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A NEW SPECIES OF *COLON* HERBST FROM HONDURAS (COLEOPTERA: LEIODIDAE: COLONINAE)

STEWART B. PECK
Department of Biology
Carleton University
1125 Colonel By Drive
Ottawa, ON K1S 5B6
Canada

Abstract

Colon (Myloechus) hondurensis, **new species,** is described from montane forests in Honduras. It is the first species of the genus to be described from Central America.

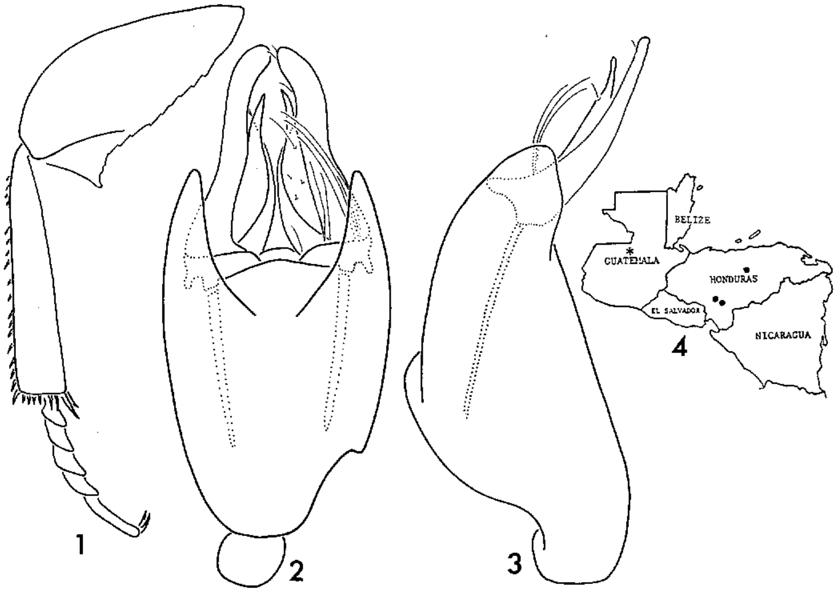
Colon Herbst is a nearly worldwide genus of small and elongate-elliptical beetles, with a distinctive antennal club. About 150 species are known worldwide, and 39 are known from the USA and Canada, and another three from Mexico (Peck and Stephan 1996). There is one published record of a misidentified species ("*Colon clavatum* Mannerheim") from Chiacam (about 26 km northeast of Coban), Department of Alta Verapaz, Guatemala (Matthews 1887:101; Selander and Vaurie 1962). This name is a junior synonym of *C. bidentatum* Sahlberg, a species distributed across northern transcontinental North America and in northern Europe. The only other species in the New World are four in Chile and Argentina (Peck *et al.*, in press). This paper describes the first Central American species to be known from sufficient material. While the genus is known from the Old World tropics of Africa and Asia (Peck 1998), it is seemingly absent or at least very rare in the New World tropics.

Systematics

The nearly cosmopolitan genus *Colon* has been divided into nine subgenera, and five of these occur in North America, including Mexico (see Peck and Stephan 1996). The subgenus *Myloechus* Latreille is Holarctic in distribution and extends southwards into central Africa in the Old World. The new species described here has characters typical of *Myloechus* (see Peck and Stephan 1996) and extends the range of the subgenus in the New World southwards from Mexico to Honduras.

Colon (Myloechus) hondurensis, new species

Type Series. Holotype. Male in Canadian Museum of Nature, Aylmer, PQ. Holotype data. Honduras. Department of El Paraíso. 7km SW of Yuscarán, Cerro Monserrat, 1800m, 24.V.94, H. Howden, malaise trap in cloud forest. Paratypes. 5 with same data; 1 on 27.V.94; 8 on 30.V.94: 15 on 8.VI.94; 5 same locality but 18-VIII-3.IX.94, FIT (flight intercept trap), S. & J. Peck. Department of F. Morazán. 12 km W Zamorano, Cerro Uyuca, 1800m, 3.VI.94, Howden, 1; 6.VI.94, H. & A. Howden, malaise trap, 5; 10.VI.94, H. & A. Howden, 2; 18.VIII-2.IX.94, S. & J. Peck, 2; in moist pine forest at 1400m, 22.VIII-2.IX.94, S. & J. Peck, 1. Department of Olancho. 14km N La Union,



Figs. 1–3. Structures of *Colon hondurensis.* 1) inside surface of left male major metathoracic leg; 2) dorsal view of aedeagus; 3) lateral view of aedeagus; 4) map of part of Central America, with three sites (dots) for *C. hondurensis* in Honduras, and Guatemala locality (star) of "*C. clavatum*" of Matthews (1888).

Parque Nacional La Muralla, 1450m, 18-VIII-1.IX.94, S. & J. Peck, in FIT in montane forest, 3.

Etymology. The species is named for the country of Honduras, from which it is described.

Diagnostic Description. Body color uniform dark brown. Protarsi dilated in both sexes. Pronotal disk coarsely punctate, without raised and interconnected lateral areas for each puncture; basal angles obtuse and narrowly rounded. Submentum with a coarse seta at each corner and with additional coarse punctures scattered at random. Male legs (Fig. 1): protibia stout, straight, widening equally to apex; metafemoral tooth (in major males) expanded before apex of outer lower margin; metatibia straight. Aedeagus (Figs. 2–3) elongate; parameres long, slender, with two or three long setae at base, incurved at blunt tips; long, tapering, pointed piece on inner sides at base, about ¾ length of parameres, and with setae near apex; in lateral view parameres long and thin, without short scattered setae on ventral surface; basal capsule with left apical indentation, as is common in the genus.

Remarks. *Colon hondurensis* shares the general features of the members of the *chiricahua* species group, which contains species in mountain pine forests and cloud forests in Arizona and the Mexican states of Chihuahua and San Luis Potosi.

It can be inserted into the key to species of the the subgenus *Myloechus* in Peck and Stephan (1996:704) as follows:

5 Area between pronotal punctures flat 5a
5′ Area between pronotal punctures raised laterad, forming wavy longitudinal ridges 6
5a Paramere tips pointed, not curved towards each other; spoon shaped piece short, tip blunt .... *C. chiracahua*
5b Paramere tips rounded, curved towards each other; spoon shaped piece long, tip pointed .... *C. hondurensis*

Distribution. This species is known only from Honduras (Fig. 4). The distance from the La Muralla site to those to the southeast suggests that the species will also be found in other montane forest habitats elsewhere in Honduras. It is possible that it is also the species collected by G. Champion from Chiacam[an], Alta Verapaz, Guatemala and reported as "*Colon clavatum*" by Matthews (1887), but that record is based on an unidentifiable female (specimen seen). Another female, in my collection, has the following data: Guatemale, Baja Verapaz, 7 km NE Parulhá, 20.V-8.VI.1991, B. Gill, 1500 m, FIT in cloud forest. Both these females match characters of female *C. hondurensis* but males are necessary for a positive identification.

Bionomics. Known from moist montane pine and cloud forests from 1400-1800m mostly from May and June, but also in August and September. All records are only from malaise and flight intercept traps in forests, even though extensive forest litter has been sifted and extracted in Honduras by R. S. Anderson (pers. comm.)

Acknowledgments

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MATERIALS AND METHODS FOR REARING SELECTED SPECIES OF THE SUBFAMILIES PAEDERINAE AND STAPHYLININAE (COLEOPTERA: STAPHYLINIDAE)

DANIEL A. SCHMIDT
198 Road 7
Schuyler, NE 68661, U.S.A.

Abstract

A listing is presented of food sources, substrates and containers that have been used for rearing selected species of the predatory staphylinid subfamilies Paederinae and Staphylininae (including Xantholinini and Diochini). Rearing methods and materials used by the author for rearing 29 species in 16 genera are given along with suggestions on working with parental adults.

The two subfamilies Paederinae and Staphylininae (including Xantholinini and Diochini), with more than 10,000 species worldwide, include some of the largest staphylinids. Both adults and larvae are predators using preoral digestion (Voris 1934; Lawrence and Newton 1982).

Most present information known about staphylinid beetles concerns adults, with only a limited amount known of the immature stages. A paper by Kasule (1970) listing the characters of the known larvae of Staphylininae and Paederinae (with keys to separate the genera) is a good example of what can be accomplished with the added characters available from the immature stages. Also, a number of characters of the immature stages appear to be visible only on fresh or live material. These characters could be used to open up entirely new character systems previously ignored in the vast majority of staphylinid systematic studies. For this, researchers must have the knowledge and ability to rear these staphylinids in order to make valid character comparisons. Towards that end, an overview of literature mentioning materials and methods regarding the rearing of species of Staphylininae and Paederinae is listed and a specific breakdown of materials and methods used by the author is presented.

Literature Review

A recurring problem with many papers that mention the rearing of staphylinines is that they do not elaborate on methods beyond that the beetles were reared. Likewise, many other papers mention only materials without noting how those materials were used. The following is a brief discussion of food sources, substrates, and containers mentioned in literature.

Food. Obtaining a food source for the rearing experiments has generally consisted of gathering suitable prey from the wild in the areas where the adult parental beetles were collected (Table 1). Often a food source from outside the immediate area of adult capture was used when it was more easily obtainable (Table 2). A food source was rarely reared in the laboratory (Table 3).

Substrates. Chapin (1915) is one of the earliest mentions of materials and methods for rearing staphylinines. He used small tin containers with plaster of Paris poured into the bottoms to maintain moisture levels and put peatmoss on top of that as a substrate for the larvae to hide among. Substrates used

Table 1. Food sources gathered from areas where adult parental beetles were collected.

Food Type	Reared Beetle Species (citations)
Cotton leafworm eggs and larvae, *Spodoptera littoralis* (Boisduval) (=*Prodentia litura*)	*Paederus alfierii* Koch and *Philonthus misor* Tott (Ahmed 1957; Tawfik *et al.* 1976b)
Brown garden snails, *Helix aspersa* (Müller)	*Ocypus olens* Müller (Orth *et al.* 1975)
Bark maggots	*Xantholinus cephalus* Say (Chapin 1915)
Hornfly eggs and larvae	*Neohypnus pusillus* (Sachse) (Hu and Frank 1995; Hunter *et al.* 1986)
Eggs of Diptera, *Haematobia irritans* (L.), *Stomoxys calcitrans* L. and *Musca domestica* L.	*Philonthus brunneus* (Gravenhorst), *P. cruentatus* Gmelin, *P. flavolimbatus* Erichson, and *P. hepaticus* Erichson (Hunter *et al.* 1986)
Fruit flies, *Bactrocera* (=*Dacus*) *dorsalis* (Hendel) and *B.* (=*Dacus*) *curcubitae* (Coquillett)	*Thyreocephalus albertisi* (Fauvel) (Marucci and Clancy 1952)
Eggs of cotton bollworm, *Helicoverpa* (=*Heliothis*) *armigera* (Hübner)	*Philonthus misor* Tott (Tawfik *et al.* 1976b)
Aphids	*Philonthus misor* Tott and *Paederus alfierii* Koch (Tawfik *et al.* 1976b; Ahmed 1957)

Table 2. General food sources gathered from areas other than where adult parental beetles were collected.

Food Type	Reared Beetle Species (citations)
Termite workers	*Ontholestes cingulatus* (Gravenhorst), *Creophilus maxillosus* (L.), *Staphylinus maculosus* (Gravenhorst), and a *Xantholinus* sp. (Voris 1939b; Costa *et al.* 1986)
Ant larvae	*Staphylinus maculosus* (Gravenhorst) (Voris 1939b)
Cockroaches	*Cafius seminitens* Horn, *C. canescens* Mäklin, *C. luteipennis* Horn, and *C. lithocharinus* LeConte (James *et al.* 1971)
House fly larvae and pupae	*Ontholestes cingulatus* (Gravenhorst), *Creophilus maxillosus* (L.), *Staphylinus maculosus* (Gravenhorst), *Thyreocephalus albertisi* (Fauvel), and *Philonthus longicornis* Stephens (Voris 1939b, Marucci and Clancy 1952; Tawfik *et al.* 1976a)
Mealworms	*Platydracus tomentosus* (Gravenhorst) (Schmidt 1994a)

Table 3. Food sources reared in the laboratory.

Food Type	Reared Beetle Species (citations)
Drosophila melanogaster Meigen larvae	*Philonthus cruentatus* (Gmelin), *P. tetragenocephalus* Notman, *Quedius capucinus* (Gravenhorst), *Q. molochinus* (Gravenhorst), *Eustilicus* sp., *Rugilus* sp., *Stilocharis* sp., *Medon* sp., and *Neobisnius sobrinus* (Erichson) (Voris 1934; Voris 1939a, pers. comm. in regard to Frania 1986; Schmidt 1994b)
Fly larvae, *Calliphora* spp., *Musca domestica* L., and *Stomoxys calcitrans* (L.)	*Creophilus maxillosus* L. (Greene 1996)
Nematodes	*Erichsonius alumnus* Frank and *E. pusio* (Horn) (Schmidt 1996)

since then have included: Plaster of Paris with soil on top (Schmidt 1994*b*; Schmidt 1996); moist soil (Marucci and Clancy 1952; Orth *et al.* 1975; Hunter *et al.* 1986; Schmidt 1994*a*); moist sand (Voris 1934; Ahmed 1957; James *et al.* 1971; Tawfik *et al.* 1976*b*; LeSage 1984; Greene 1996) on top of which was often added moist cotton (Voris 1934; Tawfik *et al.* 1976*b*; Hu and Frank 1995), moist paper towel (Hu and Frank 1995), sphagnum moss and cow feces (Hunter *et al.* 1986) or some of the material in which the beetles where captured, such as loose mulch (Orth *et al.* 1975), decaying plant leaves (Ahmed 1957), or moss and decomposing leaves (Szujecki 1966). Soil (or moist sand) has appeared to work especially well with the larger staphylinines that naturally burrow.

Containers. The choice of containers did not appear as important a choice as the food source and substrate. The containers used ranged from glass chimneys to tin boxes. Clear containers (glass or plastic) were especially used when the researcher needed to observe the beetles and immatures without overly disturbing them (Schmidt 1994*a*; Tawfik *et al.* 1976*b*). Keeping adult beetles from escaping while working inside the container with the lid open was sometimes a challenge. Larger species of the subfamily Staphylininae, as well as most species of Paederinae, would not take flight when the lid of a container was opened and could therefore be reared in a large variety of containers. However, some medium and smaller members of Staphylininae often took wing immediately upon opening of the container. Specialized containers with taller sides or small openings through which work was done (Schmidt 1994*b*; Schmidt 1996) were needed in those instances. Rearing chambers formed of plaster of Paris itself (after Steel 1970), were used by H. Frania (1986 and pers. comm.). These chambers maintain an adequate humidity level, are easy to make, and work very well in certain cases. However my experience has been that while these chambers work for less active beetles like Paederines, it is difficult to keep more energetic beetles such as *Neobisnius* from escaping during normal maintenance work.

Materials and Methods

Food Sources. I have found it advantageous to have food sources that are available year-round. The following three food sources can be maintained or stored for whenever needed and appear to fulfill the needs of all but the most specialized species (Table 4).

Frozen adult flies. For smaller staphylinids, *Drosophila melanogaster* adults work well. I use vestigial winged flies for ease of handling which can be grown using commercial growing medium and standard laboratory procedures. Only adults are used as food and can be collected by shaking them into a 5 liter plastic bucket, upon which a lid is immediately placed. This bucket is then frozen and the frozen flies can be poured into a funnel fitted over a 2 dram patent lip glass vial. The vial is sealed with a neoprene stopper and frozen until needed. In this way a substantial supply of food can be gathered prior to the rearing period. While rearing beetles, a few frozen flies are dropped into the rearing containers as needed, with the remainder returned to the freezer for use at a later date. The flies thaw quickly and are readily accepted by most adults and some larvae as food. Larger staphylinids readily take various muscoid flies. The flies can easily be caught and placed into a freezer to kill the flies or the flies can be carefully transferred to a container which is then frozen. The frozen flies are placed in sealed glass jars and stored frozen until needed. These flies are then used in the same manner as above for fruit flies.

Soil nematodes. These were initially collected by filling small containers with soil from moist and organic areas (especially around ponds and creeks) and adding water until the soil is very moist. Mealworms broken in half or small (5 mm diameter) pieces of processed cheese were then placed on top of the soil. In one or two days, the mealworm or cheese pieces were covered with nematodes, which were then removed with fine tweezers and put into the rearing containers described below.

Collembola. A white, eyeless species of Isotomidae was collected and used with good success. These Collembola were initially collected from organic debris next to a stream and appear to scavenge organic matter as their food source. They are generally reared with nematodes in the same container.

Rearing Containers

Plaster of Paris is used in the bottom of all my rearing containers to help maintain proper humidity levels required in rearing staphylinids. Rearing containers having straight sides can have the plaster of Paris poured into the bottom and simply used as is. However, nestable containers (with sloping sides) are sometimes the only option available. If plaster is poured into the bottom of these, it can pop up a small amount after hardening, creating a crack between the container and the plaster where beetle larvae might hide and inadvertently get crushed in handling. Therefore two containers should be used (Figs. 1–2), one stacked on top of the other. The upper container has a portion of the bottom cut out (Fig. 2). When the plaster of Paris is then poured into the two containers, it sets around the bottom edge of the top container and prevents movement (Fig. 5).

Large containers (Fig. 6) (200 mm wide × 160 mm tall) are used to increase the numbers of nematodes and Collembola and to maintain the colonies when active beetle rearing is not taking place. A layer of fine sand (1 to 3 mm) is spread over the entire surface of the plaster and small pieces of clear Plexiglas (a plastic glass substitute) are placed on the surface of the sand. The Collembola can hide beneath these pieces and are still visible.

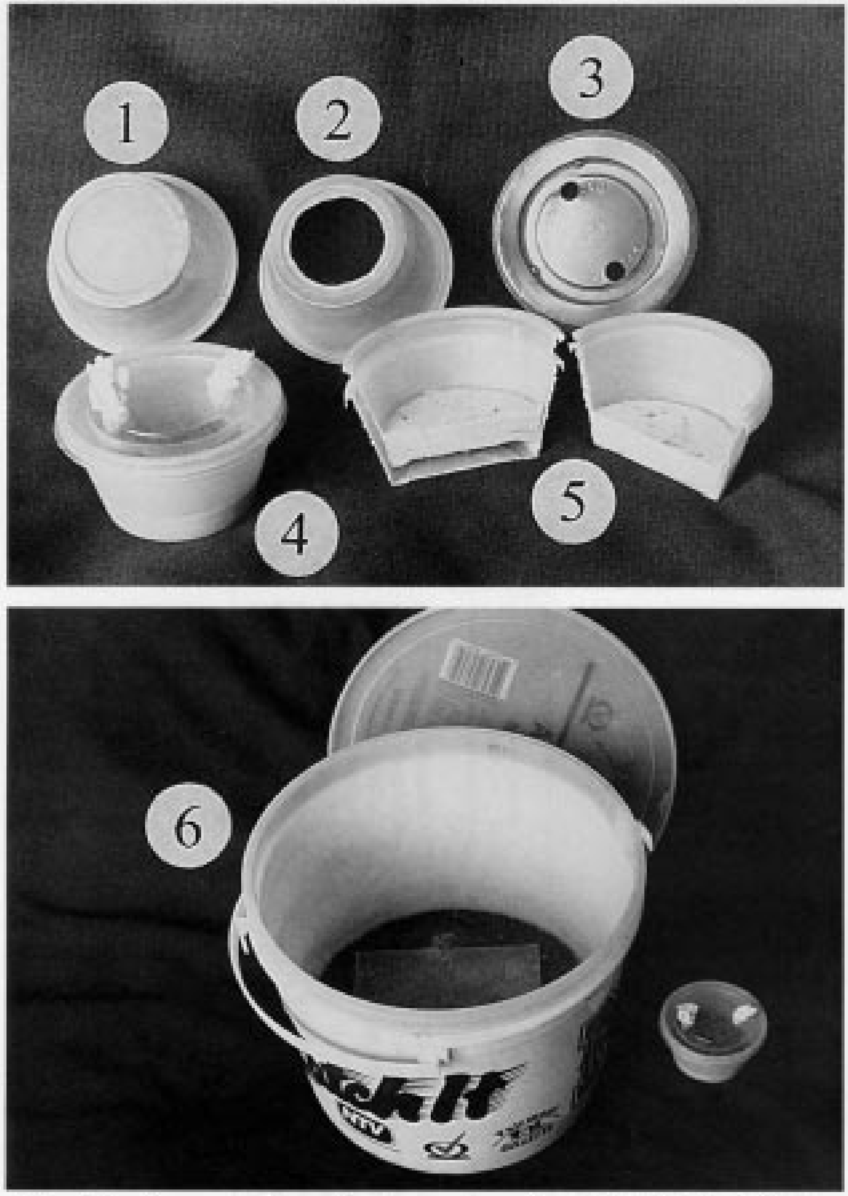
Small containers (Fig. 4) (60 mm wide × 30 mm tall) are used for the actual rearing. Tight fitting snap-on lids (Fig. 3), with two holes, punched with a

Table 4. Food sources of adults and larvae of various species of Staphylinindae reared by the author.

