slightly smaller. Total length 15-18 mm .... *Euphoria biguttata*

11 Basal half of elytra reddish, the rest black with or without variable sculpture 12

11' Basal half of elytra always lacking reddish spots 14

12 Clypeus almost square; posterior half of elytra black and lacking sculpture ..... *Euphoria dimidiata*

12' Clypeus triangular; posterior half of black elytra with sculpture 13

13 Anterior margin of clypeus rounded; sides of pronotum rounded and with whitish sculpture ..... *Euphoria canescens*

13' Anterior margin of clypeus truncate; sides of pronotum angled and lacking whitish sculpture ..... *Euphoria pulchella*

14 Pronotum black 15

14' Pronotum reddish 16

15 Elytra bicolored, black with yellow *Euphoria basalis*

15' Elytra black with irregular whitish sculpture on posterior half and sides. Total length 10-11 mm ..... *Euphoria lineoligera*

16 Anterior margin of clypeus straight, projected upward and curved in a "u" shape; sides of pronotum with whitish sculpture ..... *Euphoria leucographa*

16' Anterior margin of clypeus slightly rounded, never projected upward; sides of pronotum lacking whitish sculpture ..... *Euphoria subtomentosa*

17 External border of elytra with membranous margin ..... Anomalini 18

17' External border of elytra lacking membranous margin 24

18 Elytrae wider than posterior region. Dorsum convex ..... *Anomala* 19

18' Elytrae longer in humeral than in posterior region. Dorsum flat and glabrous ..... *Strigoderma* 23

19 Pronotum blackish-red 20

19' Pronotum green or yellowish-brown 22

20 Elytra red-brown ..... *Anomala* sp.

20' Elytra yellowish-brown 21

21 Second protarsal joint situated at same level as apical tooth of protibia ..... *Anomala foraminosa*

21' Third protarsal joint situated at same height as apical tooth of protibia . ..... *Anomala forreri*

22 Pronotum and scutellum green; protibia tridentate ..... *Anomala cincta*

22' Pronotum yellowish-brown with a blackish-red anterocentral spot variable in shape; protibia bidentate .. .. *Anomala inconstans*

23 Pronotum with a longitudinal furrow and two diagonal furrows on each side; pronotal setae widely spaced .... *Strigoderma sulcipennis*

23' Pronotum lacking furrows and setiferous, setae abundant and erect ..... *Strigoderma tomentosa*

24 Basal margin line of pronotum complete. Exterior border of mandibles clearly indented. Dorsal coloration yellow with green highlights. Total length 22-26 mm ..... *Pelidnota virescens*

24' Basal margin line of pronotum incomplete or absent 25

25 Basal margin of pronotum incomplete ..... *Chrysina macropus*

25' Basal margin line of pronotum absent 26

26 Scutellum longer than pronotum. Color shiny black. Metaepisternum rugose and punctate. Total length 23-29 mm ..... *Macraspis aterrima*

26' Scutellum shorter than pronotum. Clypeus semitrapezoidal. Labrum visible above. Protibia bidentate in males, tridentate in females, with very small basal tooth. Dorsal coloration bright metallic green. Total length 14-16 mm ..... *Calomacraspis splendens*

27 Protarsus equal to or larger than protibia. Male pronotum with tubercle; head with thin horn ..... *Golofa imperialis*

27' Protarsus shorter than protibia . 28

28 Head and pronotum without carinae, tubercles, or depressions. Tarsomeres semicylindrical. Meso- and metatibiae with wide apex ..... *Cyclocephala* 29

28' Head and pronotum with carinae, tubercles, and depressions. Tarsomeres triangular or semicylindrical. Meso- and metatibiae apex, scalloped or dentate 31

29 Elytra glabrous. Anterior margin of clypeus straight. Pronotum and elytra with irregular spots ..... *Cyclocephala lunulata*

29' Elytra setiferous. Anterior margin of clypeus sinuate. Pronotum and elytra with a more or less defined pattern 30

30 Each elytra with three irregular black points. Disc of pronotum with two black spots ..... *Cyclocephala sexpunctata*

30' Each elytra with three longitudinal spots: two short lateral spots and one large spot that widens at the posterior half ..... *Cyclocephala stictica*

31 Apex of meso- and metatibiae truncate or with dorsolateral projection; sexual dimorphism rare. Head with carinae or tubercles . Pentodontini 32

31' Apex of metatibiae denticulate or scalloped. Sexual dimorphism accentuated. Males and females without horns on head, only two transversal tubercles. Male pronotum with three horns or bumps that surround a wide central fovea. Total length 30-50 mm ..... *Strategus aloeus*

32 Apex of meso- and metatibiae extended dorsolaterally; propygidium extended towards the back with a stridulatory area. Pronotum with one tubercle and a postapical concavity. Total length 27-36 mm ..... *Bothynus complanus*

32' Apex of meso- and metatibiae truncate; propygidium not extended backwards and lacking stridulatory area. Pronotum lacking tubercles and depressions. Clypeus lacking preapical carina; front with transversal carina ..... *Tomarus* 33

33 Protibia tetradentate with a well-formed denticle between the second and third tooth. Frontal carina bituberculate. Pygidium smooth, polished, and punctate. Total length 20-21 mm ..... *Tomarus sallei*

33' Protibia tridentate, lacking denticles between teeth. Frontal carina continuous. Pygidium smooth, polished, with three scattered punctures. Total length 17-19 mm ..... *Tomarus nasutus*

34 Dorsal and ventral region covered with yellow scale-like setae ..... *Isonychus ocellatus*

34' Dorsal region smooth or covered with setae of varying lengths ... 35

35 Anterior coxae more or less conical, prominent. Length less than 12 mm. Sexual dimorphism rare 37

35' Anterior coxae transversal. Total length generally greater than 12 mm (except in *Phyllophaga oblongula*, which measures 8.5 mm). Sexual dimorphism apparent or quite noticeable. Reproductive organ complex 36

36 Antennal club formed by three antennomeres, both in males and females. Sexual dimorphism apparent or quite noticeable . *Phyllophaga* 41

36' Antennal club formed by seven antennomeres in males and five in females ..... *Polyphylla petiti*

37 Antennal club small and oval. Abdominal sternites totally or partially fused to each other at medial thirds. Head, pronotum, and ventral regions dark brown, elytra shiny straw-yellow. Total length 3 mm .... *Chnaunanthus discolor*

37' Antennal club elongate. Abdominal sternites never totally or partially fused to each other at medial thirds *Diplotaxis* 38

38 Species longer than 8 mm. Clypeus: trapezoidal, anterior margin truncate with rounded lateral angles 39

38' Small species, length less than 8 mm. Clypeus trapezoidal, anterior margin sinuate and sharply elevated with lateral angles projected. Lateral margins of elytra with long setae 40

39 Elytra twice as long as pronotum. Second elytral interval unipunctate. Lateral margins of pronotum near apex not strongly marginate or elevated. Color black with red highlights. Total length 9 mm .... *Diplotaxis cribriceps*

39' Elytra three times longer than pronotum. Second elytral interval multipunctate. Lateral margins of pronotum near apex strongly marginate and slightly elevated. Color reddish black. Total length 9 mm . ..... *Diplotaxis atramentaria*

40 Pygidium setiferous, setae long and abundant. Total length 7.5-8.2 mm ..... *Diplotaxis megapleura*

40' Pygidium setiferous, setae short and sparse. Total length 8.0 mm .... *Diplotaxis trapezifera*

41 Vertex generally with a well-marked transversal carina. Claws serrate or pectinate .... *Phyllophaga (Listrochelus)* sp.