	(*Drosophila* and muscoid flies = frozen adults)	
Reared species	Adult food	Larval food
Staphylininae: Diochini		
Diochus schaumi Kraatz	*Drosophila*, nematodes	*Drosophila*, nematodes
Staphylininae: Xantholinini		
Neohypnus fragilis (Casey)	*Drosophila*	nematodes
N. obscurus (Erichson)	*Drosophila*	nematodes
Staphylininae: Staphylinini		
Acylophorus flavicollis Sachse	*Drosophila*, nematodes	nematodes
Erichsonius alumnus Frank	*Drosophila*, nematodes	nematodes
E. pusio (Horn)	*Drosophila*, nematodes	nematodes
Heterothops pusio LeConte	*Drosophila*, Collembola	Collembola
Belonuchus rufipennis Fabricus	*Drosophila*	*Drosophila*
Neobisnius occidentoides Frank	*Drosophila*	*Drosophila*, nematodes
N. jucundus (Horn)	*Drosophila*	*Drosophila*, nematodes
N. sobrinus (Erichson)	*Drosophila*	*Drosophila*, nematodes
Philonthus aurulentus Horn	*Drosophila*, muscoid flies	*Drosophila*, muscoid flies
P. caeruleipennis Mannerheim	muscoid flies	muscoid flies
P. cruentatis Gmelin	*Drosophila*	*Drosophila*
P. politus Fabricius	*Drosophila*, muscoid flies	*Drosophila*, muscoid flies
P. rectangulus Sharp	*Drosophila*	*Drosophila*
Creophilus maxillosus (L.)	*Drosophila*, muscoid flies	*Drosophila*, muscoid flies
Platydracus caliginosus (Erichson)	muscoid flies	muscoid flies
P. cinnamopterus (Gravenhorst)	*Drosophila*, muscoid flies	*Drosophila*, muscoid flies
P. fossator Gravenhorst	muscoid flies	muscoid flies
Ontholestes cingulatus (Gravenhorst)	muscoid flies	muscoid flies

Table 4. Continued.

Reared species	(*Drosophila* and muscoid flies = frozen adults) Adult food	Larval food
Paederinae		
Homaeotarsus bicolor Gravenhorst	Collembola, *Drosophila*	Collembola, *Drosophila*
Homaeotarsus sellatum LeConte	Collembola, *Drosophila*	Collembola, *Drosophila*
Lathrobium punctulatum LeConte	Collembola, *Drosophila*	Collembola, *Drosophila*
Lathrobium rubripenne Casey	Collembola, *Drosophila*	Collembola, *Drosophila*
Lobrathium acomanum Casey	Collembola, *Drosophila*	Collembola, *Drosophila*
Lobrathium longiusculum Gravenhorst	Collembola, *Drosophila*	Collembola, *Drosophila*
Paederus littorarius L.	Collembola, *Drosophila*	Collembola, *Drosophila*
Rugilus, one species, undet.	Collembola, *Drosophila*	Collembola, *Drosophila*



Figs. 1–6. Components of small rearing containers for staphylinid beetles. **1**) bottom container; **2**) top container with hole cut in bottom to hold plaster in place; **3**) lid with two holes; **4**) assembled complete small container with paper towel plugs in holes; **5**) bisected small container showing layer of plaster of Paris: right half with top and bottom containers separated slightly to show how plaster of Paris adheres to top container; **6**) large container on the left with a small container on the right for size comparison.

paper punch, and stuffed with wads of paper toweling are also used. These containers are small enough to be placed directly under a dissecting microscope for observation. If the adult beetles being reared are active, only the paper toweling wads can be removed and observations made through the two holes in the lid. Food and water can also be added through the holes with less chance of escape by the adult beetles. All containers are kept in the dark. Smaller containers are kept in larger, covered plastic boxes (with a shallow layer of water on the bottom) to prevent them from drying out.

Setup and Maintenance

Small containers can be prepared several months in advance. A small number of nematodes (and Collembola if needed) are placed into the containers and allowed to reproduce. Water is added as needed, to keep the sand very moist and a few small pieces of processed cheese are placed in the containers every two or three weeks. It is important to add only as much cheese as can be eaten by the nematodes and Collembola. Mold on any of the cheese pieces indicates too much cheese was added.

After adult beetles are placed in the rearing containers, frozen flies are added as food daily or every other day. Cheese pieces are not needed after this, as the nematodes will consume any flies that are not eaten by the beetles or larvae and any Collembola present will subsist on beetle and nematode feces. This ability of the soil nematodes to keep mold from forming in the containers is a great asset, greatly reducing mortality and allowing the researcher to spend less time on maintenance. Nematodes will also crawl over beetle eggs laid in the container and clean off organic debris that could cause the eggs to start to mold. No damage has been observed to the eggs by this action. I have, however, observed large numbers of nematodes attacking the unsclerotized pupae of paederines. Therefore, paederine larvae should be moved to individual containers without nematodes (or with very few) as late second instars or as prepupae. I have found through trial and error that six adults in a container seems to be the optimal number. This number is small enough that the beetles can be easily kept track of, but large enough that there will always be at least one male and one female. I rotate the adult(s) out of each container daily and put them into a new small container. This keeps the adults from eating the larvae when they hatch and narrows the laying of the eggs to a 24 hour period. Large adult beetles can simply be transferred by hand as they generally are not quick flyers. Medium and small adults will sometimes take wing very quickly and can be lost during the transfer process. To limit that possibility, I turn the small container to which I am moving the adults into a aspirator. I pull the paper towel plugs out of the lid and replace them with two pieces of latex tubing. I then take the lid off the small container with the adult beetles and aspirate them into the new container as I find them. The tubes can then be removed from the lid and the paper towel plugs replaced. After a particular rearing is completed, the container does not have to be rinsed out or sterilized as the nematodes should have been able to keep any mold growth in check. However it is advisable to follow with a different, easily distinguishable species (*e.g.*, *Philonthus* followed by *Paederus*) so that any hidden specimens that might show up later would not be confused with the current larvae being reared.

Obtaining Parental Stock

Common methods of insect collection employed by entomologists often involve a method of killing the insects as they are collected (*e.g.*, a killing agent

Fig. 7. Blacklight set-up showing tin funnel and extra bucket three-fourths filled with straw.

in the bottom of a pitfall trap). As this is useless for rearing, I will elaborate on a few strategies that I have used successfully to obtain adults and identify them while still alive.

A blacklight trap will attract many types of staphylinids. However, it can be difficult to sort the various types of staphylinids at night in the dark. A setup using a large piece of tin or stretched plastic that funnels attracted beetles through a hole into a closed 5 gallon bucket three-fourths full of wadded straw or grass works well (Fig. 7). In this manner the beetles can be hand sorted in better light the following morning. Pitfall traps and berlese funnels can also work well for collecting live specimens if a wad of straw or grass is placed at the bottom of the collection chamber instead of the usual killing agent. A tight fitting funnel over the top of the container to prevent beetles from escaping up the sides is generally advisable. Hand sorting of sifted material also works well to recover live specimens.

Another problem with sorting staphylinids (and keeping them alive in the process) is that many species look very much alike and can only be sorted by the observation of obscure characters or by internal features like the aedeagus. Holding adults in a small glass test-tube for examination works well. If the underside of the beetle needs to be viewed, a small rolled up piece of paper can be inserted into the tube with tweezers and allowed to expand over the top of the beetle as it attempts to climb the side of the test-tube. This flattens and holds the beetle against the glass without causing damage to the beetle. When identifying characters are internal, females can be held individually in small containers with no males present. My experience in this area (Table 5)

Table 5. Summary of data on Staphylinid females ovipositing after collection. All females were held individually in small containers with no males present.

Species	Length of oviposition of fertile eggs after collection (in days)	No. of fertile eggs laid
Erichsonius alumnus Frank	28	25
Erichsonius pusio (Horn)	10	11
Erichsonius pusio (Horn)	14	13
Erichsonius pusio (Horn)	14	15
Erichsonius pusio (Horn)	20	19
Heterothops pusio LeConte	28	30
Neobisnius sobrinus (Erichson)	38	48
Neobisnius sobrinus (Erichson)	21	23
Platydracus caliginosus (Erichson)	28	43
Platydracus caliginosus (Erichson)	19	27
Lathrobium punctulatum LeConte	45	65

indicates that collected female staphylinid beetles can often lay fertile eggs over a fairly long period of time without a male present. Any eggs collected can then definitely be said to all belong to the same species. When internal male characters are required for identification, a good strategy is to allow a certain percentage of the eggs (25%?) to mature to adulthood. With luck at least one of the reared adults will be a male and an aedeagus can be obtained from which to make a positive identification.

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EGGS AND OVIPOSITION HABITS IN ENTIMINI (COLEOPTERA: CURCULIONIDAE)

ADRIANA E. MARVALDI
Instituto Argentino de Investigaciones de las Zonas Áridas (IADIZA),
C. C. 507, 5500 Mendoza, Argentina

Abstract

The egg stage and oviposition behavior of 15 species of Entimini (Curculionidae: Entiminae) are described. Eggs are illustrated and compared with those of related tribes Sitonini and Alophini. Scanning electron micrographs of the chorion of eight species in these three tribes are provided. The morphological diversity of the chorion is evaluated in weevils as a source of phylogenetic and ecological information.

Emden's (1950) study of eggs and egg-laying habits of broad-nosed weevils included exemplars of representative species of the entimine tribes (*sensu* Marvaldi 1997) Entimini, Sitonini and Alophini. Emden (1950, 1952) distinguished two basic oviposition modes in broad-nosed weevils: eggs deposited singly and at random ("*Sitona* type") *versus* eggs deposited in batches ("*Brachyderes* type"). The eggs laid randomly are usually deposited on plants, surface litter, or soil. These eggs darken or become black as they develop. The eggs laid in batches are covered with adhesive (glutinous substance) secreted during oviposition, and are placed between adjoining surfaces (leaves, cracks in the soil, crevices, litter, or various niches near the soil). These eggs usually remain pale. More recently, Howden (1995) published a major work on weevil oviposition behavior and female genitalia, and their variation in Curculionoidea. Howden's Category 9 is defined for eggs glued by adhesive, placed usually without use of rostrum in fabricated sites (section 9A), discovered niches (section 9B) or in ground litter (section 9C). This category might be equivalent to Emden's *Brachyderes* type. All known examples in such category 9 are taxonomically placed in Entiminae. There are also entimine species that fit Howden's definition of Category 10 for "eggs placed in soil." Eggs and information on oviposition habits of several other entimine species came about via laboratory rearing by the author (mainly to obtain weevil larvae). In addition, scanning electron microscopy (SEM) has revealed a wealth of fine structures of egg choria, which were previously impossible or difficult to resolve with light microscopy. Previous papers containing SEM information on the eggshell of weevils include *Ithycerus noveboracensis* (Forster) (Sanborne 1981), *Sitona humeralis* Stephens and *Sitona limosus* Rossi (Mazzini 1974), *Naupactus xanthographus* Germar (Loiácono and Díaz 1992), and *Naupactus leucoloma* Boheman (Lanteri and Marvaldi 1995).

Studies on insect eggs show that the surface of the chorion is sometimes marked in polygonal areas, corresponding to the follicular cells which secrete the chorion (Emden 1957; Richards and Davies 1983). These publications deal almost entirely with the microsculpture of chorion containing the aeropyles or egg respiratory channels (Hinton 1981). The chorion also presents one or more micropyles, orifices through which the spermatozoids enters the egg (Wigglesworth 1978). The micropylar area of insect eggs is defined by Mazzini (1974) as a morphologically differentiated area of the chorion containing the micropyles, generally located at the anterior or cephalic pole of the egg, which is usually of smaller diameter than the posterior pole.

The purpose of this paper is: 1) To provide descriptions of eggs and oviposition habits of 15 species of Entimini, and to compare them with information available on the related tribes Sitonini and Alophini; and 2) to provide scanning electron micrographs (SEM) of the eggs of some species representative of Entimini, Sitonini and Alophini, for the purpose of evaluating the morphological diversity of the chorion, as a potential source of information for phylogenetic or ecological considerations.

Material and Methods

In order to observe oviposition habits and obtain eggs for examination, pairs of adult weevils or single parthenogenetic females were kept in jars in the laboratory. The weevils were fed with twigs and leaves of the plants where they were caught. Folded pieces of tissue paper were provided to facilitate oviposition, following Emden (1950), and when oviposition in soil was suspected, a small container with soil was also provided.

The mean egg size for each species was calculated (n = 10). For descriptive purposes, two basic oviposition modes are referred to type (a)—eggs laid loosely and at random and type (b)—eggs laid in batches between adjoining surfaces. Tribal classification of Entiminae follows Marvaldi (1997), but the tribes treated herein may be regarded as subtribes of Brachycerinae: Entimini *sensu* Kuschel (1995).

Voucher adult specimens are housed at the Department of Entomology, "Museo de La Plata," La Plata, Argentina [MLP], and in the collection of A. E. Marvaldi [AEM] currently in the "Instituto Argentino de Investigaciones de Zonas Áridas," Mendoza, Argentina. Fifteen species of Entimini, all from Argentina, were studied and are listed below with the collection data of the adults [the asterisk indicates species whose eggs were examined using the scanning electron microscope].

**Cylydrorhinus farinosus* (Burmeister). Mendoza: San Rafael, El Nihuil, 6-III-94, host-plant *Senecio subulatus* Don *ex* Hook. *et* Arn. (Asteraceae), A. Marvaldi coll. det., 2 females, 2 males [AEM].

Pororhynchus sp. Mendoza: Luján de Cuyo, Potrerillos, 17-I-92, host-plant *Larrea nitida* Cav. (Zygophyllaceae), A. Marvaldi and S. Roig-J. colls. det., 2 females, 2 males [AEM].

**Platyaspistes argentinensis* Kuschel. Mendoza: Luján de Cuyo, Potrerillos, 17-I-92, host-plant *Baccharis* sp. (Asteraceae), A. Marvaldi coll. det., 1 female + 1 male [IADIZA]; San Rafael, Nihuil Valle Grande, 5-III-94, A. Marvaldi coll. det., 1 female [AEM].

Aramigus tessellatus (Say) (= *A. durius* (Germar)). Buenos Aires: Quilmes, 10-XII-90, A. Marvaldi coll., A. Lanteri det., 1 parthenogenetic female [MLP].

Atrichonotus taeniatulus (Berg). La Pampa: Santa Rosa, 28-II-92, host-plant *Medicago sativa* L. (Fabaceae), E. Quirán coll., A. Lanteri det., 5 parthenogenetic females [MLP].

**Enoplopactus lizeri* (Hustache). Mendoza: Lavalle, Reserva Telteca, 1-III-94, host-plants *Larrea cuneifolia Cav.* (Zygophyllaceae) and *Prosopis argentina* Burk. (Fabaceae), G. Flores coll., A. Lanteri det., 2 females, 2 males [AEM].

Naupactus dissimulator Boheman. Buenos Aires: Pereyra, 10-I-91, A. Marvaldi coll., A. Lanteri det., 1 female [AEM].

**Naupactus leucoloma* Boheman. Mendoza: Godoy Cruz, 22-III-98, A. Marvaldi coll. det., 1 parthenogenetic female [AEM].

**Naupactus rugosus* (Hustache). Mendoza: San Rafael, El Nihuil, 6-III-94, host-plants *Grindelia chiloensis* (Corn.) Cabr. and *Senecio subulatus* Don *ex* Hook. (Asteraceae), A. Marvaldi coll., A. Lanteri det., 2 females, 2 males [AEM].

Naupactus ruizi (Brèthes). Mendoza: Luján de Cuyo, Potrerillos, 17-I-92, A. Marvaldi coll., A. Lanteri det., 1 parthenogenetic female [AEM].

**Naupactus sulphurifer* Pascoe. Mendoza: Santa Rosa, Reserva Ñacuñán, 8-III-94, host-plant *Larrea cuneifolia* Cav. (Zygophyllaceae), G. Flores coll., A. Lanteri det., 1 female [AEM].

Naupactus verecundus Hustache. Córdoba: La Cumbre, 6-XII-91, A. Marvaldi coll., A. Lanteri det., 2 females [AEM].

Pantomorus auripes Hustache. Mendoza: Luján de Cuyo, Potrerillos, 17-I-92, A. Marvaldi coll., A. Lanteri det., 4 parthenogenetic females [AEM].

Pantomorus postfasciatus (Hustache). Buenos Aires: La Plata, 2-I-91, A. Marvaldi coll., A. Lanteri det., 1 female [MLP].

Priocyphus bosqi Hustache. La Pampa: Santa Rosa, 28-II-91, host-plant *Medicago sativa* L. (Fabaceae), E. Quirán coll., A. Lanteri det., 2 females, males [MLP].

Eggs of species representative of Sitonini and Alophini were also examined with SEM for outgroup comparison to phylogenetic interpretation. Eggs of **Alophus triguttatus* (Fabricius) were borrowed from the Natural History Museum, London, England, and correspond to the material obtained and studied by Emden (1952:668). Eggs of **Sitona* sp. were laid by a female with the following collection data: England, Cheshunt, 5-IV-94, A. Marvaldi and J. Beard colls. det., host-plant: Fabaceae [AEM].

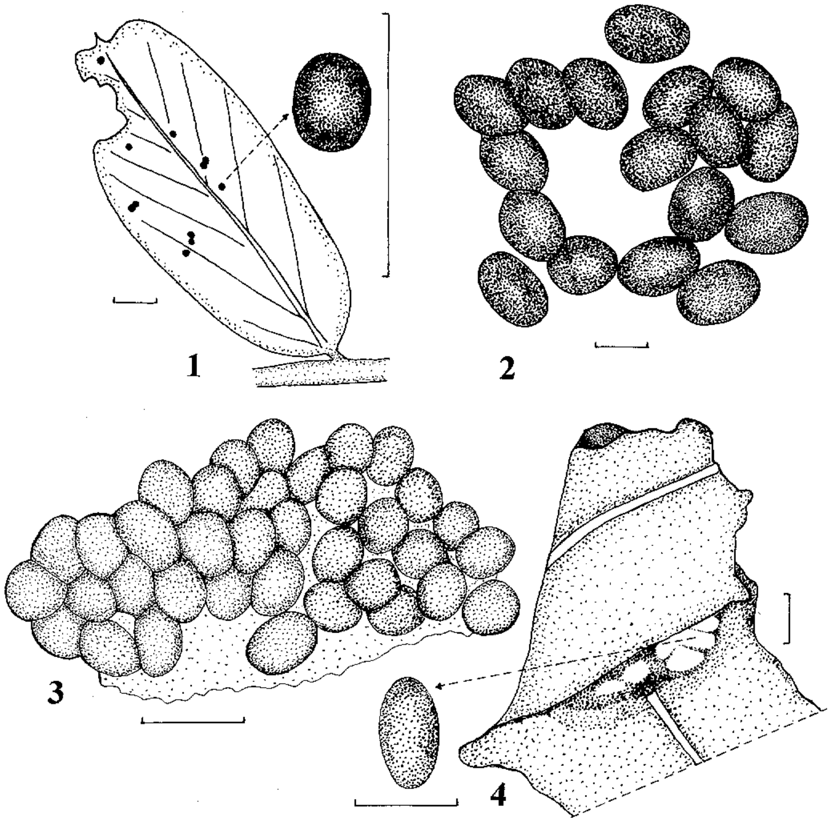
Scanning Electron Microscopy. Eggs examined with the scanning electron microscope (SEM) were prepared using the critical drying point method. Samples of eggs preserved in 75 % ethanol were dehydrated by running them through a stepped concentration series (75–95) to absolute ethanol. They were then placed into the critical point chamber. After drying, the eggs were mounted on aluminium SEM stubs with double-sided carbon tape, and sputter-coated with gold. Eggs were examined with a Siemens scanning electron microscope at 20 kv at magnifications ranging from 500× to 15,000× (SEM service of the "IHEM, Universidad Nacional de Cuyo," Mendoza, Argentina). Most micrographs (Figs. 9–17 and 21–26) show areas from the equatorial region of the egg. For two species micrographs were also taken on polar ends of the egg (Figs. 18–20).

Tribe Alophini

***Alophus triguttatus* (Fabricius).** Eggs and oviposition type (a), described by Emden (1950, 1952). Chorion (Figs. 9–11) marked in polygonal areas with impressed borders limiting contiguous hexagonal ridges; chorionic surface microsculptured by tubercules, without aeropyles.