41' Vertex lacking transversal carina. All three pairs of claws bifid, grooved, or dentate, especially in males 42

42 Tarsal claws unidentate ..... *Phyllophaga (sensu stricto)* 46

42' Tarsal claws grooved or bifid .. 43

43 Ventral region of tarsomeres with abundant setae (more conspicuous in males). Dorsum glabrous, shiny. Body elongate and yellow ..... *Phyllophaga (Chlaenobia) scabripyga*

43' Ventral region of tarsomeres with sparse or no setae. Dorsal appearance variable ..... *Phyllophaga (Phytalus)* 44

44 Pronotum opaque. Front with abundant, erect, medium-length setae; pronotum and elytra setiferous, setae short; anterior region of pronotum with sparse, long setae in anterior region and area in front of apical callus of elytra .... *P. (Ph.) epulara*

44' Pronotum shiny 45

45 Elytra and scutellum shiny. Front and anterocentral region of pronotum with short setae, conspicuous and/or inconspicuous .... *P. (Ph.) obsoleta*

45' Elytra and scutellum opaque. Long setae on front and anterocentral region of pronotum .... *P. (Ph.) crenonycha*

46 Claws with dilated and dentate base, intermediate tooth flanked by narrow, deep indentations. External claws of male mesotarsus with apical portion curved or angled downward so that intermediate tooth juts out laterally causing deformation*P. (Phyllophaga) ravida* group 47

46' Claws with intermediate tooth far from apex or base or from both ends. Claws with intermediate denticle variable in structure and position, inferior border seldom serrate ... 49

47 External claws of male mesotarsus deformed with a distal bifurcate appearance due to their great length and sharpness of intermediate tooth. Body length 14 to 19 mm (*P. ravida* group, *P. dentex* complex). Color reddish-chestnut. Total length 15-17 mm ..... *Phyllophaga ravida*

47' External claws of male mesotarsus slightly deformed and lacking distal bifurcate appearance, as intermediate tooth is very short and rounded. Body length 16 to 23 mm (ravida group, *dasypoda* complex) 48

48 Clypeus semicircular, slightly sinuate. Tegument shiny. Antennal lamella in males as long as the first seven antennomeres combined. Pygidium with long setae .... *P. dasypoda*

48' Clypeus with anterior margin sinuate. Tegument shiny. Antennal lamella in males shorter than first seven antennomeres combined. Pygidium with short setae. Color reddish-chestnut. Total length 21-22.5 mm .... *Phyllophaga fulviventris*

49 Claws of intermediate denticle as long as or longer than apical denticle; widely separated from both ends, with a slight, rounded basal dilation. Tropical species 50

49' Claws with intermediate denticle of variable length and position. Both male metatibial spurs articulate with apical border 51

50 Exterior spur of male metatibiae fused to apical border and at least 60% shorter than interior spur. Parameres short, compact, fused to base and apex. Dorsal surface variable although generally velvety. Aedeagus slightly sclerotized and lacking complex ornamentation ... . *P. (Phyllophaga)*, *P. rorulenta* group *P. martinezpalaciosi*

50' Exterior spur of male metatibiae articulate with apical border, length greater than 50% that of interior spur. Dorsal and pygidial dressing velvety or setiferous. Dorsal and pygidial surface formed by short, very abundant setae. Male and female claws similar. Parameres short, wide, fused at base and apex. Aedeagus long, sclerotized, with thick, very conspicuous setiferous ornaments. .... *P. (Phyllophaga) setidorsis* group 53

51 Male anal plate with anterior flange that reaches lateral ends, middle sec-

tion indented, one sinus or bilobed or bidentate projection. Frequently fifth sternite visible with dark, grainy medial area. Dorsum pruinose or setiferous dorsum. Parameres short, fused, ring-like, with a small ventral bidentate projection and symmetrical latero-distal denticles. Aedeagus highly ornamented, with thorns, setae, and curved filaments *P. (Phyllophaga) anodentata* group 52

51' Male anal plate narrow and slightly excavated, but lacking notable flange in anterior margin. Parameres short, fused, ring-shaped. Dorsal region with velvety or setiferous cover. Aedeagus sclerotized, highly ornamented with plates and groups of macroscopic setae ..... *(Phyllophaga), P. porodera* group *P. eniba*

52 Antennae formed by 10 antennomeres. Dorsum opaque .. *P. ardara*

52' Antennae formed by 9 antennomeres. Dorsum shiny. Total length 15-16 mm ..... *P. brevidens*

53 Superior metatibial spur curved in an open "s" shape. 3-6 antennal antennomeres of equal length, 7 shorter ..... *P. crinalis*

53' Superior metatibial spur curved. 3-4 antennomeres of equal length, 5-7 shorter ..... *P. setifera*

General comments about phytophagous Scarabaeidae found in the Central Region of the State of Guerrero, Mexico

Phyllophaga Harris. Adults exhibit crepuscular or nocturnal habits and feed on the foliage of various plants; larvae, in contrast, eat roots (Deloya *et al*. 1995; Morón *et al*. 1988). 293 specimens from 17 species were captured at lights in Mochitlán (9), Atlixtac (172), Chilpancingo (84), and Tixtla (28) during May (130), June (75), July (1), August (1), and September (2).

Diplotaxis Kirby. Adults exhibit crepuscular or nocturnal habits; larvae consume roots (Deloya *et al*. 1995). 39 samples from 4 species were captured at lights, *D. megapleura* (4), *D. cribriceps* (2), *D. atramentaria* (30), and *D. trapezifera* (3) in Mochitlán (1), Atlixtac (37), and Tixtla (1) during May (20) and June (19).

Polyphylla Harris. The genus is widely distributed from Canada to Guatemala. In Mexico, captures have been made in eight states at an altitude of 300 to 1.650 m (Deloya *et al*. 1995). The only *P. petiti* sample was captured at lights in Tixtla in December in an area near croplands.

Isonychus Mannerheim. *Isonychus ocellatus* is a common species of wide distribution; its food preferences are unknown (Morón *et al.* 1997). In May, the 3 specimens were captured at lights in Atlixtac (2) and Tixtla (1).

Chnaunanthus Burmeister. *Chnaunanthus discolor* is a very common species in central Mexico (Morón *et al.* 1997). The four samples reviewed were captured in Compositae blossoms during October in Chilpancingo (3) and Atlixtac (1).

Calomacraspis Bates. *Calomacraspis splendens* has been found on verbena and asclepiadaceous flowers; larvae develop on detritus deposits of the ant *Atta mexicana* (Fr. Smith) (Deloya 1988). The species is exclusive to Mexico (Jameson *et al.* 1994) and lives in warm parts of Jalisco, Puebla, Veracruz, Chiapas, Morelos, Hidalgo, and Guerrero (Deloya *et al.* 1994, 1995; Morón, 1994). The only specimen in this study was captured on Compositae plants during October in Chilpancingo.

Macraspis MacLeay. *Macraspis aterrima* is a species exclusive to Mexico; adults consume annona fruits, and larvae develop on rotten *Persea americana* trunks (Deloya *et al.* 1995). The only specimen reviewed was captured in flight during September in Mochitlán.

Pelidnota MacLeay. *Pelidnota virescens* adults exhibit nocturnal habits and feed on the foliage of various trees. Larvae are found inside rotten stumps, and the life cycle is complete in one year; they are widely distributed between Mexico and Costa Rica (Deloya *et al.* 1995; Morón *et al.* 1997). The only specimen collected was captured at lights in Mochitlán during May.

Chrysina Kirby. *Chrysina macropus* adults are frequently attracted to various types of light. Their alimentary preferences are unknown; larvae have been collected from rotten stumps. This species life cycle requires two years (Morón *et al.* 1997). The two specimens studied were captured at lights in Atlixtac during May.

Anomala Samouelle. 87 specimens from 5 species were captured at lights: *A forreri* (5), *A. cincta* (2), *A. foraminosa* (1), *A. inconstans* (48), and one undetermined species (31) during March (2), May (43), June (33), July (2), and October (3) in Mochitlán (3), Atlixtac (27), and Chilpancingo (57).

Strigoderma Burmeister. The 8 specimens captured correspond to two species, *S. sulcipennis* (6) and *S. tomentosa* (2) and were collected in Mochitlán (3), Chilpancingo (1), and Tixtla (4) during September (2), October (3), November (1), and December (1). *Strigoderma sulcipennis* was captured on *Tagetes erecta* (Cempanzuchitl) flowers and *S. tomentosa* on Compositae flowers.