Tribe Sitonini

***Sitona* sp.** Eggs and oviposition type (a) (Fig. 1), described by Emden (1950, 1952). Chorion (Figs. 12–14) not distinctly marked by polygonal areas; cho-



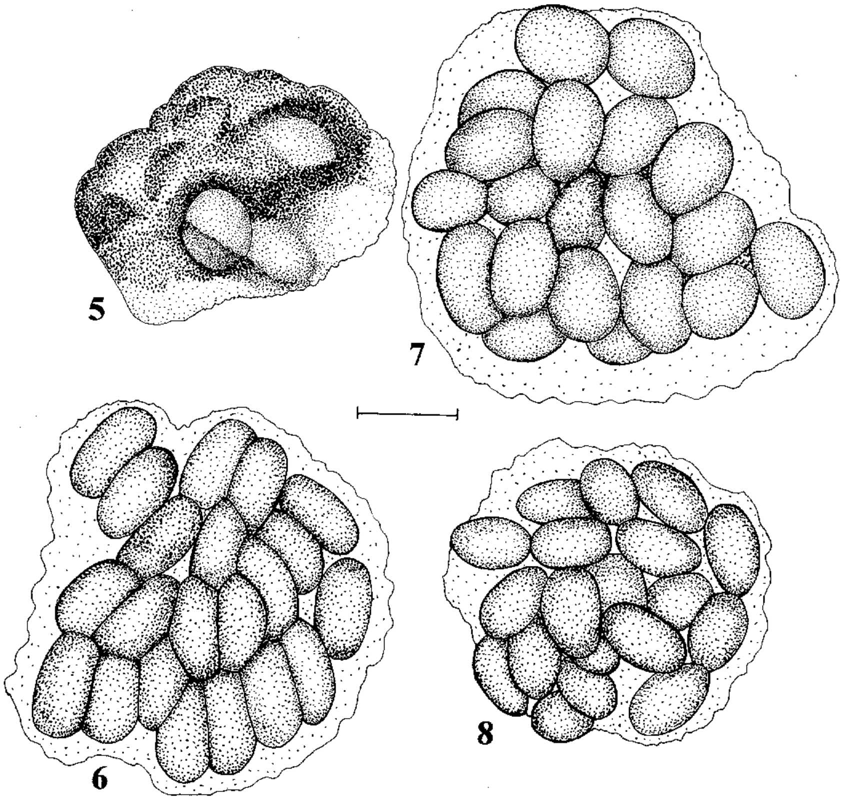
Figs. 1–4. Eggs and deposition pattern. **1**) *Sitona* sp; **2**) *Cylydrorhinus farinosus*; **3**) *Pororhynchus* sp.; **4**) *Platyaspistes argentinenesis*. Scales = 1 mm.

rionic surface microsculptured by tubercules, with scattered aeropyles. The species studied by Mazzini (1974:362, plate xxvii) show a similar chorionic pattern of tubercules but no aeropyles, and polygonal marks are discernible at the micropylar area.

Tribe Entimini

Information on eggs and postures of additional species representative of Entimini can be found in Bruch (1932), Emden (1950, 1952), May (1966), Jackson (1987), Kovarik and Burke (1989), Loiácono and Díaz (1992), Lanteri and Marvaldi (1995).

***Cylydrorhinus farinosus* (Burmeister).** Eggs (Fig. 2). Mean size: 1.58 × 1.16 mm. Oval. Color whitish-yellow at first, becoming deep black as they develop. Oviposition type (a), eggs laid in great numbers (up to 50) at a time, on soil or on the host-plant. Chorion (Figs. 15, 16) marked by polygonal areas limited by narrow channel-like borders; chorionic surface rather smooth, with a sandy aspect, without aeropyles.



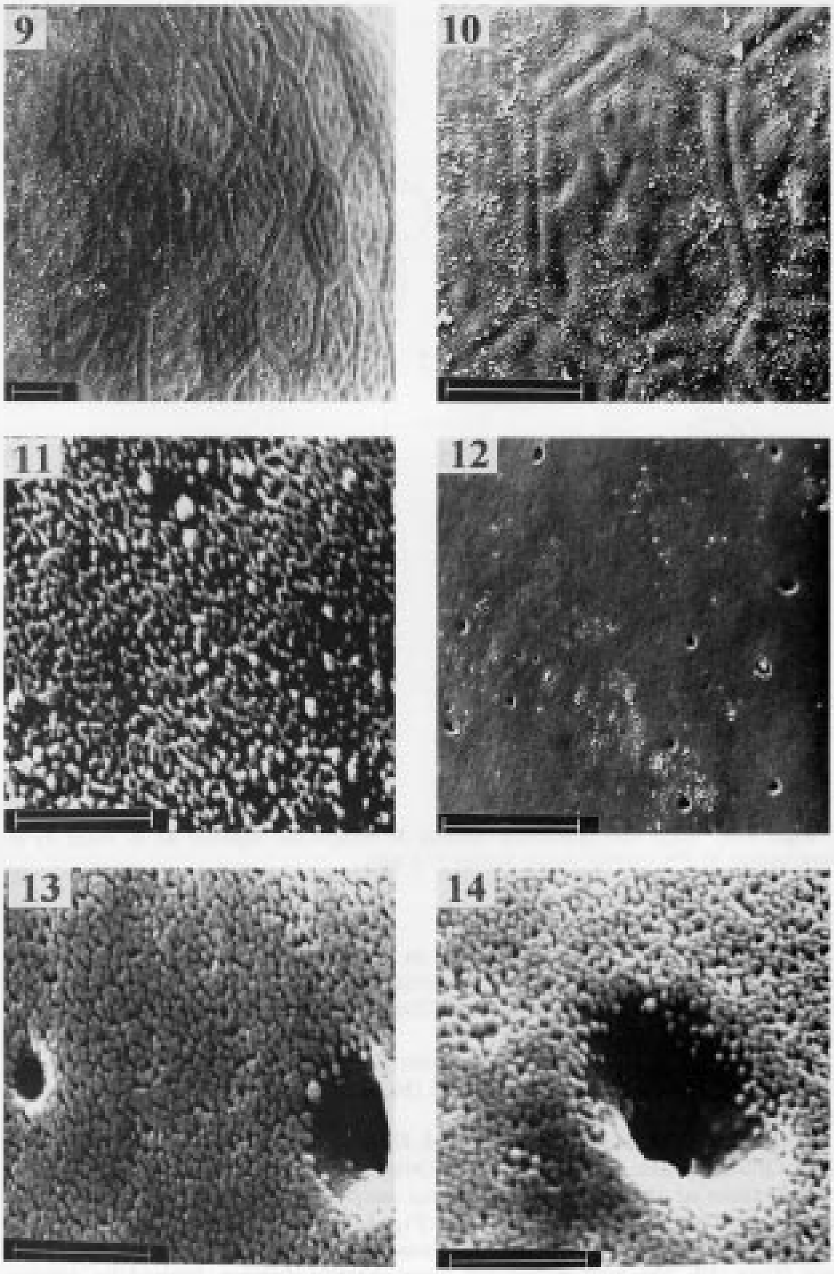
Figs. 5–8. Eggs and deposition pattern. **5**) *Naupactus rugosus*; **6**) *N. ruizi*; **7**) *N. verecundus*; **8**) *Priocyphus bosqi*. Scales = 1 mm.

Remarks. Other examples reported in Entimini of eggs laid in loose lumps and becoming dark include some species of *Otiorhynchus* Germar (Emden 1950; May 1966), *Barynotus* Germar (Emden 1952), and *Eudiagogus* Schoenherr (Kovarik and Burke 1989).

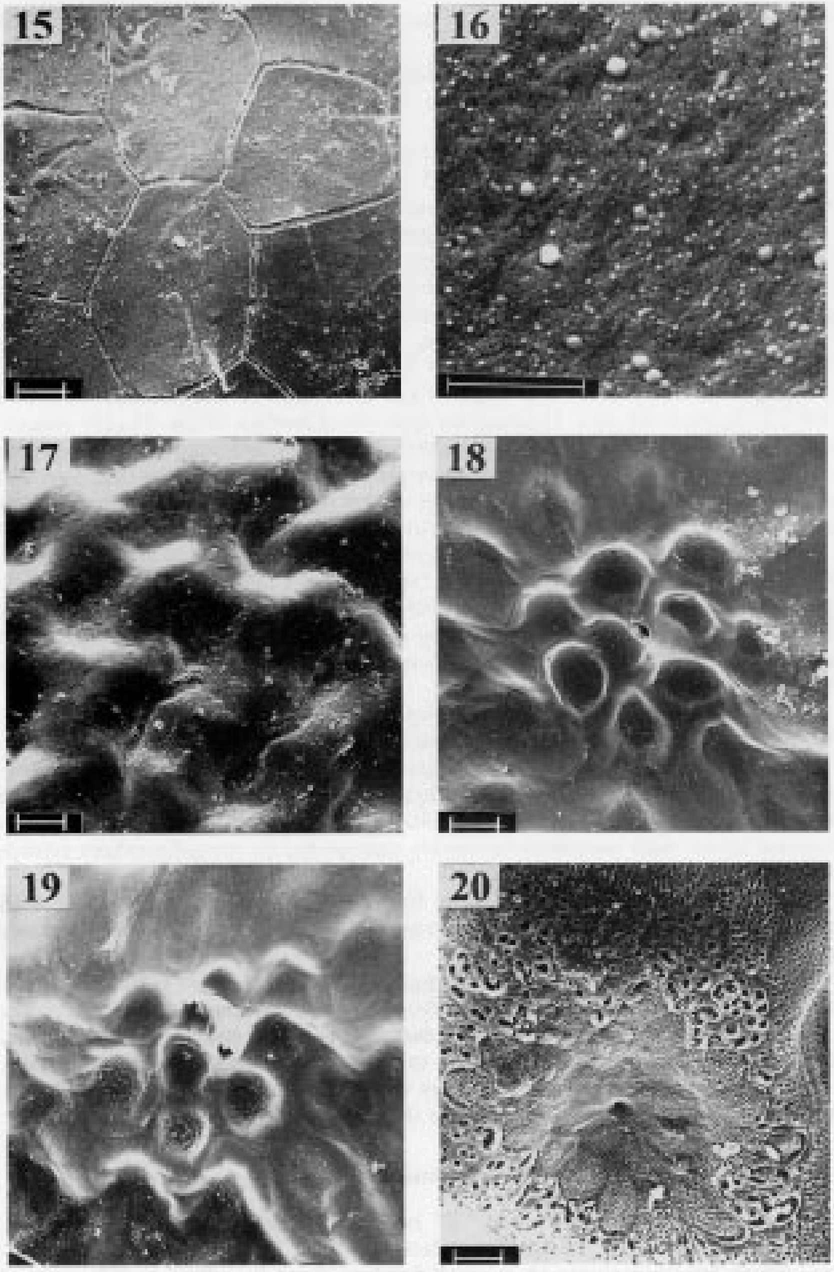
***Pororhynchus* sp.** Eggs (Fig. 3). Mean size: 0.72 × 0.56 mm. Subspherical. Color intense yellow. Oviposition type (b), eggs laid usually on the host-plant, glutinous substance orange.

***Platyaspistes argentinensis* Kuschel.** Eggs (Fig. 4). Mean size: 1.11 × 0.58 mm. Oblong-ovate. Color yellowish. Oviposition type (b), eggs laid between two surfaces of a leave, folded with that purpose by the female, and glued by a brown glutinous substance. Chorion (Fig. 17) surface with a pattern of swellings and shallower areas, lacking microsculpture and aeropyles. Poles of the egg (Figs. 18, 19) with polygonal areas weakly distinct, limited by narrow ridges. Both the anterior and posterior poles of the egg present an orifice (micropyla?), placed on a protuberance like a short stalk.

The oviposition habits of *P. argentinensis* are very similar to those described for *P. glaucus* Fahraeus from Chile (see Jackson 1987). Oviposition behavior



Figs. 9–14. Scanning electron micrographs of chorion, egg equatorial portions. 9–11) *Alophus triguttatus.* **9)** 500×, scale = 10 μ; **10)** 1,500×, scale = 10 μ; **11)** 15,000×, scale = 1 μ. 12–14, *Sitona* sp. **12)** 1,500×, scale = 10 μ; **13, 14)** 15,000×, scale = 1 μ.



Figs. 15–20. Scanning electron micrographs of chorion. 15–17) egg equatorial portions. 15, 16) *Cylydrorhinus farinosus.* **15**) 500×, scale = 10 µ; **16**) 15,000×, scale = 1 µ. **17**) *Platyaspistes argentinensis,* 500×, scale = 10 µ. 18–20) egg polar ends. **18, 19**) *Platyaspistes argentinensis,* 500×, scales = 10 µ; **20**) *Naupactus leucoloma,* 500×, scale = 10 µ.

of these species should be added to the examples given for Howden's (1995) section 9A.

***Aramigus tessellatus* (Say).** Eggs (illustrated in Lanteri *et al.* 1997: Fig. 13). Mean size: 0.96 × 0.40 mm. Oblong. Color yellowish. Oviposition type (b), glutinous substance yellow.

***Atrichonotus taeniatulus* (Berg).** Eggs (illustrated in Loiácono and Marvaldi 1994: Fig. 1). Mean size: 0.95 × 0.54 mm. Ovate. Color yellowish. Oviposition type (b), glutinous substance yellow.

***Enoplopactus lizeri* (Hustache).** Eggs. Mean size: 1.10 × 0.84 mm. Ovate. Color whitish-yellow. Oviposition type (b), glutinous substance yellow. Chorion (Fig. 26) without distinct polygonal areas; chorion surface like a dense papillous carpet, with few scattered aeropyles irregularly distributed.

***Naupactus dissimulator* Boheman.** Eggs. Mean size: 1.00 × 0.60 mm. Oval. Color whitish. Oviposition type (b), glutinous substance pale yellow.

***Naupactus leucoloma* Boheman.** Eggs (described in Lanteri and Marvaldi 1995:223, Figs. 40, 41). Oviposition type (b). **Chorion** (Figs. 21–23) weakly marked by polygonal areas with slightly impressed borders; chorion surface strongly punctate, with numerous aeropyles. Anterior pole of the egg (Fig. 20) with an orifice (micropyla?) located at center of an area, which is marked by smaller polygonal facets and surrounded by conspicuous holes (aeropyles?).

***Naupactus rugosus* (Hustache).** Eggs (Fig. 5). Mean size: 0.80 × 0.60 mm. Oval. Color pale yellow. Oviposition type (b), eggs laid on leaves of the hostplant, held together by yellowish hyaline glutinous substance and covered by fecal matter (black and with rugose aspect). Chorion (Fig. 25) without distinct polygonal areas; chorion surface microsculptured by granules, with few scattered aeropyles.

***Naupactus ruizi* (Bréthes).** Eggs (Fig. 6). Mean size: 1.00 × 0.56 mm. Oval. Color intense yellow. **Oviposition type** (b), glutinous substance orange yellow.

***Naupactus sulphurifer* Pascoe.** Eggs. Mean size: 1.76 × 0.72 mm. Oblong. Color yellowish at first, becoming grayish-green as they develop. Oviposition type (b), glutinous substance yellowish. Chorion (Fig. 24) not marked by polygonal areas, with numerous aeropyles surrounded by irregular ridges crowded together.

***Naupactus verecundus* Hustache.** Eggs (Fig. 7). Mean size: 0.95 × 0.68 mm. Oval. Color intense yellow. Oviposition type (b), glutinous substance orange yellow.

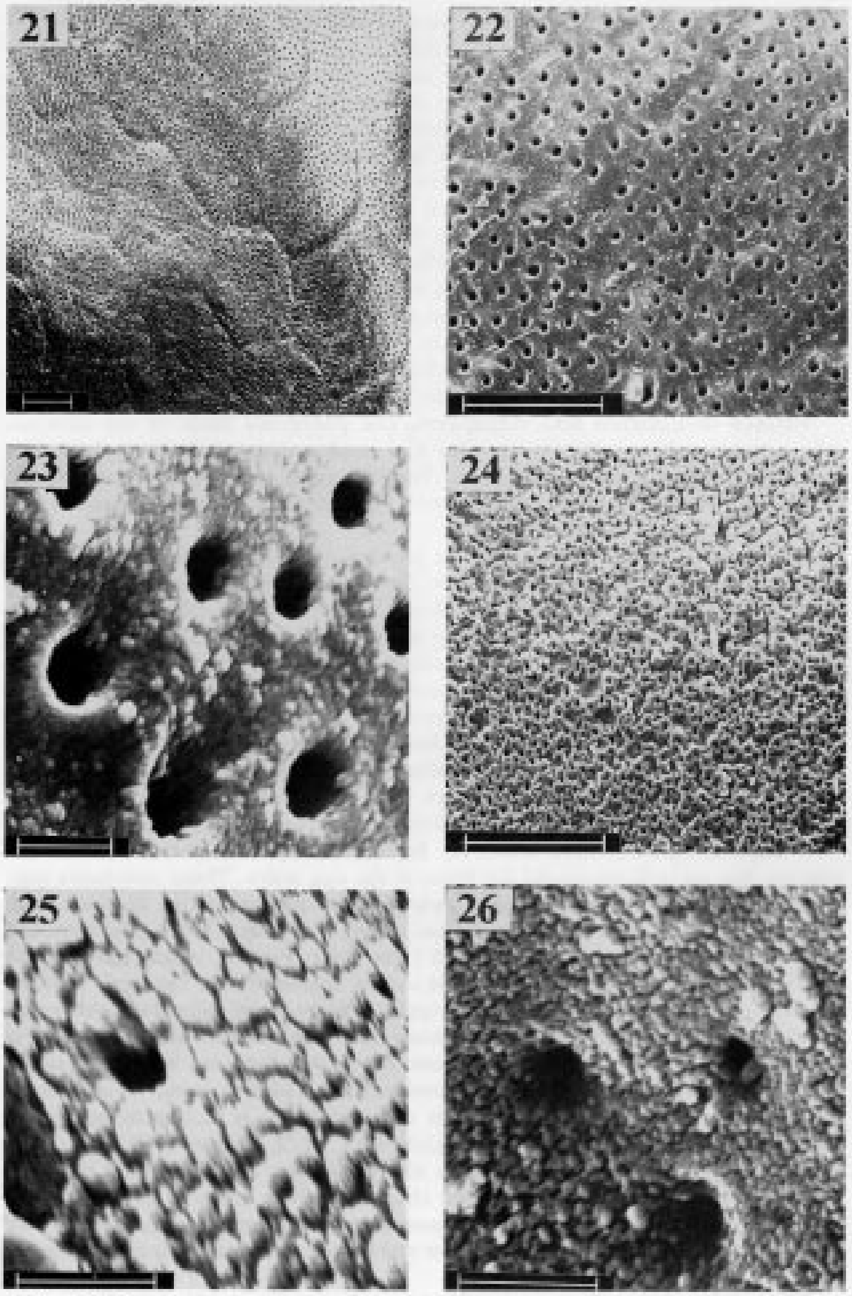
***Pantomorus auripes* Hustache.** Eggs. Mean size: 0.78 × 0.52 mm. Oval. Color pale yellow. Oviposition type (b), glutinous substance yellowish.

***Pantomorus postfasciatus* (Hustache).** Eggs. Mean size: 0.88 × 0.50 mm. Oval. Color pale yellow. Oviposition type (b), glutinous substance yellowish.

***Priocyphus bosqi* (Hustache).** Eggs (Fig. 8). Mean size: 0.85 × 0.51 mm. Oval. Color whitish. Oviposition type (b), glutinous substance hyaline.

Discussion

Types. The oviposition mode "a" is found in representatives of Sitonini, Alophini, and some Entimini. Eggs also turn black in species of Ectemnorhinini, which lay eggs single or in small batches glued by adhesive (Chown and Scholtz 1989), thus this is an example of combined types "a" and "b." Within Entimini, eggs laid in batches of numerous eggs and remaining pale are frequent, and this type "b" appears to occur exclusively in this tribe. However, the character is thought to be highly homoplastic as suggested by the fact that



Figs. 21–26. Scanning electron micrographs of chorion, egg equatorial portions. 21–23) *Naupactus leucoloma*. **21**) 500×, scale = 10 μ; **22**) 1,500×, scale = 10 μ; **23**) 10,000×, scale = 1 μ; **24**) *Naupactus sulphurifer*, 1,500×, scale = 10 μ. **25**) *Naupactus rugosus*, 15,000×, scale = 1 μ; **26**) *Enoplopactus lizeri*, 15,000×, scale = 1 μ.

both states "a" and "b" are found among members of the supposed natural groups "A," "B," and "C" within Entimini (Marvaldi 1998) [A comprises part of traditional "Brachyderinae," most "Otiorhynchinae," "Eremninae," and also probably "Tanyrhynchinae"; B is coincident with the "Entiminae (= Leptopiinae)" of authors, and C comprises part of "Brachyderinae" and some "Otiorhynchinae"]. As already noted in previous works (Emden 1950, 1952; Howden, 1995), oviposition in weevils cannot be easily categorized because of the great diversity among and even within species. As new examples become known, new categories need to be defined or the boundaries of previously defined ones have to be modified to fit each example. For instance, covering eggs with feces, as reported herein for *Naupactus rugosus,* was not supposed to occur in category 9 (Howden 1995:79). Before reaching to evolutionary conclusions about oviposition in weevils, considerable work remains to be done to have a well supported phylogenetic hypothesis and to know the oviposition habits of a large proportion of the taxa being analysed.

Surface of Chorion and Aeropyles. The polygonal areas of the chorion, when distinct, show variation in size and border shape and these characters might be diagnostic at specific level. The variety of chorion structures shown by the weevil eggs studied herein seem to be stem from ecological associations instead of phylogenetic relationships.