Golofa Hope. *Golofa imperialis* lives at an altitude of 500-2.100 m on the internal slopes of principal mountains and mesetas or woody high plateaus (Morón 1993). The only specimen was captured at lights in Tixtla during October.

Strategus Kirby. *Strategus aloeus* has wide neotropical distribution (Morón *et al.* 1988). The 16 specimens were collected at light (15) and on rotting wood (1) during May (7), June (1), July (4), and August (4) in Mochitlán (7), Tixtla (2), Atlixtac (2), and Chilpancingo (5).

Cyclocephala Dejean. This genus has a wide neotropical distribution. The 168 specimens represent three species: *C. lunulata* (166), *C. stictica* (1), and *C. sexpunctata* (1), all of which were captured at lights during the months of May (113), June (46), September (1), and October (8) in Mochitlán (3), Atlixtac (15), Chilpancingo (148), and Tixtla (2).

Tomarus Erichson. The 9 specimens represent 2 species: *T. sallei* (8) and *T. nasutus* (1) and were collected at lights lighting during the months of May (6), July (2), and August (1) in Chilpancingo (6) and Tixtla (3).

Bothynus Hope. *Bothynus complanus*, 5 specimens were captured at lights during May (3) and November (2) in Tixtla.

Cotinis Burmeister. It has a wide distribution from northern South America to the southern United States. Most species are diurnal and favor flowers and ripe fruits (Deloya *et al.* 1995). A total of 75 samples from 2 species were collected: *C. mutabilis* (65) and *C. pauperula* (10) during January (5), May (14), June (23), July (2), September (6), October (9), November (7), and December (9) in Mochitlán (24), Atlixtac (2), Chilpancingo (34), and Tixtla (15). *Cotinis mutabilis* was collected from *Tagetes erecta* flowers and *Pithecelobium dulce* foliage as well in flight and from fermented fruit traps.

Hologymnetis Martínez. *Hologymnetis cinerea* is found in Guatemala and widely distributed throughout the Mexican territory, except on the Baja California peninsula and in Yucatán (Deloya *et al.* 1995). The 9 samples were captured in fermented fruit traps and on *Tagetes erecta* flowers during the months of September (1), October (5), and November (3) in Mochitlán (1), Atlixtac (2), Chipancingo (4), and Tixtla (2).

Euphoria Burmeister. It is widely distributed across most of the American continent. Adults favor flowers, while larvae are saprophagous (Morón *et al.* 1988; Deloya *et al.* 1995). The 585 samples collected represent 11 species: *E. basalis* (112), *E. leucographa* (17), *E. dimidiata* (12), *E. iridescens* (43), *E. canescens* (3), *E. vestita* (1), *E. biguttata* (23), *E. subtomenstosa* (365), *E. lineoligera* (3), *E. pulchela* (2), and *E. westermanni* (4), all captured in fermented fruit traps and on pumpkin flowers (*Cucurbita pepo*), campanzuchitl (*Tagetes erecta*), huizache *(Acacia schaffneri*) and other Compositae in Mochitlán (96), Atlixtac (309), Chilpancingo (140), and Tixtla (40) during January (8), May (5), June (3), September (3), October (460), November (95), and December (11).

Discussion

With regard to specific richness in each region, 22 species were captured in Mochitlán, 34 in Atlixtac, 32 in Chilpancingo, and 23 in Tixtla (Table 3; Fig. 2); 43.65% of the specimens were obtained in Atlixtac, 36.92% in Chilpancingo, 11.39% in Mochitlán, and only 8.02% in Tixtla. Of the 57 species studied, *C. mutabilis, H. cinerea, E. leucographa, E. dimidiata, E. subtomentosa, S. aloeus, P. ardara* and *P. brevidens* were found in the four regions at an altitude of 840-1.600 meters. The similarity index (Sørensen 1948) between the localities is as follows: Mochitlán-Atlixtac 53%, Mochitlán-Chilpancingo 55%, Mochitlán-Tixtla 48%, Atlixtac-Chilpancingo 60%, Atlixtac-Tixtla 38% and Chilpancingo-Tixtla 47%; this indicates a greater similarity between Atlixtac and Chilpancingo, intermediate regions found at altitudes of 1.210 and 1.360 m, respectively.