According to Hinton (1981:108), a great proportion of terrestrial eggs tolerate prolonged flooding from time to time by means of plastron respiration (extraction of oxygen in water), which is effective in eggshells with numerous aeropyles. Egg choria of the outgroup representative species, *Alophus* sp. and *Sitona* sp., have a microsculpture of tubercules. In addition the aeropyles are absent in the former and scarce in number in the latter. Eggs of these species are deposited on leaves away from ground level where prolonged flooding is improbable. *Cylydrorhinus farinosus* has a smooth chorion surface, without a carpet of tubercules or papillae and also without respiratory holes (at least at the non-polar areas); all these features may stem from the fact that the eggs are laid on arid soil. Eggs of *Platyaspistes argentinensis* are protected between two leave surfaces (where relatively high humidity is maintained), and the chorion has no orifices except for those at the egg poles. These structures may function as aeropyles and/or micropyles. The examples above contrast with the eggs of some species of *Naupactus,* as *N. leucoloma, N. sulphurifer,* and also *N. xanthographus* (Loiácono and Díaz 1992: Fig. 3), which have choria pierced by numerous aeropyles that are evenly scattered over the egg's surface. In these species plastron respiration appears to be very important. Although survival of eggs under wetted conditions has been verified for *N. leucoloma* by rearing experiments, it has also been noted that they are very resistant to prolonged dry conditions (Wasbauer, undated; Marvaldi, personal observation). The loss of water of insect eggs under dry conditions is known to be limited by an inner waxy membrane (Wigglesworth 1978; Hinton 1981:119). Air trapped in the plastron meshwork may also aid to prevent desiccation by slowing down the evaporation rate at the chorion surface (Hinton 1981:146). Interestingly, the eggs of *Naupactus rugosus* and *Enoplopactus lizeri* have very few aeropyles as might be expected for species occurring in arid environments (Lanteri 1990, pers. comm.).

Micropylar Area. The micropylar area of eggs in weevils certainly needs further research. The anterior (?) pole of egg of *Naupactus leucoloma* Boheman has a morphologically distinct area of the chorion pierced by an orifice, that corresponds in position and aspect to the micropyle of *Sitona* spp. and other insects (Mazzini 1974). The micropyle is nonfunctional in the parthenogenetic lineage of *N. leucoloma.* Unfortunately, eggs from females of a non-parthenogenic lineage were not available to check for potential differences in the micropylar areas between the two lineages of this species. Another unexpected finding of this study is the presence of a micropylar-like orifice at both anterior and posterior poles of the egg of *Platyaspistes argentinensis.* The micropylar apparatus is located at the anterior pole of the egg in most known examples in Insects (Mazzini 1974; Hinton 1981), although the presence of both anterior and posterior micropyles has been reported for species in two families of Neuroptera (Hinton 1981:645). Further studies on the micropylar area of other weevil species are needed for a more complete understanding of the morphology of this structure.

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SCIENTIFIC NOTE

A New Country Record for *Chrysina karschi* Nonfried (Scarabaeidae: Rutelinae)

Since Nonfried described *Chrysina karschi* in 1891 from "San Pedro Sula, Honduras" it has remained known only from his type. This was recently confirmed by Moron (1990. The Beetles of the World. Part 10: Rutelini I Sciences Nat, Venette, France. 145 pp.). Howden (1998. Coleopterists Bulletin 52(2):171–173) noted that the ongoing discovery of large, spectacular scarabs in parts of Central America indicates how little we know of the beetle fauna of these areas. *C. karschi* is certainly a case in point as it is a shining light green with body length in males ranging around 35 mm. Data from the specimen on hand are: Guatemala: Baja Verapaz, Purulha, IX-4-1992, P. Hubbell, Collector. Though this is a minor increase in the latitudinal range of *C. karschi* it does constitute the first locality known since the species was established and a new country record.

Ronald M. Young, *Absaroka Natural History Trust, 79 Rd 8RW, Powell, WY 82435.*

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NEW COMBINATION AND REDESCRIPTION OF *BRUCHUS INDIGOFERAE* GYLLENHAL (COLEOPTERA: BRUCHIDAE)

CLARENCE DAN JOHNSON
Department of Biological Sciences
Northern Arizona University
Flagstaff, Arizona 86011, U.S.A.

AND

KLAUS-WERNER ANTON
Grünewaldstr. 13
D-79312 Emmendingen
Germany

Abstract

The female holotype of *Bruchus indigoferae* Gyllenhal was presumably collected in India from the seeds of *Indigofera tinctoria* L. We examined the holotype and because it had all the characters necessary to place it into the New World genus *Acanthoscelides* Schilsky and it resembled closely some New World species of *Acanthoscelides*, we put it into *Acanthoscelides* as a **new combination.** The holotype is described and the collection locality questioned. The bruchids that feed in New and Old World species of *Indigofera* L. are discussed. We suggest that researchers studying the bruchids of *Indigofera* verify the names of the insects.

The genus *Acanthoscelides* Schilsky is characterized by having several subapical spines on the medial margin of the hind femur. Most Bruchinae with this characteristic are from the New World and have been studied in several monographs by Johnson (1970, 1983, 1990). The genera *Bruchidius* Schilsky and *Bruchus* L., as presently defined, do not have the above characteristic and are of Old World origin. Most early authors placed most of their new species in *Bruchus*. After examining the type of *Bruchus indigoferae* Gyllenhal, the junior author determined that it was a species of *Acanthoscelides* because it has a subapical spine on the medial margin of the hind femur about as long as the width of the base of the hind tibia, which is followed by 3 spines about 0.5 as long as the first spine. So it is of probable New World origin. This is curious because the label on the type indicates that it was from India (India orient. Indigofera tin/ctoria Stev: [handwritten], 99, Typus [red label], 113 73, Naturhistoriska Riksmuseet Stockholm Loan no 331/96 [blue label], Naturhistoriska Riksmuseet Stockholm Loan no 802/98 [green label]). We have again examined the female type and it has affinities with many species in *Acanthoscelides* and is almost certainly of New World origin. We are therefore putting the specific epithet *indigoferae* into *Acanthoscelides* and we have described it below.

Acanthoscelides indigoferae (Gyllenhal), **New Combination**

Bruchus indigoferae Gyllenhal 1839:34 (Type locality: India orientalis); Allard 1895:226; Pic 1913:29; Vazirani 1975:744; Udayagiri and Wadhi 1989: 135.

Holotype Female. *Length* (pronotum-elytra) 1.8 mm. Width 1.1 mm. Maximum thoracic depth 0.9 mm. *Integument Color.* Head, pygidium, appendages, and abdomen red-orange, eyes dark reddish brown, undersurfaces of thorax reddish brown, especially on lateral margins, pronotum and elytra mostly red orange but with median brown to dark brown stripe of variable width extending from apex of pronotum to apex of elytra. Vestiture. With recumbent white and golden hairs as follows: Eye with medial fringe of white hairs; postocular lobe with short white setae; postocular patch of white hairs; remainder of head with sparse white hairs; pronotum with dense white hairs, with dense stripe of white hairs on midline flanked by broad stripes of golden hairs; vestiture of elytron dense white on intervals between striae interrupted by patches of golden hairs as follows: intervals between striae 2 and 4 about 0.2 from base and at apex; between striae 1 and 4 about 0.3 from apex, between striae 5 and 9 about 0.5 from base; pygidium with moderately dense white hairs, dense white stripe on midline; undersurfaces and legs with moderately dense to dense white hairs, hairs more dense on lateral margins of undersurfaces. *Structure.* Head. Moderate in length, densely punctulate; frons with median glabrous line extending from frontoclypeal suture to vertex; vague transverse sulcus between upper limits of eyes; eye width equal to width of frons; ocular sinus about 0.7 width of eye; posterior margin of eye protruding from adjacent surfaces; postocular lobe rounded; distance from base of antennae to apex of labrum about half as long as distance from upper limits of eyes to apex of labrum; antennal segments 1–5 filiform to moniliform, 6–10 eccentric, 11 subacute apically, slightly longer than broad; antenna reaching to base of elytron. Prothorax. Disk subcampanulate with moderately dense punctations in no apparent pattern; cervical sulcus moderately deep, extending from near coxal cavity to about 0.6 distance to pronotal midline; lateral prothoracic carina extending from base to about 0.3 distance to coxal cavity; short median impressed line on median basal lobe; prosternum separating procoxae for about 0.7 their length. Mesothorax and Metathorax. Scutellum moderate in size, bifurcate at posterior margin, clothed with dense white pubescence to give quadrate appearance; elytron about twice as long as broad; striae deeply impressed, punctate, strial intervals punctulate; striae 3 and 4 closer at base than to adjacent striae, others subequal at base; humerus with fine punctations; undersurfaces punctulate, punctate on lateral margins of thorax; all of hind coxa punctate; hind femur constricted basally and apically, expanded medially to slightly wider than width of coxa; undersurface of femur with carina on inner margin; femur armed on inner edge with subapical acuminate spine about as long as width of tibial base followed by 3 spines about 0.5 as long as spine 1; tibia with ventral, lateroventral, lateral, and dorsomesal glabrous longitudinal carinae, shallow sulcus between ventral and lateroventral carinae; dorsal surface of tibia without fossa; tibial corona with 3 spinules; mucro about 0.3 as long as tarsomere 1, with slight sinus at base of mucro; tarsomere 1 with ventral, lateral, and mesal glabrous longitudinal carinae. Abdomen. Sternum 1 slightly flattened medially, about 0.4 as long as abdomen, posterior margin straight; sterna 2–4 unmodified, sternum 5 not emarginate at apex; pygidium punctate, convex in lateral view.

Discussion. *Acanthoscelides indigoferae* most closely resembles *A. difficilis* (Sharp). This is curious because all 12 of the known hosts of *A. difficilis* are in the genus *Mimosa* L. (Johnson 1990). We were unable to match it with any other known species because many species of *Acanthoscelides* species are separated primarily by differences in the male genitalia. Therefore, we must wait until the experts in molecular biology and cladistics solve this problem.

Acanthoscelides indigoferae (Gyllenhal), *A. caroni* Johnson, *A. indigoferestes* Johnson, *A. kingsolveri* Johnson and *A. ruficoxis* (Sharp) are the New World species that have been reported to feed in seeds of *Indigofera* L. (Gyllenhal 1839; Johnson 1983, 1990, 1998). *Acanthoscelides indigoferae* resembles some specimens of all of these species in external color and external morphology but without male genitalia, it is impossible to combine it with another species.

Either the type-specimen was not collected in India and had erroneous labels attached to it or it was introduced into India from the New World and was on or feeding in seeds of indigo, *Indigofera tinctoria* L., an important source of indigo. Or there are indigenous species of *Acanthoscelides* in the Old World.

The specific epithet *indigoferae* Gyllenhal has appeared in the literature in combination with *Bruchus* and *Bruchidius*. *Bruchidius indigoferae* has been reported to feed in seeds of *Indigofera arrecta* Hochst. (Luca 1964; Udayagiri and Wadhi 1989), and *I. tinctoria* (Udayagiri and Wadhi 1989). *Bruchus indigoferae* has been reported to feed in seeds of *I. tinctoria* (Gyllenhal 1839; Zacher 1952).

Bruchidius indigoferae Singh and Saini (1978) was described from India after it was reared from seeds of *Indigofera tentoria* (sic). There is high probability that this is a synonym of *Bruchidius nalandus* (Pic 1927).

We wrote this paper with the hope that researchers in the future will find more specimens and hosts of the species to which the epithet *indigoferae* of Gyllenhal has been applied and that the species of bruchids that feed in species of *Indigofera* can be clarified.

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TWO NEW CENTRAL AMERICAN *ONTHOPHAGUS* LATREILLE OF THE *MIRABILIS* SPECIES GROUP (COLEOPTERA: SCARABAEIDAE, SCARABAEINAE)

FRANÇOIS GÉNIER AND HENRY F. HOWDEN
Canadian Museum of Nature
PO Box 3443, Station D
Ottawa, ON, K1P 6P4
Canada

Abstract

Onthophagus barretti, **new species,** from Daríen Province (Panama) and *O. breviconus*, **new species,** from Guatemala and Honduras are described and illustrated. *Onthophagus orphnoides* Bates is now considered a valid species and removed from synonymy with *O. mirabilis* Bates. The limits of the *mirabilis* species group are redefined to exclude *O. quetzalis* Howden and Gill. A key is given to the species in the *mirabilis* group.

Résumé

Les auteurs décrivent et illustrent deux nouvelles espèces, soit *Onthophagus barretti* de la province de Daríen au Panama et *O. breviconus* du Guatemala et du Honduras. Le statut de l'espèce *O. orphonoides* Bates, qui était considéré synonyme de *O. mirabilis* Bates, est révisé; l'espèce redevient valide. Les limites du groupe d'espèces *mirabilis* sont redéfinies et *O. quetzalis* Howden et Gill est maintenant exclue de ce groupe. On présente un tableau de détermination pour les espèces du group *mirabilis*.

Recent collecting in Honduras, Guatemala and Panama by R. S Anderson, J. S. Ashe, R. Brooks, H. and A. Howden and S. and J. Peck yielded numerous specimens of *Onthophagus* Latreille of the *mirabilis* group. Until recently long series of specimens from the *mirabilis* group were rare in collections. However, the use of flight interception traps has proven very effective in catching species belonging to this group. These *Onthophagus* are seldom collected using dung traps. Observations on the ecology of *O. orphnoides* (*O. mirabilis,* sensu Howden and Young 1981) in Panama (Gill 1986), suggest that all species included in this group feed on rotting fruits on the ground.

Based on recently collected material, a new species, *O. barretti* is described from Panama. The Guatemalan-Honduran population of what was considered *O. neomirabilis* is given specific status and described as new. Also, a recent visit to the Muséum national d'Histoire naturelle, Paris by one of the authors (FG) allowed the reexamination of the type of *O. mirabilis,* resulting in a reassesment of the status of *O. orphnoides* Bates. See remarks under *O. mirabilis* and *O. orphnoides* for more details.

Howden and Gill (1993), in their revision of the *mirabilis* group, tentatively included *O. quetzalis* Howden and Gill. However, they stated that this relationship was not strongly supported by their phylogenetic analysis. Our present concept of the *mirabilis* group excludes *O. quetzalis.* We suggest that *O. quetzalis* is more closely related to species of the dicranius group as defined in Howden and Gill (1993). This exclusion is supported by the distinctly bicolored body, the more widely separated first and second external teeth of the anterior tibia, and the absence of major morphological differences in females.

Females belonging to the *mirabilis* group are unusual for New World *Onthophagus* in that large (well developed) individuals show greater external differences than do the males.

The format used here is essentially the same as used by Howden and Gill (1993). The following's initials are used to identify collections from which the material was studied or deposited: **BDGC,** B. D. Gill Collection; **BMNH,** The Natural History Museum, London, M. D. Kerley; **CMNC,** Canadian Museum of Nature, Ottawa; **FGIC,** F. Génier Insect Collection, Aylmer; **HAHC,** H. and A. Howden Collection, Ottawa; **MNHN,** Muséum national d'Histoire naturelle, Paris, Y. Cambefort; **SEMC,** Snow Entomological Museum, Lawrence, Kansas, S. Ashe and R. Brooks.

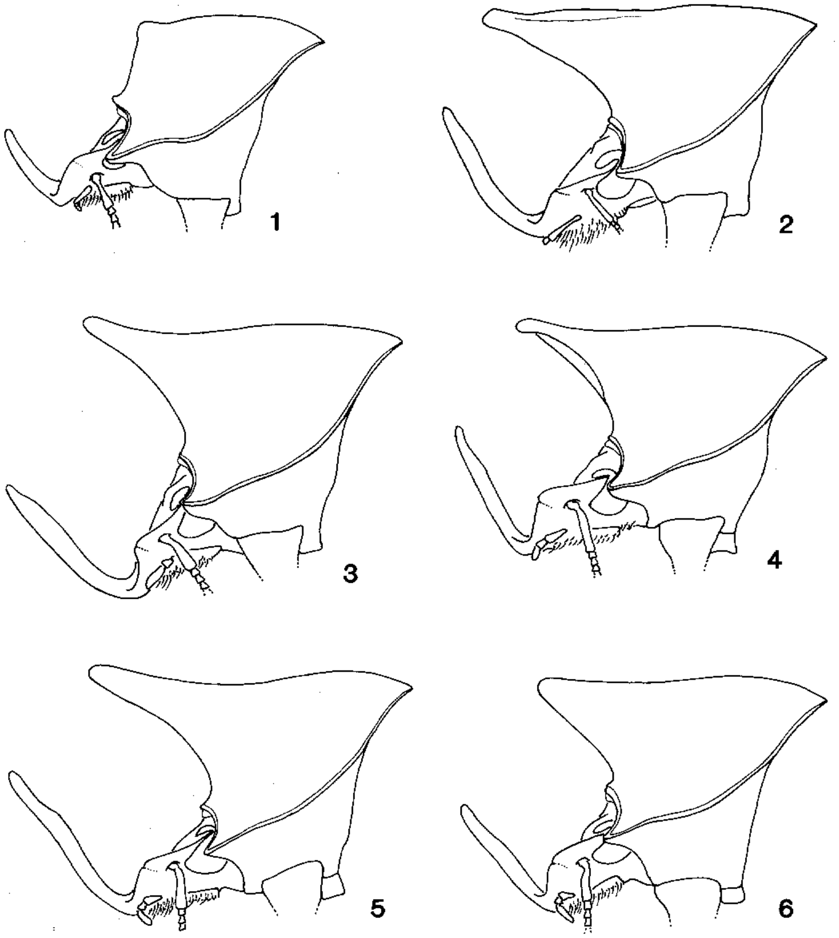
Key to Adults of *Onthophagus* of the *mirabilis* Group

Remarks on the use of the Key. Small or very small individuals usually lack good external characters for precise identification. In the case of a small male it maybe necessary to extract the aedeagus and for small females to use the locality data. Females of *O. mirabilis* are unknown.

1 Abdominal sternite 6 narrowed medially; anterior tibia (Figs. 13–14) slender, with tuft of long setae apically (males) 2
1′ Abdominal sternite 6 not strongly narrowed medially; anterior tibia more robust, lacking tuft of long setae apically (females) 7

Males

2(1) Anterior pronotal marginal bead (Fig. 1) abruptly, angularly reflexed medially; pronotum of moderate to large males broadly tumescent anteriorly, apical portion of tumescence with widely separated lateral tubercles; Costa Rica (Guanacaste) .... *O. solisi* Howden and Gill
2′ Anterior pronotal marginal bead (Figs. 2–6) not abruptly and angularly reflexed medially; pronotum of moderate to large males with anteriorly directed conical process or horn, apical portion of horn usually bifurcate or bilobate 3
3(2′) Clypeal horn (Fig. 16) wider apically than medially, apex notched or bilobed; pronotal process shallowly but distinctly longitudinally sulcate along midline 4
3′ Clypeal horn (Fig. 17) slender, median and apical portions nearly parallel-sided, at most slightly wider in apical tenth, apical edge usually rounded or truncate, rarely shallowly emarginate; pronotal process never distinctly longitudinally sulcate along midline, at most flat (exceptionally shallowly sulcate in some males of *O. barretti*) 5
4(3) Pronotal horn concave laterally, dorsal surface sharply carinated on each side of midline; anterior tibia (Fig. 13) with first and second teeth widely separated, the distance between the first and second teeth slightly longer than the distance between the second and third teeth; Ecuador .... *O. mirabilis* Bates
4′ Pronotal horn convex laterally, dorsal surface not carinated on each side of midline, at most with shallowly sulcated midline; anterior tibia (Fig. 14) with first and second teeth narrowly separated, the distance between the first and second teeth shorter than the distance between the second and third teeth; Costa Rica, Panama .... *O. orphnoides* Bates
5(3′) Head with dorsal surface shiny, punctures fine to minute on clypeus and



Figs. 1–6. Lateral view of head and pronotum of largest males. **1)** *O. solisi* Howden and Gill; **2)** *O. mirabilis* Bates; **3)** *O. orphnoides* Bates; **4)** *O. barretti* sp. nov.; **5)** *O. neomirabilis* Howden; **6)** *O. breviconus*, new species.

gena, usually lacking on vertex; lateral portion of gena (Fig. 17) strongly upturned, raised above eyes in frontal view; pronotal process slender medially, bilobed apical portion twice as wide as narrowest median portion in moderate to large males, pronotal process strongly and sharply carinate ventrally; Panama (Darien) .... *O. barretti*, new species

5′ Head with dorsal surface rugose, punctures moderate in size, dense and usually present on vertex; lateral portion of gena slightly upturned, at most raised in line with dorsal portion of the eyes in frontal view; pronotal process broad medially, bilobed or bituberculate apical portion only slightly wider than narrowest portion in moderate to large males, pronotal process not carinate ventrally 6

6(5′) Gena with widest portion in line with anterior edge of the eyes; pronotal process of large males (Fig. 5) with ventral portion concave in lateral view, distance from anterior edge of pronotum (excluding membranous portion) to base of process at midline approximately as long as dorsal portion of the eye; elytron with intervals 2–5 straight or raised basally, basal edge not deflected downward basally; Mexico (Oaxaca) .... *O. neomirabilis* Howden

6′ Gena with widest portion posterior to anterior edge of the eyes; pronotal process of males (Fig. 6) with ventral portion straight in lateral view, distance from anterior edge (excluding membranous portion) to base of process at midline approximately as long as half dorsal portion of the eye; elytron with intervals 2–5 basally sloping down for a distance approximately equal to width of first interval (best seen in lateral view); Guatemala, Honduras .... *O. breviconus*, new species

Females

7(1′) Pronotum longitudinally concave at midline, concavity never bordered by a tubercle posteriorly, very deep in moderate and large individuals, anterior marginal bead reflexed and produced into a spine medially: Costa Rica, Panama .... *O. orphnoides* Bates

7′ Pronotum convex throughout or with a more or less rounded flat area anteriorly, in larger individuals the area is slightly concave and with a median tubercle on posterior edge of flat area, anterior marginal bead at most broadly reflexed medially, lacking spine 8

8(7′) Pronotum (Fig. 24) with sharp transverse carina anteriorly, carina as wide as distance between eyes, lacking posterior tubercle; vertex of moderate to large individuals with two acute horns, each horn directed laterally and located in line with median portion of the eyes; Panama (Daríen) .... *O. barretti*, new species

8′ Pronotum with a broadly oval flat or slightly depressed area anteriorly, flat area bordered by a low tubercle posteriorly; vertex of moderate to large individuals with at most two low conical tubercles, each tubercle located before or in line with anterior portion of the eyes 9

9(8′) Vertex of moderate to large individuals (Fig. 21) with tubercles low, transverse and always set closer to the clypeal carina than anterior edge of the eyes; Mexico (Oaxaca) .... *O. neomirabilis* Howden

9′ Vertex of moderate to large individuals (Figs. 18, 22) with tubercles conical and set more or less in line with anterior edge of the eyes 10

10(9′) Anterior pronotal marginal bead lobate and upturned medially; flat area of pronotum with anterolateral edges ill-defined, posteromedian tubercle conical, approximately as wide as elytral interval 2 at base in largest individuals; Costa Rica (Guanacaste) *O. solisi* Howden and Gill

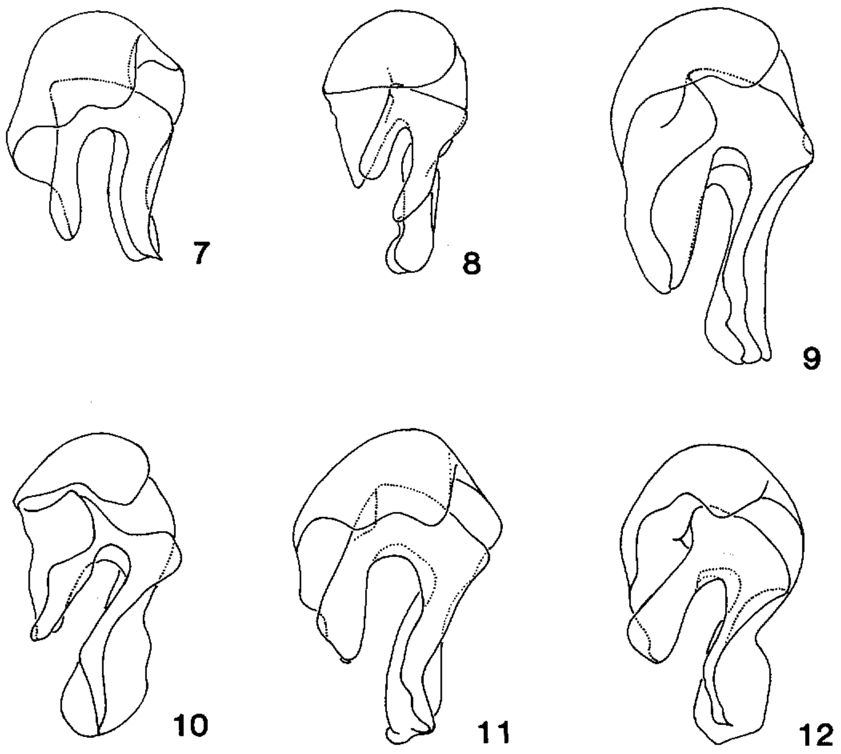
10′ Anterior pronotal marginal bead unmodified or feebly produced forward medially; flat area of pronotum with anterolateral edges well-defined, posteromedian conical process wide, approximately as wide as elytral interval 2 and 3 at base in largest individuals; Guatemala, Honduras .... *O. breviconus*, new species

Onthophagus solisi Howden and Gill

Figs. 1, 7, 15, 18; Map 1

Onthophagus solisi Howden and Gill 1993:1100.

Material Studied. 4♂♂, 1♀ (FGIC, HAHC).



Figs. 7–12. Copulatory lamella of internal sac. **7)** *O. solisi* Howden and Gill; **8)** *O. mirabilis* Bates; **9)** *O. orphnoides* Bates; **10)** *O. barretti,* new species; **11)** *O. neomirabilis* Howden; **12)** *O. breviconus,* new species.

Distribution. COSTA RICA: **Guanacaste**: Estacion Cacao, SW side Volcan Cacao (1,000–1,400 m); Estacion Pitilla, 9 km S Santa Cecilia, P. N. Guanacaste (700 m).

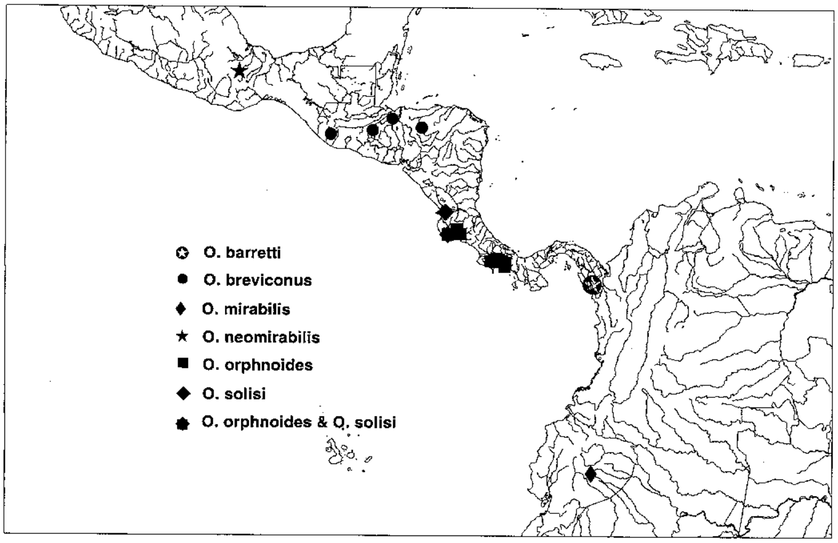
Additional data. Collecting dates: June.

Onthophagus mirabilis Bates
Figs. 2, 8, 13; Map 1

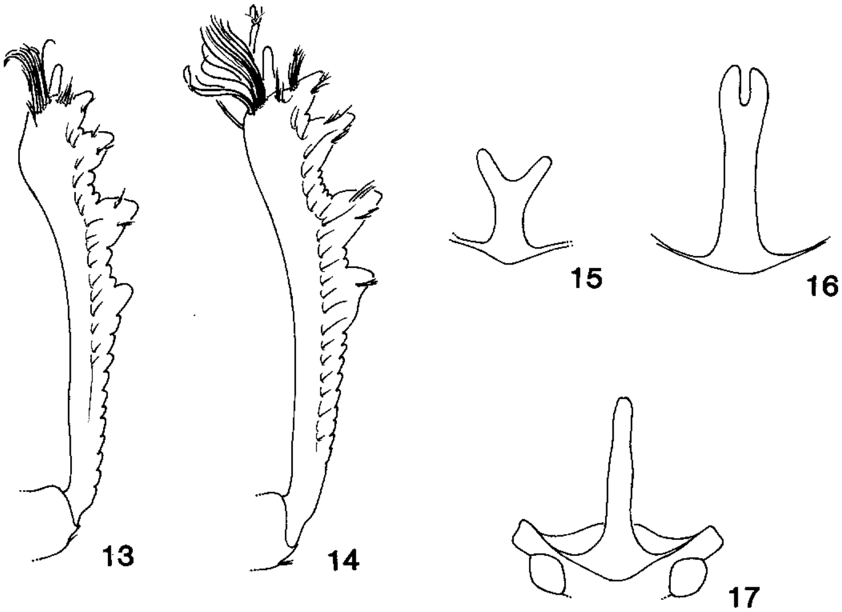
Onthophagus mirabilis Bates 1887:74.

Material Studied. 1♂ (MNHN). Holotype ♂ (MNHN): R. Morona, Ecuador/ ex. Musæo H. W. Bates 1892/ Museum Paris, COLL. H.W. BATES, 1952/ Onthoph. mirabilis Bates (Bates hand writing). The specimen appears slightly teneral or faded and has been dissected by M. Zunino. Aedeagus and internal sac removed.

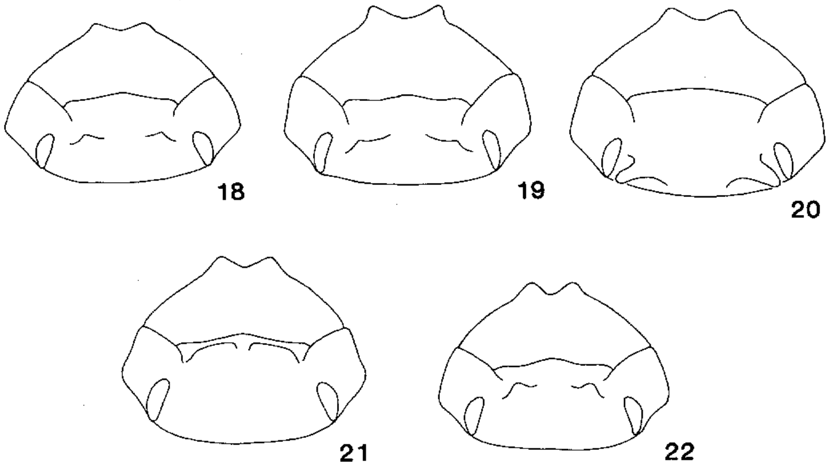
Remarks. During a visit to the Muséum national d'Histoire naturelle (Paris) by H. Howden (1962), the type of *O. mirabilis* was located in the Oberthür collection. This specimen, a male, was the only representative of this species found in the Museum collection. The specimen matches Bates's (1887) de-



Map 1. Known distribution of species of the mirabilis group.



Figs. 13–17. 13–14, Anterior tibia in dorsal view, **13)** *O. mirabilis* Bates; **14)** *O. orphnoides* Bates. 15–17, Fontal of male clypel horn, **15)** *O. solisi* Howden and Gill; **16)** *O. orphnoides* Bates; **17)** *O. barretti,* new species.



Figs. 18–22. Head of females. **18)** *O. solisi* Howden and Gill; **19)** *O. orphnoides* Bates; **20)** *O. barretti,* new species; **21)** *O. neomirabilis* Howden; **22)** *O. breviconus,* new species.

scription and locality (Ecuador: Rio Morona). In 1998 F. Génier reexamined the type and concluded that it was a dinstinct species.

It is interesting to note that the type is partly covered with a spider web. This fact suggests that the specimen was retrieved from a spider web, a natural flight interception trap!

In addition to the characters given in the key, similar sized males of *O. mirabilis* and *O. orphnoides* differ in the shape of the anterior tibia (Fig. 13) and the shape of the copulatory lamella of the internal sac (Fig. 8).

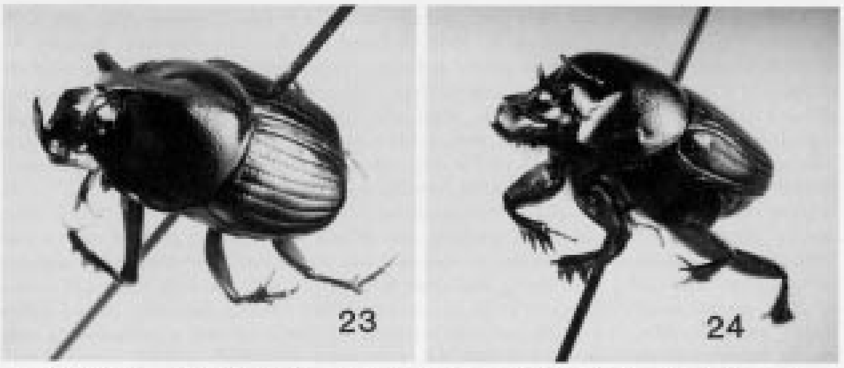
Onthophagus orphnoides Bates
Figs. 3, 9, 14, 16, 19; Map 1

Onthophagus orphnoides Bates 1887:75; Howden and Young 1981:116 (synonymized under *O. mirabilis*)

Material Studied. 83♂♂, 75♀♀ (BMNH, CMNC, FGIC, HAHC, MNHN). Lectotypes ♀ (BMNH): Panama, Volcan de Chiriqui, 2,500–4,000′ (Champion)/ Type/Specimen figured B.C.A. Lectotype here designated. Paralectotype: Same data as lectotype (1♀ BMNH) (1♀ MNHN).

Distribution. COSTA RICA: **Alajuela**: Peñas Blanca (500–1,000 m). **Guanacaste**: Estacion Cacao, SW side Volcan Cacao (1,000–1,400 m) **Puntarenas**: Las Cruces Biol. Sta. (1,200 m); Monteverde (1,400–1,520 m). **PANAMA**: **Chiriqui**: 5.6 km N Boquete, La Culebra trail, 1,450 m); Pelota, Hartmann's Finca, 4 km N Santa Clara (1,450–1,500 m); 2 km W Cerro Punta, 8°51′N, 82°36′W (1,300–1,720 m); Cerro Pando, 12 km NE Santa Clara, 8°54.74′N, 82°43.29′W (1,850 m); Finca La Suiza, 20 km N. Gualaca (1,350 m); 15 km NW Hato del Volcan, Hartmann Finca (1,500 m); Hartmann's Finca, 2 km N Santa Clara (1,200 m); La Fortuna, Bocas del Toro Border, 0.5 km N Contin. divide trail (1,100 m); Las Lagunas, 4 km W Hato del Volcan (1,360 m).

Additional Data. Specimens have been collected using dung, carrion, light and flight interception traps. Collecting dates: February, May to August.



Figs. 23–24. *Onthophagus barretti*, new species, habitus. **23**) male; **24**) female.

Remarks. Since we concluded that the Ecuadorian *O. mirabilis* is distinct from the Central American population, a name is needed for the Costa Rica—Panama species. Originally, Bates had described a female, belonging to the Central American population under the name *O. orphnoides*. This name had been synonymized by Howden and Young (1981). Based on these new observations we are here reestablishing the name *O. orphnoides* Bates for the Central American population.

Onthophagus barretti, **new species**

Figs. 4, 10, 17, 20, 23–24; Map 1

Holotype. Male, length 10.0 mm, greatest width 6.0 mm. Dorsum dark reddish brown. Head with dorsal surface shiny, several minute punctures in the ocular region. Clypeus (Fig. 4) at anterior median edge with upright horn, basal portion of horn wide, median portion subquadrate in transverse section, apical portion slightly bent posteriorly and gradually narrowed anteroposteriorly toward apex; each side of clypeus with distinct marginal bead, nearly straight in dorsal view from base of horn to clypeogenal suture; clypeal surface transversely concave posterior to base of horn; gena with lateral edge rounded posterior to clypeogenal suture, straight medially, lateral edge emarginate at clypeogenal junction. Vertex with feebly indicated tubercles on each side near anterior edge of each eye. Pronotum (Fig. 4) with ill-defined minute punctures on anterior declivous portion, remainder of the surface with moderate coarse umbilicate punctures separated by 1–3 diameters; anterior edge of pronotum not abruptly raised medially; with large median conical horn extending over head, apex of horn flattened dorsoventrally, forming two lateral lobes, ventral surface of horn with strong longitudinal carina; pronotal surface near anterior lateral angles concave; marginal bead of posterior margin feeble medially. Elytral surface shiny between punctures, punctures of intervals ill-defined and slightly irregular in shape, slightly umbilicate, lacking setae and separated by 1–2 diameters; elytral striae deeply impressed, strial punctures separated by 1–2 diameters, encroaching on intervals. Pygidium with closely set coarse umbilicate punctures throughout, surface between punctures shiny to feebly alutaceous. Metasternum with median lobe moderately coarsely punctate laterally, impunctate medially, posterior half longitudinally sulcate medially. Fore tibia elongate, apex with median angle produced into small acute tooth, anterior edge with tuft of long setae; apical and subapical teeth distinctly closer to each other than second to third or third to fourth. All femora with ventral surfaces minutely punctate, punctures slightly larger and denser posteriorly, surface between punctures feebly alutaceous on median and posterior femora. Copulatory lamella of internal sac as in Fig. 10.

Allotype. Female, length 10.0 mm, greatest width 6.0 mm. Clypeus (Fig. 20) with anterior margin distinctly bidentate, teeth reflexed, median emargination broadly V-shaped, lateral margins of teeth nearly parallel; clypeal margin on each side slightly outwardly arcuate, sharp, lacking marginal bead; clypeus flat, with surface shiny, lacking distinct transverse wrinkles, with wide, sharp and slightly anteriorly arcuate carina reaching clypeogenal suture posteriorly; gena with surface flat and shiny with few minute punctures along lateral edge, with lateral edge narrowly rounded posterior to clypeogenal suture, straight medially, widest portion forming a blunt angle. Vertex (Fig. 20–23) with surface shiny throughout, lacking minute punctures, slightly convex, with two slender conical horns, each horn pointing laterally and in line with median portion of eye and each at approximately lateral third of distance between eyes. Pronotum with anterior margin unmodified, disc with strong and sharp transverse carina, median portion of carina slightly arcuate anteriorly, apical edge of carina slightly sinuous medially, lateral edges nearly parallel; surface of carina and anterior declivity shiny, surface of pronotum behind carina moderately punctate and almost flat, remainder of surface evenly convex, with coarse umbilicate punctures. Elytra similar to those of male. Fore tibia not elongate, lacking median tooth and tuft of setae apically. Metasternum with median lobe similar to male. Femora similar to male.

Material Studied. 10 ♂♂, 11♀♀ (CMNC, FGIC, HAHC, SEMC). Holotype ♂ (CMNC): **Panamá**: **Daríen,** Cana Station, Pirre trail, 1,450 m, 7°45′N, 77°41′W, 4–7.VI.1996, J. Ashe & R. Brooks, #108, *ex.* f.i.t. Allotype ♀ (CMNC): same data as holotype except: 7–9.VI.1996, #109. Paratypes: **Panamá**: **Daríen**: Cana Station, Pirre trail, 1,450 m, 7°45′N, 77°41′W, 4–7.VI.1996, J. Ashe & R. Brooks, #105 (1♂ FGIC), same data except: #106 (1♂ FGIC), #107 (1♂, 2♀♀ FGIC)(1♂, 1♀ HAHC), #108 (1♂, 1♀ FGIC), 7–9.VI.1996, #109 (1♂, 4♀♀ FGIC)(1♂, 1♀ SEMC), 7–9.VI.1996, #110 (1♀ FGIC); Estacion Ambiental Cana, 07°45.32′N, 77°41.07′W, Cerro Pire, 1,300–1,450 m, 6–7.1996, R.S. Anderson, 96–109 cloud for. transition, human dung traps (2♂♂ CMNC).

Remarks. Male paratypes vary in length from 8.5–10.5 mm. The smallest of the ten male specimen available has the clypeal and the pronotal horn similar to larger males except for their shorter size. In one of the male paratypes the pronotal horn is approximately 1.5× wider than the in other males; the apical lobes are semicircular instead of more or less acute. This specimen was collected in a trap along with a normally configured male. This variation could be the result of allometric development since the specimen is slightly more robust than the other specimen from the same trap.

Etymology. We dedicate this species to Robert K. Barrett of Mississauga (Ontario, Canada), for his keen interest in nature and especially in collecting Scarab beetles and for his support of entomology at the Canadian Museum of Nature.

Onthophagus neomirabilis Howden
Figs. 5, 11, 21; Map 1

Onthophagus neomirabilis Howden 1973:334; Zunino 1981:75.

Material Studied. 8♂♂, 11♀♀ (CMNC, HAHC). Holotype ♂ (CMNC): 4,000′, Km 140 on Hwy 175, Oax. Mex. May 22, 1969, H.F. Howden/ Holotype, Onthopagus neomirabilis H.F. Howden. Specimen studied.

Distribution. Mexico: **Oaxaca**: 26 km E Valle Nacional.

Additional Data. All of the specimens were collected using a flight interception trap set in montane tropical forest. Collecting date: August.

Onthophagus breviconus, **new species**

Figs. 6, 12, 22; Map 1

Onthophagus neomirabilis Howden: sensu Zunino 1981:75.