The vegetation of Balsas River Basin and the Mexican Pacific slope is mainly deciduous tropical forest, xerophyllous scrub, and lowland oak forest mixed with pine forest at intermediate altitudes. As such, studies of Scarabaeidae Pleurosticti were carried out in the south of Morelos

Table 3. Phytophagous Scarabaeidae (Melolonthinae, Rutelinae, Dynastinae, Cetoniinae) species captured by region in Central Guerrero, Mexico. (Numbers correspond to abundance).

Species/ Altitude	Mochitlan 840 m	Atlixtac 1210 m	Chilpancingo 1360 m	Tixtla 1600m
Cotinis mutabilis	22	2	27	14
C. pauperula	2	0	7	1
Hologymnetis cinerea	1	2	4	2
Euphoria basalis	0	0	1	12
E. s. leucographa	8	4	3	2
E. dimidiata	3	1	7	1
E. iridescens	0	43	0	0
E. canescens	0	3	0	0
E. vestita	0	0	0	1
E. biguttata	15	8	0	0
E. subtomentosa	67	247	16	35
E. lineoligera	2	1	0	0
E. pulchella	*0*	2	0	0
E. westermanni	1	0	2	1
Macraspis aterrima	1	0	0	0
Calomacraspis splendens	0	0	1	0
Strigoderma sulcipennis	2	0	0	4
S. tomentosa	1	0	1	0
Anomala forreri	0	2	3	0
A. cincta	0	0	2	0
A. foraminosa	0	0	1	0
A. inconstans	3	25	20	0
Anomala sp.	0	0	31	0
Pelidnota virescens	1	0	0	0
Chrysina macropus	0	2	0	0
Strategus aloeus	7	2	5	2
Cyclocephala lunulata	3	15	148	0
C. stictica	0	0	0	1
C. sexpunctata	0	0	0	1
Golofa imperialis	0	0	0	1
Tomarus nasutus	0	0	1	0
T. sallei	0	0	5	3
Bothynus complanus	0	0	0	5
Chnaunanthus discolor	0	1	3	0
Polyphylla petiti	0	0	0	1
Isonychus ocellatus	0	2	0	1
Diplotaxis megapleura	1	3	0	0
D. cribriceps	0	2	0	0
D. atramentaria	0	30	0	0
D. trapezifera	0	2	0	1
Phyllophaga ardara	1	5	6	14
P. dasypoda	0	0	0	4
P. crinalis	0	1	14	6
P. setifera	0	2	5	0
P. integriceps	0	4	18	0
P. eniba	0	*2*	2	0
P. disca	0	0	1	0
P. brevidens	1	4	10	2
P. ravida	0	7	4	0
P. fulviventris	0	0	13	2
P. martinezpalaciosi	0	3	7	0
Phyllophaga sp.	0	2	0	0
P. epulara	1	0	0	0
P. crenonycha	0	23	0	0
P. obsoleta	0	80	0	0
Phyllophaga sp.	1	1	3	0
P. scabripyga	5	38	1	0

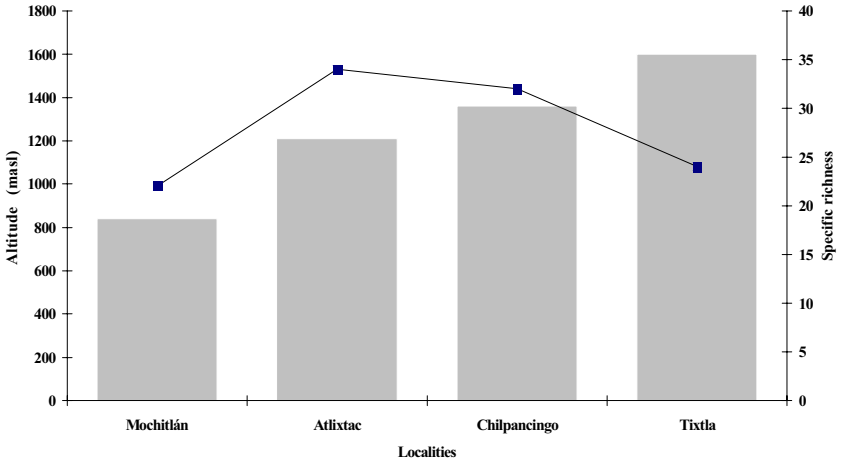

Figura 2. Relation between altitude (bars) and specific richness (line) by locality of the phytophagous Scarabaeidae (Melolonthinae, Rutelinae, Dynastinae Cetoniinae) from the Central Region of Guerrero, Mexico (July 1999-June 2000).

and Tepic, Nayarit between 800 and 1.200 masl, where there is deciduous tropical forest. Species richness was 72 and 78 species in these two locales, respectively. In Cuernavaca, Morelos (1.250-1.850 masl) for tropical deciduous forest and *Pinus-Quercus* forest there were 93 species. In Tentzo, Puebla (2.000-2.350 masl) in xerophyll scrub and oak forest there were only 32 species (Deloya *et al*. 1993,1995; Morón *et al*. 1998, 2000). Considering the altitudinal ranges (350, 400 and 600 masl) and the species richness recorded, in the central region of Guerrero over an altitudinal range of 760 masl, 57 species were recorded; a relatively low number for the sites located between 850 and 1.850 masl, and relatively high compared to Tentzo, Puebla. Results in central Guerrero suggest that as altitude increases (840 to 1.360 masl) species richness increases (Mochitlán$_{840m}$ S = 22, Atlixtac$_{1210\ m}$ S = 34, Chilpancingo$_{1360\ m}$ S = 32), up to 1.600 masl in Tixtla where it decreases (S = 23).

Based on the feeding habits of Scarab larvae and adults in the regions studied, the following guilds were represented: a) phylo-rizophagous (61.4%), covering *Phyllophaga*, *Diplotaxis, Polyphylla, Anomala, Strigoderma, Strategus, Cyclocephala* and *Tomarus*; b) sapro-meliphagous (28%), grouping *Calomacraspis*, *Cotinis, Hologymnetis* and *Euphoria;* c) phylo-xilophagous (3.5%), represented by *Macraspis aterrima* and *Pelidnota virescens*, and d) sapro-rizo-xilophagous (3.5%), which included *Golofa imperialis* and *Chrysina macropus*. Feeding habits are unknown for adults and larvae of the species *Isonychus ocellatus* and *Bothynus complanus*.

The structure of the trophic guilds in central Guerrero suggests that there is a predominance of phylo-rhizophages during spring owing to the reproductive habits of the Melolonthinae: larvae must feed and make it to the third larval instar as quickly as possible because the rainy season – when vegetation renews its foliage and roots are produced – is very short. Sapro-meliphages predominate during autumn when the Asteraceae are flowering and when the cellulose based material that the larvae consume has accumulated (decomposing litter and wood) on the soil. The limited representation of the phylo-rhizophages and the sapro-meliphages could be an indication that small scale removal of wood from the forest could be contributing to the extinction of these populations on a local scale.

New Records. Of the total species captured (N=57), 30% (17) represent new records for Guerrero; they correspond to the genera *Anomala, Strigoderma, Euphoria, Phyllophaga, Polyphylla* and *Chnaunanthus* (Table 4), making the to-

Table 4. New records of phytophagous Scarabaeidae species for the State of Guerrero, Mexico (Melolonthinae, Rutelinae, Dynastinae, Cetoniinae).