Holotype. Male, length 10.5 mm, greatest width 6.0 mm. Dorsum dark brown to black. Head dorsally finely punctate throughout, punctures denser on genal surface, surface between punctures shiny throughout. Clypeus (Fig. 6) at anterior median edge with upright horn, basal portion of horn wide, median portion subquadrate in transverse section, apical portion slightly bent posteriorly and gradually narrowed anteroposteriorly toward apex; each side of clypeus with distinct marginal bead, nearly straight in dorsal view from base of horn to clypeogenal suture; clypeal surface concave posterior to base of horn; gena with lateral edge slightly rounded posterior to clypeogenal suture, almost straight medially, lateral edge at clypeogenal junction lacking emargination. Vertex with feebly indicated tubercles on each side near anterior edge of each eye. Pronotum (Fig. 6) with small umbilicate punctures on anterior declivous portion, except for a narrow longitudinal impunctate area on ventral face of pronotal horn, remainder of the surface with moderate coarse umbilicate punctures separated by 1–3 diameters; anterior edge of pronotum not raised medially; with large median conical horn extending over head, apex of horn flattened dorsoventrally, forming two laterally oriented tubercles, ventral surface of horn lacking longitudinal carina; pronotal surface near anterior lateral angles feebly concave; marginal bead of posterior margin feeble medially. Elytral surface shiny between punctures, puncture of intervals ill-defined and slightly irregular in shape, not umbilicate, lacking setae and separated by 1–2 diameters; Elytral striae deeply impressed, strial punctures separated by 1–2 diameters, encroaching on intervals. Pygidium with closely set coarse umbilicate punctures throughout, surface between punctures shiny to feebly alutaceous. Metasternum with median lobe moderately coarsely punctate laterally, impunctate medially, longitudinally and feebly sulcate medially for most of length. Fore tibia elongate, apex with median angle produced into moderately acute tooth, anterior edge with broad tuft of long setae; apical and subapical teeth distinctly closer to each other than second to third or third to fourth teeth. All femora with ventral surface finely punctate, punctures evenly distributed, surface between punctures feebly alutaceous on median and posterior femora. Copulatory lamella of internal sac as in Fig. 12.

Allotype. Female, length 10.5 mm, greatest width 6.0 mm. Clypeus (Fig. 22) with anterior margin sharply bidentate, teeth reflexed, median emargination shallow, broadly V-shaped, lateral margins of teeth oblique; clypeal margin on each side slightly, outwardly arcuate, sharp, lacking marginal bead; clypeus flat, with surface coarsely, transversely wrinkled, with wide, moderately sharp and angulate carina reaching clypeogenal suture posteriorly; gena with surface flat and shiny, coarsely punctate on most of surface, with lateral edge slightly arcuate anterior to lateral angle, widest portion forming blunt angle. Vertex (Fig. 22) with surface shiny behind tubercles, lacking minute punctures, concave, with two rounded tubercles, posterior portion each tubercle in line with anterior edge of eye and each at approximately lateral third of distance between eyes. Pronotum with anterior margin feebly upturned medially, disc with almost circular slightly concave depression on anterior three-fourths; posterior-most portion of declivity bordered by low, transverse apically emarginate tubercle; surface of declivity feebly and scarcely punctate laterally, surface of pronotum around depression evenly convex and with coarse umbilicate punctures. Elytra similar to those of male. Fore tibia not elongate, lacking median tooth and tuft of setae apically. Metasternum with median lobe similar to male. Femora similar to male.

Material Studied. 71♂♂, 45♀♀ (BDGC, CMNC, FGIC, HAHC, SEMC). Holotype ♂ (CMNC): GUAT.: ZACAPA, 3.5 km S.E. La Union, 1,500 m, 25–27.VI.1993, J. Ashe & R. Brooks, cloud forest, FIT. Allotype ♀ (CMNC): same data as holotype. Paratypes: **Guatemala**: **Quetzaltenango**: 12.5 km S. E. Zunil, 1,520 m, 20.VI.1993, R. Anderson, wet oak for. litter, 93-9B (1♀ CMNC). **Zacapa**: 3 km S La Union, 4.VI.1991, B. D. Gill 1,400 m (1♂, 1♀ BDGC); 3.5 km S.E. La Union, 1,500 m, 25–27.VI.1993, J. Ashe & R. Brooks, cloud forest, FIT (25♂♂, 4♀♀ CMNC)(3♂♂, 1♀ FGIC)(4♂♂, 2♀♀ HAHC)(3♂♂, 2♀♀ SEMC). **Honduras**: **Cortés**: 25 km N Cofradia, PN Cusuco, 1550 m, FIT 1, cloud for., 26.VIII-15.IX.94, S&J Peck, 94-59 (1♂ CMNC), same data except: 15.IX-7.X.94, 94-60 (1♂ CMNC), FIT II, 94-61 (1♂ CMNC), 15.IX-22.XI.94 (1♂ CMNC). **Olancho**: La Union, La Muralla, 14 Sep 1994, rcol R. Cordero (2♂♂, 4♀♀ HAHC), same data except: Parque Nac. La Muralla, 20–31 Ago 1994 (2♂♂, 3♀♀ HAHC), P.N. La Murralla, ±1,800 m, 30 June 1995 (1♀ BDGC); 15 km N La Union, 15°07′N, 86°45′W, 5.XI.1995, leg. R. Cave (2♂♂, 2♀♀ FGIC); 14 km N La Union, PN La Muralla, 1,450 m, wet mont. for. FIT, 16.VIII-1.IX.94, S&J Peck. 94-35 (15♂♂, 8♀♀ CMNC)(1♀ FGIC), same data except: 1500 m, 16.VIII.94, 94-37 (2♂♂, 2♀♀ CMNC)(1♂ FGIC), 1350 m, Liquidambar for., 17.VIII-1.IX.94, 94-38 (7♂♂, 12♀♀ CMNC), montane forest, 17.VIII.94, 94-40 (1♀ CMNC).

Remarks. Male paratypes vary in length from 7.0–11.0 mm. Small males have the clypeal horn reduced to a short and triangular upturned tooth and in smallest males this tooth is truncate apically. The anterior portion of the pronotum is produced into a low conical process notched apically in small males, the pronotum is simply evenly convex in smallest males. Female paratypes vary in length from 7.0–10.0 mm. Smallest females have the clypeofrontal carina straight and the anterior pronotal depression feebly indicated and lacking a posterior tubercle. The single female specimen from the vicinity of Zunil (Guatemala) differ slightly in having the elytral punctures more deeply impressed.

Females and small males of this species were described by Zunino (1981) under the name *O. neomirabilis* Howden from 11♂♂ and 3♀♀ collected at Finca Seacté, Cobán, Guatemala.

Etymology. The name "breviconus" (short+cone) is a Latin adjective which refers to the proportionately shorter pronotal development of this species.

Relationships within the *mirabilis* Group

The purpose of the current analysis is essentially to examine relationships among 6 species of the *mirabilis* group and to compare the phylogeny with the known distribution. We have used as an outgroup species in the *Onthophagus dicranius* group because some species of that group appear to be closely related to the *mirabilis* group. This close relationship we believe is reasonable based on the external morphology and the geographic distribution. In the *dicranius* group, *O. dorsipilulus* Howden and Gill shares a number of similarities in the head and pronotum with *O. solisi,* which we believe is the most primitive species in the *mirabilis* group. Sister species status should have a similar configuration of the clypeus and pronotum, a larger than average size for the group and a unicolored body. The least derived species of the *mirabilis* group, *O. solisi,* has the configuration of the pronotum similar to species belonging to the dicranius group. Species of the dicranius group have a low conical swelling on the anterior portion of the pronotum which may terminate with two closely set small tubercles on each side of the midline in the male. In *O. dorsipilus* these two small tubercules are widely separated as in *O. solisi.*

Species of the *mirabilis* group, with the exception of *O. mirabilis,* are known from middle to high elevation sites. *Onthophagus mirabilis,* which is known only from the type, is from Rio Morona (= Morona) Ecuador. Morona is situated along Rio Morona on the eastern side of the Cordillera Cutucú Oueste in the Province Morona-Santiago. This locality is below 300 m and part of the lowland rainforest. The presence of *O. mirabilis* in lowland rainforests is questionable and further collecting will be necessary to support this data. There is a possibility that the specimen was washed down stream from a higher elevation in the Cordillera Cutucú Oueste. This assumption is supported by the fact that the specimen is partly covered with spider webs and appears discolored, hence was probably dead for some time when it was recovered from a spider web attached to a branch in a stream. Surprisingly, extensive and more recent collecting in Ecuador with the aid of flight interception traps has not yielded specimens belonging to this group. *Onthophagus solisi* is the presumed least-derived species of the group and it is known from relatively low elevations (700 m and higher) in Guanascaste Province of Costa Rica. As noted in Howden and Gill (1993) it is found in sympatry with *O. orphnoides* (*O. mirabilis* sensu Howden and Gill) in this portion of the distribution of *O. orphnoides.* All other species of the *mirabilis* group, as far as we know, are found at elevation above 1000 m and have disjunct distributions (Map 1) as follows; *O. barretti* is known from Cerro Pirre (Daríen Prov., Panama), *O. breviconus* is known from the highlands of Guatemala and Honduras, and *O. neomirabilis* is known from the eastern slopes of the Sierra Juárez (Oaxaca, Mexico). *Onthophagus orphnoides* seems to have the widest distribution within the group and occurs on the Pacific side of Cordillera Central in Costa Rica and Panama. There are no records of the occurrence of this group of species from Colombia. However, the presence of *O. mirabilis* in Ecuador suggests that the group must be present in Colombia. As a whole the group shows an insular distributional pattern likely reflecting their association with montane cloud forest.

An exhaustive search for the most parsimonious tree using characters defined in Table 1, and coded in Table 2 was performed using PAUP* (4.0b, Swofford 1998). All characters were run unordered and equally weighted. A single most parsimonious tree was obtained from a search totaling 945 possibilities. This tree is described as follow: length = 32, consistency index (CI) = 0.7188, homoplasy index (HI) = 0.2812, CI excluding uninformative characters = 0.7000, CI including uninformative characters = 0.3000, retention index (RI) = 0.6087, rescaled consistency index (RC) = 0.4375. Two characters are parsimoniously uninformative. These characters are the average body size and the degree of separation of the apical and penultimate teeth of anterior tibia. Both of these characters are derived in all of the species of the *mirabilis* group and are used here to separate species of the *mirabilis* group from the dicranius group. The analysis was repeated with the following parameter: character 3 (shape of clypeal horn in males) ordered 0→1→2. This change had no impact on the most parsimonious tree obtained. We felt confident that the shape of clypeal horn as ordered in Fig. 15→16→17 was a natural progression and was not reversible. We had previously thought that the spiniform condition was the most derived state of the clypeal horn of male and had evolved only once. However, the current analysis showed that it evolved independently for the pair *O. neomirabilis—O. breviconus* and for *O. barretti.*

Considering that this group is primarily montane habitat-adapted, the unique most parsimonious tree obtained (Fig. 25) suggest that the group evolved from an ancestor in the Central Cordillera of Costa Rica and Panama which is delimited northward by the lowlands of the Nicaragua-Costa Rica

Table 1. Characters transformation in *Onthophagus* of the *mirabilis* group.

Character	Plesiomorphic (0)	Apomorphic/Transition (1)	Apomorphic (2)
1. Average body size	less than 9 mm		9 mm or more
2. Tibial teeth 1 and 2	normally separated		closely set
3. Clypeal horn of ♂	short Y-shaped	long Y-shaped	spiniform
4. Clypeal teeth of ♀	closely set		more widely separated
5. Edge of clypeus at gena in ♂	not emarginate		notched
6. Widest portion of head	in front of eyes		in line with eyes
7. Vertex of ♀	horn		tubercle
8. Pronotal posterior tubercle of ♀	absent	conical	transverse
9. Lateral edge of gena of ♂	subequal		longest anterior to angle
10. Lateral edge of gena of ♂	feebly upturned	moderately upturned	strongly upturned
11. Anterior edge of pronotum of ♀	unmodified		strongly upturned
12. Pronotal horn of ♂	not strongly produced		strongly produced
13. Pronotal horn of ♂	not carinate ventrally		carinate ventrally
14. Pronotal horn of ♂	not or feebly widened at apex		distinctly widened at apex
15. Pronotal horn of ♂	not depressed dorsally	feebly depressed dorsally	strongly depressed dorsally
16. Base of third elytral interval	sloping downward		straight or slightly raised
17. Edge of pronotum of ♂	broadly arcuate anterolaterally		straight anterolaterally
18. Pronotal horn of ♂	convex laterally		largely concave laterally
19. Pronotum of ♂	feebly concave anterolaterally		strongly concave anterolaterally

Table 2. Nexus file input.

	[0000000001111111111 1234567890123456789]
OUTGROUP	0000000000000000000
SOLISI	2210022100200002000
MIRABILIS	221?02??21?20222222
ORPHNOIDES	2212202021222210202
BARRETTI	2222200022022212222
NEOMIRABILIS	2220022221020002000
BREVICONUS	2220002221020200000;
end;	

border and southward by the lowlands of the Choco department of Colombia. This assumption is further supported by the fact that this region possesses the presumed least-derived species (*O. solisi*) in addition to two more derived species (*O. orphnoides* and *O. barretti*). The presence of the pair *O. neomirabilis* and *O. breviconus* north of the Nicaragua-Costa Rica border could result from the radiation of the common ancestor northward during a cooler epoch, events that would have permitted the expansion downward of the cloud or mountain type forest. The same event or a similar one would also have permitted the radiation of another ancestor southward in the Andes of Ecuador and possibly Colombia.

Acknowledgments

We wish to thank the curators of the collections cited in the introduction section. Yves Cambefort for his assistance while working at the MNHN. Robert Anderson for help with the phylogenetic analysis and Anne Howden for her careful review of the manuscript.

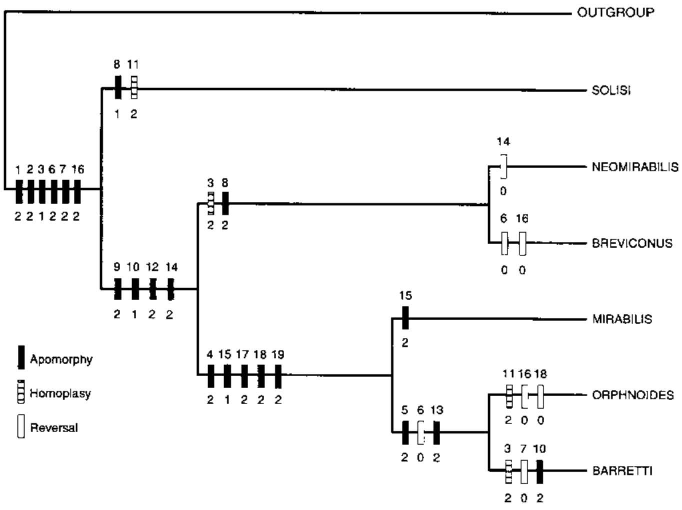


Fig. 25. Reconstructed phylogeny of *Onthophagus* of the mirabilis group.

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BOOK REVIEW

SAKAI, K. AND S. NAGAI. 1998. **The Cetoniine Beetles of the World.** Mushi-Sha, Tokyo. 421 pp., 144 plates. ISBN: 4-943955-03-7. Hard cover. Available from Mushi-Sha, 23-1-209 Nakano 2, Nakano, Tokyo, 164-0001, Japan. FAX: 81-3-3383-1417. Price ¥28,000 or $237, postage extra.

What a book! This fabulous contribution by Sakai and Nagai is Mushi-Sha's third volume in its Iconographic Series of Insects. The first volume was a similarly stunning treatment of the stag beetles (Lucanidae) of the world. In the cetoniine volume, the authors have illustrated, with the most superb photos imaginable, nearly 2,000 color photographs of cetoniine scarabs. The number of species illustrated is 1,704, and many of these are represented by multiple pictures to show color and pattern variation or sexual differences. Photos of 59 type specimens are also included. In what has to be a remarkable achievement, ALL of the specimens (except the types) have had their legs and antennae perfectly positioned. There are 144 full color plates, each with six (for the larger species) to 36 (for the smaller species) beetles shown. The main text is in Japanese, but each figure is accompanied by a scientific name. The plates are arranged by tribes and are preceded by a synopsis page, in English, of nomenclatural changes proposed in the book. Of great importance to non-Japanese readers is the extensive English summary at the end of the volume. Here you will find, by tribe, a list of genera (with authors and dates) and a brief statement of the number of species included and their general distribution. For each species illustrated there is a scientific name, author, date, and distribution. Although not every species in every genus in the world is illustrated (a virtually impossible task), a high percentage is illustrated. A page of the more synoptic literature references to Cetoniinae is also included. This treatment is definitely going to facilitate identification of cetoniines, and, I predict, with a fair degree of accuracy. In a brief test, I was unable to find a couple of species of Central American *Euphoria* species (25 species illustrated out of 37). On the other hand, entire drawers of previously unidentified African and Asian cetoniines in our collections can now be identified to genus and many to species. Even with Miksic's comprehensive treatment of the Palearctic and Oriental Cetoniinae (R. Miksic, Monographie der Cetoniinae der paläarktischen und orientalischen Region, Vols 1–4, 1976–1987), it was still difficult to identify many taxa. A picture being worth a thousand words comes into play here with this volume. The Japanese have a long and distinguished tradition, like no one else in the world, of publishing beautifully illustrated faunal works, and this series sets new standards of excellence.

The book is published on quality paper, and it is nicely bound and boxed. While $237 is a relatively high price, I believe it is a bargain for what you get. For anyone interested in Cetoniinae, I unequivocally recommend this book.

Brett C. Ratcliffe, *W436 Nebraska Hall, University of Nebraska, Lincoln, NE 68588-0514, U.S.A.*

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A STUDY OF THE LARVA OF *CARABDYTES UPIN* BALKE, HENDRICH AND WEWALKA (COLEOPTERA: ADEPHAGA: DYTISCIDAE), WITH COMMENTS ON THE PHYLOGENY OF THE COLYMBETINAE

YVES ALARIE
Department of Biology
Laurentian University
Ramsey Lake Road, Sudbury, ON
Canada

AND

MICHAEL BALKE
AG Evolutionsbiologie
Institüt für Zoologie, Freie Universität Berlin
Königin Luise Straße 1–3
D-14195, Berlin
Germany

Abstract

Description of structures of the second and third instars of *Carabdytes upin* Balke, Hendrich, and Wewalka are presented, including detailed chaetotaxal and porotaxal analyses. Larvae of *Carabdytes* Balke, Hendrich and Wewalka are compared phylogenetically with those of other genera of the subfamily Colymbetinae. *Carabdytes* belongs to the tribe Colymbetini based on the synapomorphies of (i) a more distal insertion of the primary seta CO7 on procoxa, (ii) the presence of marginal basoventral spinulae on tarsal claws, and (iii) a more distad insertion of the primary pore ANg on antennomere 4. Within the Colymbetini, *Carabdytes* is characterized by a fewer number of natatory setae which may represent either a plesiomorphic condition or an adaptation to a creeping way of life.

The monotypic, endemic New Guinea genus *Carabdytes* Balke, Hendrich and Wewalka (1992) contains one species, *C. upin* Balke, Hendrich and Wewalka. Traditionally, *Carabdytes* was treated as a member of the colymbetine tribe Colymbetini, based on the presence of transversal rugae on the second abdominal pleurite of adults (Nilsson and Hilsenhoff 1991; Balke, Hendrich and Wewalka 1992), which is otherwise comprised of eight genera worldwide: *Bunites* Spangler, *Colymbetes* Clairville, *Hoperius* Fall, *Meladema* Laporte, *Melanodytes* Seidlitz, *Neoscutopterus* J. Balfour-Browne, and *Rhantus* Dejean. The relative position of *Carabdytes* within the subfamily Colymbetinae was reconsidered recently by Pederzani (1995) who suggested the tribal name Carabdytini for placement of that one genus. However, as such a change was not rigorously demonstrated, Carabdytini was synonymised with Colymbetini by Nilsson and Roughley (1997).

The Colymbetinae constitute a large and diverse group of insects. However, larval descriptions of members of the subfamily are generally lacking or, where present, inadequate because of a lack of comparative precision and details. In part because of this, and also to develop a system useful for phylogenetic analysis, a system of nomenclature of larval chaetotaxy and porotaxy was developed by Alarie (1995, 1998). Chaetotaxal and porotaxal analysis is generally recognized as of great importance in the characterization of taxa because of the non-adaptative status of the majority of its components (Betsch 1997).

Study of immatures in the Dytiscidae has proven useful for reconsidering classifications based mainly on adult characteristics (Alarie 1997; Alarie and Nilsson 1996, 1997; Alarie and Delgado 1999). As an expression of the same genotype, the immature stages provide an array of characters that supplement those of the adult stage. Therefore, a more rigorous and stable classification can result from combining characters from many life stages. A preliminary phylogenetic reconstruction based on larval features of the Colymbetinae was proposed recently (Alarie 1995, 1998; Alarie *et al.* 1998). Accordingly, the discovery of the larva of *C. upin* is important as it provides an opportunity to reconsider the phylogenetic relationship of *Carabdytes* with those colymbetine genera whose larvae have been studied.

This study focuses on the comparative morphology of the genus *Carabdytes* with an emphasis on chaetotaxy and porotaxy. It has the following three goals: i) description of the second and third instars of *C. upin*; ii) identification of genus level characters; and iii) comparison of the genus *Carabdytes* with other genera of the Colymbetinae for which the larvae have been described.

Material and Methods

Descriptions of the larval stages and taxonomic conclusions reported in this paper are based on examination of one second, and two third instars collected in association with adults. The exact locality from which the specimens were obtained is stated following the larval descriptions.

The methods, terminology, and format of this paper follow those of other recent studies on larvae of the Colymbetinae (Alarie and Larson 1998; Alarie *et al.* 1998). Larval specimens were disarticulated and mounted on standard glass slides with Hoyer's medium. Examination at magnifications of 80–800× was done using an Olympus BX50 compound microscope equipped with Nomarsky differential interference optics. Voucher specimens are deposited in the research larval collection of the senior author (Laurentian University, Department of Biology, Sudbury, Ontario, Canada).

Measurements. The part to be measured was adjusted so that it was, as nearly as possible, parallel to the plane of the objectives. Abbreviations and definitions of some terms used in the descriptions are:

HL: total head length, including the frontoclypeus, measured medially along the epicranial stem.

HW: maximum head width measured posterior to the stemmata.

FCL: length of frontoclypeus measured from apex of the frontoclypeus to the back of the ecdysial suture.

OcW: maximum occipital foramen width measured along the dorsal margin.

Length of antenna: derived by adding the entire length (*i.e.*, not only the sclerotized portion) of each individual antennomere; antennomeres are indicated by the capital letter A and a number corresponding to the segment considered, *e.g.*, **A1** for antennomere 1 and **A3′** is the lateral elongation of antennomere 3 (=sensorial appendage).

Length of maxillary and labial palpi: each derived by adding the entire length of each individual palpomere, excluding the length of the palpifer.

Length of galea: entire length measured from apex of the galea to margin of the stipes.

Length of legs: derived by adding the length of each individual segment, including the longest claw; the length of each segment was taken at the longest point except for the trochanter, which includes only the proximal portion (the length of the distal portion is included in the femoral length).

LLAS: dorsal length of the last abdominal segment; includes the whole sclerite, measured from the anterior margin of the prescutum to the apex of the siphon. **"Siphon"** refers to the dorsal prolongation of the 8th abdominal segment (=last abdominal segment); the length of the siphon was determined by measuring the difference between the dorsal and ventral lengths of the segment.

Length of urogomphus: maximum length measured along the outer margin.

The individual measurements defined above were used to calculate several ratios aimed at characterizing the body shape. Ratios used here are those mentioned in previous papers dealing with the larval morphology of the Colymbetinae (Alarie and Larson 1998; Alarie *et al.* 1998) and are not defined herein.

Chaetotaxic Analysis. Primary and secondary setae and pores were distinguished on the cephalic capsule, head appendages, legs, last abdominal segment, and urogomphi according to the systems proposed by Alarie (1995, 1998). The ground-plan condition of the legs of the Colymbetinae generally incorporates a variable number of additional setae (Alarie 1995) which, preferably, must be excluded when counting the number of secondary setae. As the recognition of those additional setae necessitates comparison with the first instar (unavailable for this paper), we were forced to include them in our count of the secondary setae found on the legs of *Carabdytes*.

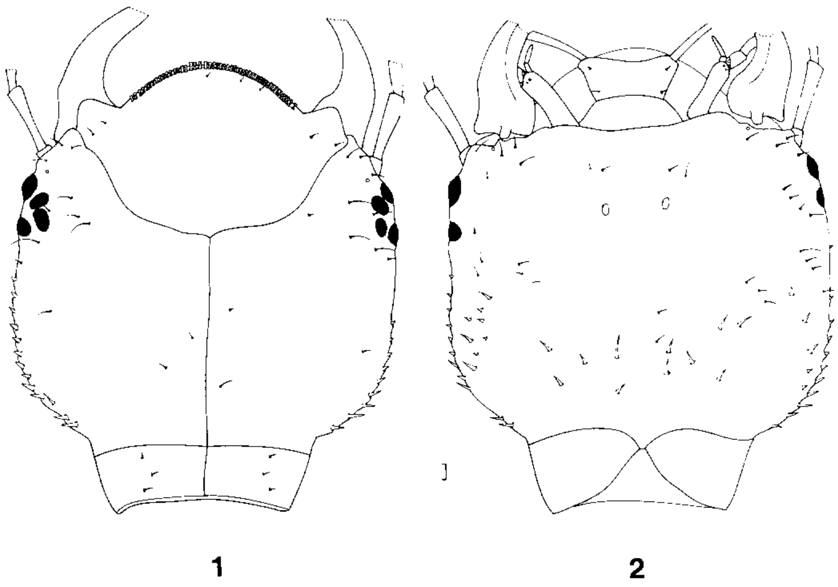
Description of Larvae of *Carabdytes upin* Balke, Hendrich and Wewalka

Figs. 1–7

Diagnostic combination. Frontoclypeus extending beyond level of lateral lobes (adnasalia) (Fig. 1); mandibular channel present; lateral elongation of antennomere 3 (A3′) not visible, hole-like; legs with numerous secondary setae, natatory setae present; primary seta T17 short and spine-like; pretarsal claws with faint marginal spinulae; siphon lacking a lateral lobe on each side; urogomphus one-segmented, with numerous secondary setae.

Color. Larva entirely brown (alcohol-preserved specimen).

Description, 2nd Instar. *Head.* HL = 2.60 mm (n = 1); HW = 2.18 mm (n = 1); FCL = 1.08 mm (n = 1). *Cephalic capsule.* Subquadrate, longer than broad (HL/HW = 1.20), strongly constricted posteriorly, HW/OcW = 2.82; parietal area with numerous short temporal spines laterally and ventrally; occipital foramen deeply indented ventrally; ecdysial suture well-developed: coronal suture ≈ 0.60 times HL; occipital suture present; frontoclypeus strongly convex mesally, 0.41 times HL, extending well beyond level of lateral lobes (=adnasalia); apical margin of frontoclypeus with ≈ 50 club-shaped setae (lamellae clypeales of Bertrand 1972) variable in size; gular suture not visible; ocularium present, stemmata visible ventrally and subdivided into 2 vertical series; tentorial pits visible ventrally on each side of middle at about midlength. *Antenna.* Four-segmented, shorter than HW (length of antenna/HW = 0.51); A1 ≈ A2 ≈ A3 ≈ A4, A2/A3 = 0.81–0.91; lateral elongation of antennomere 3 hole-like; antennomere 3 with a ventroapical spinula. *Mandible.* Falciform, ≈2.80 times as long as broad, ≈0.40 times HL, mandibular channel present, lacking tooth along inner margin, pubescence well-developed. *Maxilla.* Stipes subrectangular, narrow and elongate; cardo and galea present, lacinia lacking; galea short, 0.67 times length of palpomere 1; palpus 3-segmented, shorter than antenna (length of antenna/length of maxillary palpus = 1.30); palpomere 1 < 2 < 3, length of palpomere 3/length of palpomere 2 = 1.13. *Labium.* Prementum subrectangular, broader than long, sinuate mesally; palpus 2-segmented, slightly shorter than maxillary palpus



Figs. 1–2. Cephalic capsule of third instar of *Carabdytes upin*: **1)** dorsal surface; **2)** ventral surface. Note all secondary setae represented. Scale bar = 0.10 mm.

(length of maxillary palpus/length of labial palpus = 1.10); palpomere 2 0.90 times as long as palpomere 1. *Chaetotaxy and Porotaxy.* Cephalic capsule with numerous minute secondary setae (best seen at > 400×); head appendages generally lacking secondary setae, except mandible which a variable number of minute secondary setae (best seen at > 400×); primary pore ANg inserted distally on antennomere 4. *Thorax.* Pronotum subrectangular with a posterotransverse carina; length of pronotum about twice that of mesonotum; metanotum subequal to mesonotum in length, both subequal in width to pronotum; both meso- and metanota with anterotransverse and posterotransverse carina; thoracic venter membranous; spiracular openings absent. *Chaetotaxy and Porotaxy.* Secondary setation on each notum. *Legs.* Five-segmented; metathoracic legs longest, ≈1.30 times length of prothoracic legs, and ≈2.20 times HW; coxa ≈ femur > tibia ≈ tarsus ≈ trochanter; tarsus with two claws, posterior claw slightly shorter than anterior claw on pro- and mesothoracic legs, slightly longer on metathoracic leg; anterior metathoracic claw 0.36 times as long as metatarsus; spinulae on ventral margin of protibia weakly developed, lacking on other legs. *Chaetotaxy and Porotaxy.* Position and number of secondary setae as expressed in Table 1; natatory setae present, but very weakly developed (best seen at > 400×); i) primary seta CO7 inserted more distally insertion on procoxa. *Abdomen.* LLAS = 1.40 mm (n = 1). Eight-segmented, dorsally sclerotized; segments 1–6 membranous ventrally, subequal in width to thorax, segments 7 and 8 completely sclerotized; all terga with anterodorsal transverse carina; spiracular openings absent; segment 8 shorter than HW, LLAS/HW = 0.64, subcylindrical, abruptly narrowing posterior to insertion of urogomphi. *Siphon.* Short, slightly indented mesally. *Chaetotaxy and Porotaxy.* With several spine-like secondary setae of variable length. *Urogomphus.* One-segmented. Total length of urogomphus = 2.29 mm (n = 1), 1.63 times as long as LLAS, 1.05 times as long as HW. *Chaetotaxy and Porotaxy.* With several spine-like secondary setae.

Description, 3rd Instar (Figs. 1–7). As 2nd instar except as follows. *Color.* Dark brown. *Head* (Figs. 1–2). HL = 3.00–3.08 mm (mean = 3.04 mm, n = 2); HW = 2.55–

Table 1. Number of secondary setae[1] on the legs of second- and third-instar larvae of *Carabdytes upin* Balke, Hendrich and Wewalka. A = anterior, AD = anterodorsal, AV = anteroventral, CO = coxa, D = dorsal, Di = distal, FE = femur, NS = natatory setae, PD = posterodorsal, Pr = proximal, PV = posteroventral, TA = tarsus, TI = tibia, TR = trochanter, V = ventral, n = number of specimens studied (both legs included), range = total number of secondary setae on segment.

Segment	Sensillar series	Second instar (n = 1)	Third instar (n = 2)
ProCO	D	3–7	24–28
	A	9	10–20
	V	4	5–12
	Range	16–20	39–60
ProTR	Pr	2–3	4–7
	Di	3	5–7
	Range	5–6	11–13
ProFE	D(NS)	4	3–4
	AD	12	16–23
	AV	8–10	16–20
	PD	0–1	2–6
	PV	11–12	21–27
	Range	36–39	62–72
ProTI	D(NS)	3–4	5–7
	AD	1–4	10–13
	AV	3–5	7–10
	PD	4	0–2
	Range	15–18	30–35
ProTA	D(NS)	5	5–6
	D	5–8	5–8
	V	7	12–14
	Range	17–20	22–26
MesoCO	D	7–8	27–31
	A	5	16–22
	V	0	10–15
	Range	12–13	58–61
MesoTR	Pr	2–3	5–8
	Di	1–3	5–7
	Range	4–5	10–15
MesoFE	D(NS)	3	2–3
	AD	12–14	18–22
	AV	7–8	17–21
	PD	1	1–5
	PV	8–11	21–24
	Range	32–34	64–71
MesoTI	D(NS)	3	7–8
	AD	5	13–19
	AV	3	5–7
	PD	4–5	3–5
	PV	3–4	5–7
	Range	19	35–45
MesoTA	D(NS)	7–8	7–11
	D	7	8–11
	V	6–7	11–15

Table 1. Continued.

Segment	Sensillar series	Second instar (n = 1)	Third instar (n = 2)
	Range	20–22	30–33
MetaCO	D	5–8	21–24
	A	7	21–30
	V	0	14–19
	Range	12–15	60–71
MetaTR	Pr	2–3	11–12
	Di	2	5–9
	Range	4–5	16–21
MetaFE	D(NS)	1	1–3
	AD	13–15	21–24
	AV	7–10	23–27
	PD	1	4–7
	PV	11–13	25–29
	Range	35–38	78–84
MetaTI	D(NS)	7	11–14
	AD	4	19–21
	AV	2	7–9
	PD	6	4–5
	PV	3	5–7
	Range	22	50–51
MetaTA	D(NS)	8–11	12–16
	D	10	13–15
	V	7	12–14
	Range	25–28	40–44

[1] including additional setae (see material and methods for explanation).

2.59 mm (mean = 2.57 mm, n = 2); FCL = 1.20 mm (n = 2). *Cephalic Capsule.* HW/OcW = 2.22–2.28; apical margin of frontoclypeus with ≈70 lamellae clypeales; frontoclypeus length 0.42–0.44 times HL. *Antenna.* Length of antenna/HW = 0.58–0.65; A1 > A2 ≈ A3 ≈ A4, A2/A3 = 0.96–1.05. *Mandible.* ≈3.20 times as long as broad. *Maxilla.* Galea, 0.59–0.62 times length of palpomere 1; palpomere 1 ≈ 2 ≈ 3; length of palpomere 3/length of palpomere 2 = 0.92–0.95. *Labium.* Palpomere 2, 0.70–0.76 times as long as palpomere 1. *Thorax.* Mesopleural region with spiracular opening on each side. *Legs* (Figs. 3–6). Metathoracic legs ≈ 1.40 times length of prothoracic legs, ≈ 2.93 times HW; femur > coxa ≈ tibia ≈ tarsus > trochanter. *Chaetotaxy and Porotaxy.* Position and number of secondary setae as expressed in Table 1. *Abdomen.* LLAS (Fig. 7) = 2.13–2.33 mm (mean = 2.23 mm; n = 2); Segments 1–7 each with pair of spiracular openings; LLAS/HW = 0.83–0.90. *Urogomphus.* Total length of urogomphus = 3.38–3.41 mm (mean = 3.40 mm, n = 2), 1.45–1.61 times as long as LLAS, 1.30–1.34 times as long as HW.

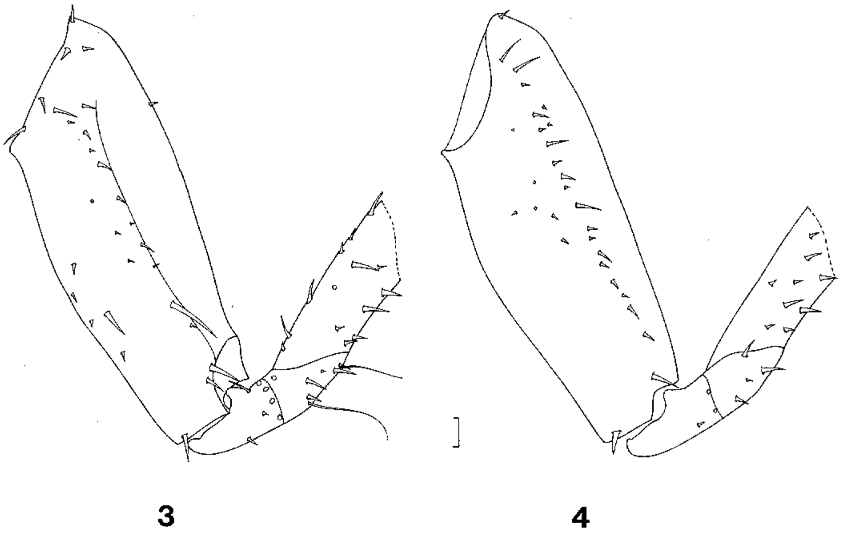
Source of Larvae and Associated Material. Indonesia, Irian Jaya, Jayawijaya Province, between Aipomek and Diruemna, approx. postn. 139°57′E 04°26′S, 2,600 m asl., 26.ix.1993, M. Balke.

Habitat. Narrow streamlet with numerous small cascades; larvae and adults collected from beneath large stones and from spaces in the rough gravel.

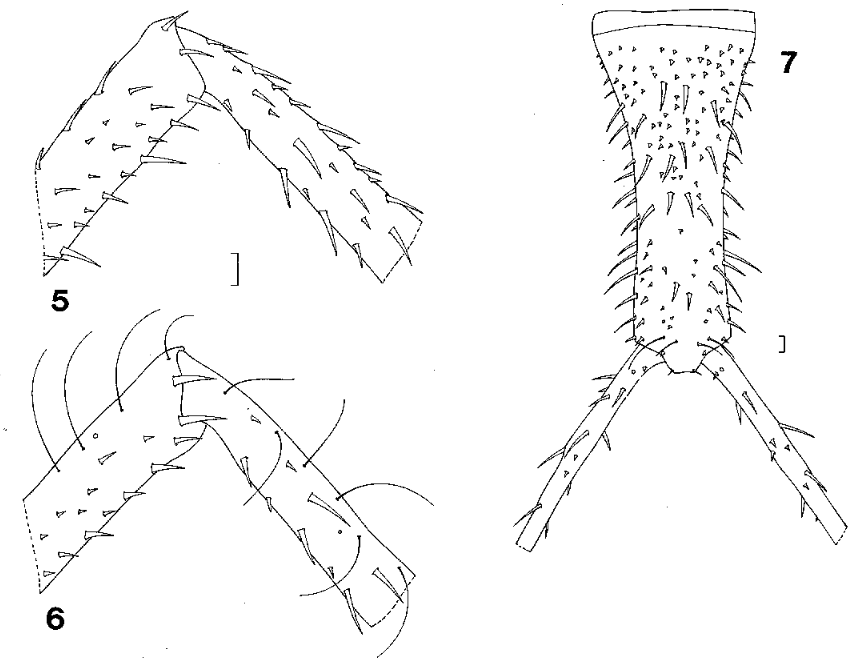
Distribution. Papua New Guinea and East Irian Jaya.

Discussion

The subfamily Colymbetinae constitutes a large, diverse and worldwide group of 24 genera (five tribes) (Nilsson and Roughley 1997). Intergeneric



Figs. 3–4. Proximal segments of prothoracic leg of third instar of *Carabdytes upin*: **3)** anterior surface; **4)** posterior surface. Scale bar = 0.10 mm.



Figs. 5–7. Third instar of *Carabdytes upin*: **5–6)** distal and proximal portion of profemur and protibia respectively; **5)** anterior surface; **6)** posterior surface; **7)** dorsal surface of last abdominal segment. Scale bar = 0.10 mm.

relationships of members of the subfamily are not well known. Recently, Alarie (1995, 1998), Alarie *et al.* (1998), and Alarie and Larson (1998) presented preliminary cladistic analyses of several Nearctic genera based on larval features.

Colymbetinae was postulated to be monophyletic based on the shared presence of the primary seta AB14 at the apex of the last abdominal segment (Alarie 1995). We were unable to determine if this seta occurs also in *Carabdytes* because of the lack of first instar specimens and the presence of numerous secondary setae on the last abdominal segment of second and third (Fig. 7) instar specimens.

Traditionally, the genus *Carabdytes* was included with other members of the tribe Colymbetini based on the presence of transversal rugae on the second abdominal pleurite of adults (Nilsson and Hilsenhoff 1991). Such an hypothesis of relationship is also supported by the larval morphology. Indeed, all those genera of Colymbetini for which the larvae have been described [*Colymbetes, Hoperius, Meladema, Melanodytes, Neoscutopterus,* and *Rhantus* (s. lat.)] share (i) a more distal insertion of the primary seta CO7 on procoxa, (ii) the presence of marginal basoventral spinulae on tarsal claws, and (iii) a more distad insertion of the primary pore ANg on antennomere 4. These characters are unique within the Colymbetinae (Alarie 1995, 1998).

The relatively low number of natatory setae on the legs of *Carabdytes* is of interest (Table 1; Fig. 6). The presence of natatory setae is recognized as being a derived condition within the Dytiscidae (Alarie and Nilsson 1997; Alarie and Delgado 1999; Alarie *et al.* 1998). Hair-bearing appendages are used by small animals to swim (Loudon *et al.* 1994), so it seems likely that the number and size of natatory setae on legs should have a direct functional relationship to swimming propensity. Unfortunately, we do not have detailed ecological information on *C. upin.* However, as the larvae were found under stones and within rough gravel, this suggests that they are more likely to be creepers and not efficient swimmers. If this is so, the reduced number of natatorial setae could represent an apomorphic reduction resulting from adaptation to their habitat.

An alternative hypothesis is to consider the lesser swimming propensity of *C. upin* as a plesiomorphic condition. Within the Colymbetinae, members of the most basal lineages [*Agabus, Ilybius, Agabinus,* and *Hydrotrupes*] generally lack natatorial setae and this is deemed to represent the ancestral condition for members of the subfamily (Alarie and Larson 1998; Alarie *et al.* 1998). Such a viewpoint would suggest that *Carabdytes* posits more basally within the Colymbetini. However, a phylogenetic analysis of *Carabdytes* including first instar larvae is needed to clarify such an hypothesis.

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DUNG BEETLES (SCARABAEIDAE: SCARABAEINAE) ATTRACTED TO WOOLLY MONKEY (*LAGOTHRIX LAGOTHRICHA* HUMBOLDT) DUNG AT TINIGUA NATIONAL PARK, COLOMBIA

MARÍA CLARA CASTELLANOS
Department of Ecology and Evolution
State University of New York at Stony Brook
Stony Brook, NY 11794-5245, U.S.A.
e-mail: mcastel@life.bio.sunysb.edu

FEDERICO ESCOBAR S.
Programa de Inventarios de Biodiversidad
Instituto de Investigaciones en Recursos Biológicos
Alexander von Humboldt
Apartado Aéreo 8693
Bogotá, Colombia

AND

PABLO R. STEVENSON
Department of Anthropology
State University of New York at Stony Brook
Stony Brook, NY 11794-4364, U.S.A.