Species	Distribution	New records for Guerrero
Phyllophaga ardara	Hgo	Mochitlan, Atlixtac, Chilpancingo, Tixtla
P. dasypoda	Chis,Oax,Pue,Ver	Tixtla
P. crinalis	Hgo,Pue	Atlixtac, Chilpancingo, Tixtla
P. setifera	Hgo, Jal,Mex,Nay, Oax,Pue,Sin	Atlixtac, Chilpancingo
P. eniba	Mex,Nay,Sin,Son	Chilpancingo
P. disca	Mex	Chilpancingo
P. brevidens	Jal, Mex,Mor,Nay, Pue,Sin	Mochitlan, Atlixtac, Chilpancingo, Tixtla
P. fulviventris	Chis,Col,Jal,Mich, Mor,Nay	Chilpancingo, Tixtla
P. crenonycha	Mex	Atlixtac
P scabripyga	Oax	Mochitlan, Atlixtac, Chilpancingo
Isonychus ocellatus	Sin,Hgo,Oax,Pue,Ver	Atlixtac, Tixtla
Polyphylla petiti	Mor,Pue	Tixtla
Chnaunanthus discolor	Gto,Mich,Oax,Pue	Atlixtac, Chilpancingo
Anomala forreri	Sin	Atlixtac, Chilpancingo
A. foraminosa	BCS,Chis,Hgo,Mor, Oax,Pue,QRo,Sin,Tab, Tamps,Ver	Chilpancingo
Strigoderma tomentosa	Oax	Mochitlan, Chilpancingo
Euphoria canescens	Ags,Gto,Pue,Ver	Atlixtac

Ags (Aguscalientes), BCS (Baja California Sur), Chis (Chiapas), Col (Colima), Gto (Guanajuato), Hgo (Hidalgo), Jal (Jalisco), Mex (México), Mich (Michoacán), Mor (Morelos), Nay (Nayarit), Oax (Oaxaca), Pue (Puebla), QRo (Quintana Roo), Sin (Sinaloa), Son (Sonora), Tab (Tabasco), Tamps (Tamaulipas), Ver (Veracruz).

tal present number of phytophagous scarab species 137.

Agricultural aspects. In the central part of Guerrero, the so-called "wire worms" (Coleoptera: Elateridae) and "white grubs" (Coleoptera: Scarabaeidae) are serious agricultural pests, having caused great economic losses to basic crops in most temporal zones (Morón 1999, 1988; Cortés *et al.* 1994). Species of *Phyllophaga, Diplotaxis, Anomala, Cyclocephala, Strategus* and *Tomarus* could also be considered potential pests, given that in the phylo-rhizophagous guild, there are species with rhizophagous, saprophagous or facultative larvae, as observed for *Cyclocephala lunulata.* This species behaves like a saprophage in soils with a high content of decomposing organic material, and eats the remains of harvested rice and sugar cane crops, but has been observed eating roots in sandy soils with little organic material (Deloya 1998).

Zoogeographical aspects. The fauna obtained from the central region of Guerrero makes up 5.6% of all phytophagous scarabs recorded in the country and 13.47% of all species recorded in the state. Melolonthinae (24) and Cetoniinae (14) are the subfamilies with the greatest specific richness; *Phyllophaga* and *Euphoria* are the most diverse genera and include 66.66% of species. In terms of genera, six are in the subfamily Rutelinae, five each in Dynastinae and Melolonthinae, and only three in Cetoniinae. The composition of the fauna observed was compared in that of five different regions previously studied: Cuernavaca, southern Morelos, Sierra del Tentzo, Puebla in the Balsas Basin and Chamela, Jalisco, and Tepic, Nayarit on the Mexican Pacific slopes. Similarity (Sørensen 1948) was greatest between southern Morelos (QS = 0.46) and Cuernavaca, Morelos (QS = 0.38; Morón *et al.* 1988, 1998, 2000; Deloya *et al.* 1993), compared with Chamela, Jalisco (QS = 0.30), Tepic, Nayarit (QS = 0.29) and Tentzo, Puebla (QS = 0.23). Geographic distance could influence the similarity between the fauna of central Guerrero and that of southern Morelos and Cuernavaca. The latter are the two closest localities, at 123 km and 169 km from the central region of Guerrero and they also share a common biogeographical history in the Balsas River Basin. This is in contrast to Chamela and Tepic which are farther away from the central region of Guerrero at 577 km and 692 km, respectively. Although Tentzo is located at an intermediate distance (307 km), its altitude and cold climate could be a cause of the low similarity and species richness. The other sites are located at an altitude of 1.200 masl, with the exception of Chamela at 100 masl, which has a humid tropical climate.

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