Abstract

The species list of Scarabeinae attracted to woolly monkey (*Lagothrix lagothricha* Humboldt) dung at Tinigua National Park, Meta, Colombia is presented. Nineteen species of dung beetles in nine genera were captured, representing 36.5% of 52 species that have been found in the study area. This high proportion and the fact that woolly monkeys are the most abundant diurnal mammals in the study site suggest that woolly monkey dung can be especially important for the dung beetle community at Tinigua National Park. The results indicate the importance of conducting studies on the type and availability of food resources for tropical dung beetles.

Resumen

Se presenta la lista de especies de Scarabeinae atraídas por el excremento de micos churucos (*Lagothrix lagotricha* Humboldt) en el Parque Nacional Tinigua, Meta, Colombia. Las 19 especies de escarabajos estercoleros encontradas representan el 36.5% de 52 especies que han sido registradas en la zona de estudio. Esta alta proporción y el hecho de que los churucos constituyen una de las especies de mamíferos diurnos más abundante en el lugar, sugieren que el excremento de estos primates puede ser de especial importancia para la comunidad de escarabajos en el Parque Tinigua. Los resultados resaltan la importancia de realizar estudios sobre el tipo y la disponibilidad de recursos para los escarabajos etercoleros en el trópico.

Coprophagous scarabs constitute a conspicuous group of beetles that use vertebrate dung as food for adults and larvae (Halffter and Matthews 1966, Hanski 1989). Besides their importance as organic recycling agents and their interesting behavioral and natural history (Halffter and Matthews 1966), dung beetles have an important role as secondary seed dispersal agents in tropical forests (Estrada and Coates-Estrada 1991, Estrada *et al.* 1993; Shepherd and Chapman 1998). Competition with other beetles and flies is so severe that excrement must be detected and buried rapidly by dung beetles. These beetles have been classified into two groups based on their dung relocation technique; ball rollers and burrowers (Halffter and Edmonds 1982). Ball rollers construct dung balls, roll them away and then bury them, whereas burrowers bury the dung directly under the place where the dung is found. In both cases, many seeds defecated by monkeys are accidentally relocated and buried by beetles (Estrada and Coates-Estrada 1991).

Primate dung is an important food resource for dung beetles in tropical forests (Estrada and Coates-Estrada 1991, Howden and Young 1981). This study presents the species of dung beetles attracted to dung of woolly monkeys (*Lagothrix lagothricha* Humboldt), an abundant frugivorous primate species in the Duda River forest at Tinigua National Park, Colombia (Stevenson 1996). Based on instantaneous samples of foraging activity, the diet of woolly monkey consists of 60% fruit, 23% arthropods and 17% of vegetative plant parts and flowers; however, these proportions vary throughout the year according to the fruit availability in the forest (Stevenson *et al.* 1994).

Few studies have focused on the resources used by dung beetles in tropical forests (*e.g.,* Ratcliffe 1980, Gill 1991, Estrada and Coates-Estrada 1991). This study reports new information on tropical dung beetle food, and is a preliminary step in the study of the role of dung beetles in seed dispersal by woolly monkeys.

Methods and Materials

Dung beetle collections were made in the tropical rain forest of the Centro de Investigaciones Ecológicas de La Macarena (CIEM), located on the Duda River at the eastern border of Tinigua National Park, Meta, Colombia (2°40′N, 74°10′W, elevation 350 m). The region has a dry period from December to March and a rainy period through the rest of the year. Annual rainfall varies between 2216 and 2953 mm, with a mean of 2622 mm (Kimura *et al.* 1994).

Dung beetles were captured from January to July 1997 (including part of the dry season and part of the rainy season) as part of a study of seed dispersal by woolly monkeys. A group of woolly monkeys was followed for 60 h each month, and feces were collected during the day from a single focal individual each sample period. Dung beetles attracted to the excrement were collected in plastic bags along with the monkeys dung sample (n = 520). Feces were collected between 5 minutes after defecation. On the next day the fecal samples were revised and all the dung beetle species not collected before were preserved in alcohol for later identification. Collections were made indistinctly in the different forest types present in the study area, which are used by the monkeys according to the fruit availability (Stevenson *et al.* 1994). Additionally, five pitfall traps on soil surface were used during a three days and three nights in mature *terra firme* forests, in order to complement the sample for nocturnal and delayed visitors. In these cases, woolly monkey dung was replaced daily.

Results and Discussion

Nineteen species of dung beetles in nine genera were attracted to woolly monkey dung (Table 1). They represent 36.5% of the 52 species that have been

Table 1. Dung beetle species attracted to woolly monkey dung in Tinigua National Park, Colombia.

Tribe	Species	Relocation technique
Canthonini	*Canthon angustatus* Harold	BR
	Canthon femoralis (Chevrolat)	BR
	Canthon luteicollis Erichson	BR
	Canthon sp.	BR
	Deltochilum amazonicum Bates	BR
Dichotomiini	*Ateuchus murrayi* (Harold)	Bu
	Ateuchus sp.	Bu
	Canthidium funebre Balthasar	Bu
	Canthidium ruficolle (Germar)	Bu
	Canthidium g. cupreum*	Bu
	Canthidium sp. A	Bu
	Canthidium sp. B	Bu
	Canthidium sp. C	Bu
	Dichotomius cf. *problematicus* (Luederwaldt)	Bu
	Uroxys sp. A	Bu
	Uroxys sp. B	Bu
Onthophagini	*Onthophagus haematopus* Harold*	Bu
Phanaeini	*Oxysternon conspicillatum* (Weber)	Bu
	Phanaeus chalcomelas (Perty)	Bu

BR: Ball roller, Bu: Burrower (see text). * = most abundant species in our sample.

found in the study area (I. Jiménez and Escobar, unpublished data), and nearly 8% of the total of dung beetles species recorded for Colombia (Escobar and Medina 1996). Fourteen of the 19 species of dung beetles recorded were burrowers and five were ball rollers (Table 1). This is a higher proportion of burrowers compared with other localities like Leticia, Colombia (Howden and Nealis 1975), where 18 burrowers species and 13 ball roller species were found. Estrada and Coates-Estrada (1991) collected in Los Tuxtlas, Mexico, 10 burrowers and eight ball rollers attracted to howler monkey dung (*Alouatta palliata* Gray).

Primate dung is apparently also an important food resource for dung beetles in other tropical localities. Species attracted to monkey dung constitute between 25 and 83% of the total coprophagous beetle community in different tropical forests (Table 2), perhaps as a result of the high availability or quality of this kind of food. In the Tinigua forest, for example, primates are the most abundant diurnal mammals in terms of density and biomass; woolly monkeys present the highest population density (30 ind./Km.^{2}) (Stevenson 1996). Each individual in a group defecates between 15 and 20 times during a day (night depositions were not quantified) (P. R. Stevenson, unpublished data). Therefore, we can estimate that at least 450–600 depositions/Km^2 are produced each day by the woolly monkeys. In quantitative terms this dung may be of special importance to the dung beetle community in the study area. Dung availability and quality, however, vary seasonally related to food availability for the monkeys in the forest. At the end of the rainy season woolly monkeys eat more leaves and seeds than in other periods (Stevenson *et al.* 1994). Moreover, at the beginning of the rainy season, when fruit availability increases, woolly

Table 2. Number of Scarabaeinae species attracted by primate dung in different localities in the Neotropics.

Locality	Total number of dung beetle species	Number of dung beetle species attracted to primate dung	Primate species included in the analysis
Leticia (Colombia)[1]	60	33	Not reported
Barro Colorado (Panamá)[2]	59	15	*Alouatta paliatta*
Lox Tuxtlas (México)[3,4]	24	20	*Alouatta paliatta*
Tinigua (Colombia)[5]	52	19	*Lagothrix lagothricha*

[1] Howden and Nealis 1975; [2] Gill 1991; [3] Estrada and Coates-Estrada 1919; [4] Favila and Halffter 1997; [5] this study.

monkeys defecate more often, and excrement contains a larger number of seeds (P. Stevenson, unpublished data).

Four species of dung beetles attracted to *A seniculus* dung in a preliminary study, *Canthon angustatus* Harold, *Ontherus pubens* Génier, *Eurysternus hamaticollis* Balthasar and *E. velutinus* Bates, were recorded at the study site during a preliminary survey (I. Jiménez and Escobar, unpublished data.). Only *C. angustatus* was also present in woolly monkey dung. As *A. seniculus* is a highly folivorous species, such results suggest some differential use of primate dung. In Los Tuxtlas, Mexico, Díaz (1998) found that *A. palliata* dung is of basic importance for *Canthon femoralis* (Chevrolat) to achieve sexual maturity. Thus quantitative comparative data are needed to assess the degree of niche overlap among different dung beetle species in one community at every season, and to determine the effect of variation in food quality and availability on the scarab populations.

Observations on the behavior of dung beetles showed that they usually roll or burrow small seeds along with their dung balls. Less often, large seeds (>1 cm in length.) like those of *Pourouma bicolor* Mart. (Cecropiaceae), may also be carried by dung beetles. Dung beetle activity therefore reduces clumping of seeds in the feces and results in some seeds being burrowed. The implication of these behaviors can be important, because when seeds are buried or less clumped, the probability of being found by a predator decreases (Estrada and Coates-Estrada 1991, Shepherd and Chapman 1998). Thus the activity of dung beetles as secondary seed dispersal agents may have a significant effect on the plant species dispersed by monkeys (Estrada and Coates-Estrada 1991) and in the natural regeneration of the forest. The effects of different dung beetle species on the fates of dispersed seeds by relocating them and protecting them from predators, the beetle's preferences, and variation of availability and quality of dung throughout the year remain to be studied.

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DYTISCID FAUNA (COLEOPTERA: DYTISCIDAE) IN CATTAIL PONDS OF NORTHEASTERN ONTARIO, CANADA

DANIEL PAQUETTE AND YVES ALARIE[1]
Department of Biology
Laurentian University
Ramsey Lake Road
Sudbury, ON P3E 2C6
Canada

Abstract

A list of the species of Dytiscidae found in cattail ponds of northeastern Ontario, Canada is provided. A total of 1,890 specimens representing 47 species (17 genera) was collected among which 32 species are considered common elements in that freshwater habitat. Local assemblages were dominated, in descending order, by *Hygrotus sayi* Balfour-Browne, *Agabus anthracinus* Mannerheim, *Hygrotus picatus* (Kirby), *Ilybius biguttulus* (Germar), *Liodessus affinis* (Say), *Rhantus binotatus* (Harris), and *Desmopachria convexa* (Aubé). *Laccophilus proximus* Say is reported for the first time north of the Canada-U.S.A. border and its presence in northeastern Ontario is deemed to represent an extended northern distribution.

Wetlands are a major feature of the landscape in almost all parts of the world playing major roles by providing unique habitats for a wide variety of flora and fauna. Wetlands have many distinguishing features, the most notable of which are the presence of shallow standing water, and vegetation and animals adapted to or tolerant of saturated soils. All accumulate organic plant materials that decompose slowly (Mitsch and Gosselink 1993).

In the temperate zone, cattail ponds are a common wetland feature of the landscape. They vary considerably in size and, although water is generally present for most time of the year, the depth and duration of flooding may vary considerably. Those freshwater habitats are characterized by hydrophilic vegetation such as cattail (*Typha* spp.), bur reed (*Sparganium* spp.), sedges (*Carex* spp.), bull-rush (*Scirpus* spp.), arrowhead (*Saggittaria* spp.), smartweed (*Polygonum* spp.), and horsetail (*Equisetum* spp.). Like other wetland systems, cattail ponds are detrital ecosystems and as such are considered among the most productive ecosystems on Earth (Hildrew and Townsend 1975).

Members of the family Dytiscidae are predaceous water beetles which constitute one of the most abundant components of beetles communities found in shallow freshwater habitats (Alarie and Leclair 1988). These beetles generally occur along the shallow shores of standing waters although some genera like *Oreodytes* Seidlitz, *Nebrioporus* Guignot, and *Stictotarsus* Zimmermann, contain species more restricted to slowly flowing waters (Hilsenhoff 1991; Alarie 1993). The family Dytiscidae constitutes a very diverse group of insects which comprises more than 4,000 species worldwide (Dali *et al.* 1978). In North America, approximately 500 species are recognized of which 262 are found in Canada and 155 in Ontario (Larson and Roughley 1991).

Despite their ecological importance as predators and their positive value as

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[1] To whom correspondance should be addressed.

Table 1. Localities of the sampling sites in Ontario Canada.

Site	Locality	Numbers of specimens collected	Sampling period
E1	Laurentian University campus, Sudbury	667	Once a week from May 21 until August 21 and on September 17, 1997
E2	Lily creek off Paris street, facing Science North, Sudbury	210	Once a month from June until August, 1997
E3	Ramsey Lake road, off Laurentian University campus; Sudbury	253	Once a month from June until August, 1997
E4	Minnow lake area; junction of Rheal and Estelle Street, Sudbury	228	Once a month from June until August, 1997
E5	Junction of Maley Drive and Barrydowne Road, Sudbury	155	Once a month from June until August, 1997
C1	6 km east of Webbwood at Highway 17	32	August 26, 1997
C2	Serpent river off Highway 17 west	95	August 26, 1997
C3	2 km east of Nairn off Highway 17	53	August 26, 1997
C4	3 km west of North Bay off Highway 17	118	August 27, 1997
C5	Rutherglen at Highway 17	60	August 27, 1997
C6	10 km east of North Bay off Highway 17	19	August 27, 1997

bioindicators (Larson 1985), the dytiscid fauna of the smaller lentic habitats across Canada has been little studied (Alarie and Leclair 1988; Alarie and Maire 1991). Accordingly, the main objective of this study is to assess the species of Dytiscidae typically found in cattail ponds of northeastern Ontario.

Materials and Methods

Beetles were collected in typical ponds characterized by an abundance of cattails (*Typha angustifolia* L. and *T. latifolia* L.). Five sites (E1–E5) located in Sudbury, Ontario, Canada (46°30′N, 81°0′W) were sampled on a weekly or monthly basis in order to mitigating any effect of seasonal variation on the species collected. Six additional sites (C1–C6) located approximately 100 km east and west of the Sudbury region were sampled one time only. Locality, sampling period, numbers of specimens at each site, are included in Table 1.

Three abiotic parameters were measured to characterize the habitat: temperature, pH and conductivity. No significant variation was observed between the sites studied. The minimum and maximum temperature was recorded with a minimum-maximum thermometer. Values obtained ranged between 15°C and 29°C. The pH and conductivity of water samples were analysed using a standard pH and conductivity meter. Values ranged from 6.1 to 7.6 and 975 to 1863 micromhos/cm respectively.

Table 2. Dytiscidae collected in cattail ponds of northeastern Ontario in 1997; B = boreal, E = eastern, H = holarctic, N = nearctic, T = transcontinental, Tp = temperate, W = western.

	Sudbury sites						Other sites									Distribution		
Species	C1	C2	C3	C4	C5	C6	E1	E2	E3	E4	E5	Total	% of Total	# of sites	% of sites	H/N	ETW	B/Tp
***Acilius* Leach**	**0**	**0**	**0**	**3**	**0**	**0**	**1**	**1**	**5**	**0**	**3**	**13**	0.69	**5**	**45**			
A. mediatus (Say)	0	0	0	0	0	0	0	0	0	0	1	1	0.05	1	9	N	E	B
A. semisulcatus Aubé	0	0	0	3	0	0	1	1	5	0	12	12	0.63	5	45	N	T	B
***Agabus* Leach**	**1**	**0**	**2**	**7**	**14**	**4**	**79**	**5**	**32**	**15**	**23**	**182**	**9.63**	**10**	**91**			
A. ambiguus (Say)	0	0	0	0	4	1	17	0	4	0	3	29	1.53	5	45	N	T	Tp
A. anthracinus Mannerheim	1	0	2	7	10	3	29	1	6	5	16	80	4.23	10	91	N	T	B
A. bifarius (Kirby)	0	0	0	0	0	0	1	0	0	0	1	2	0.11	2	18	H	T	B
A. inscriptus (Crotch)	0	0	0	0	0	0	7	0	1	2	0	10	0.53	3	27	N	T	B
A. semipunctatus (Kirby)	0	0	0	0	0	0	7	4	14	0	0	25	1.32	3	27	N	T	B
A. seriatus (Say)	0	0	0	0	0	0	2	0	0	0	0	2	0.11	1	9	N	T	B
A. subfuscatus Sharp	0	0	0	0	0	0	16	0	7	8	3	34	1.80	4	36	N	E	Tp
***Colymbetes* Clairville**	**1**	**0**	**0**	**0**	**1**	**0**	**5**	**5**	**2**	**2**	**1**	**17**	**0.90**	**7**	**64**			
C. sculptilis Harris	1	0	0	0	1	0	5	5	2	2	1	17	0.90	7	64	N	T	B
***Coptotomus* Say**	**0**	**4**	**0**	**0**	**0**	**0**	**14**	**0**	**0**	**0**	**1**	19	1.01	3	27			
C. longulus LeConte	0	4	0	0	0	0	14	0	0	0	1	19	1.01	3	27	N	T	Tp
***Desmopachria* Babington**	**0**	**0**	**1**	**1**	**0**	**1**	**16**	**0**	**18**	**1**	**13**	51	2.70	7	64			
D. convexa (Aubé)	0	0	1	1	0	1	16	0	18	1	13	51	2.70	7	64	N	T	Tp
***Dysticus* Linnaeus**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	1	0.05	1	9			
D. verticalis Say	0	0	0	0	0	0	0	0	0	0	1	1	0.05	1	9	N	E	Tp
***Graphoderus* Dejean**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**1**	**0**	3	0.16	3	27			
G. occidentalis Horn	0	0	0	0	0	0	1	0	1	0	0	2	0.11	2	18	N	W	B
G. perplexus Sharp	0	0	0	0	0	0	0	0	0	1	0	1	0.05	1	9	N	T	B
***Hydaticus* Leach**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**8**	**1**	**2**	12	0.63	4	36			
H. aruspex Clark	0	0	0	0	0	0	1	0	8	1	2	12	0.63	4	36	H	T	Tp
***Hydroporus* Clairville**	**9**	**0**	**2**	**10**	**17**	**0**	**129**	**56**	**48**	**44**	**22**	**337**	**17.83**	**9**	**82**			
H. badiellus Fall	0	0	0	0	0	0	4	0	0	0	1	5	0.26	2	18	N	T	B
H. columbianus Fall	0	0	0	0	0	0	2	1	0	0	0	3	0.16	2	18	N	T	B
H. dentellus Fall	9	0	0	8	9	0	3	3	0	0	13	45	2.38	6	55	N	T	B
H. fuscipennis Schaum	0	0	0	0	0	0	0	0	1	0	0	1	0.05	1	09	**H**	T	B
H. niger Say	0	0	1	0	0	0	11	0	3	3	1	19	1.01	5	45	N	E	Tp
H. notabilis LeConte	0	0	0	0	0	0	24	1	6	5	0	36	1.90	4	36	H	T	B

Table 2. Continued.

Species	Sudbury sites						Other sites						% of	# of	% of	Distribution		
	C1	C2	C3	C4	C5	C6	E1	E2	E3	E4	E5	Total	Total	sites	sites	H/N	ETW	B/Tp
H. paugus Fall	0	0	0	0	7	0	6	0	0	0	0	13	0.69	2	18	N	T	B
H. signatus Mannerheim	0	0	1	0	0	0	9	2	2	34	1	49	2.59	6	55	N	T	B
H. striola (Gyllenhal)	0	0	0	2	1	0	52	43	25	0	3	126	6.67	6	55	H	T	B
H. tenebrosus LeConte	0	0	0	0	0	0	2	4	1	2	1	10	0.53	5	45	H	T	Tp
H. tristis (Paykull)	0	0	0	0	0	0	16	2	10	0	2	30	1.59	4	36	H	T	B
***Hygrotus* Stephens**	**16**	**24**	**28**	**86**	**8**	**4**	**207**	**96**	**77**	**55**	**44**	**645**	**34.13**	**11**	**100**			
H. impressopunctatus (Schaller)	0	0	0	1	0	0	30	63	27	3	6	130	6.88	6	55	H	T	B
H. laccophilinus (LeConte)	2	2	1	39	0	0	0	0	0	0	20	64	3.39	5	45	N	E	Tp
H. picatus (Kirby)	2	0	0	15	2	0	49	33	39	4	9	153	8.10	8	73	N	T	B
H. sayi Balfour-Browne	12	22	27	31	6	4	128	0	11	48	9	298	15.77	10	91	N	T	B
***Hybius* Erichson**	**2**	**25**	**9**	**7**	**4**	**6**	**98**	**6**	**25**	**6**	**22**	**210**	**11.11**	**11**	**100**			
I. angustior (Gyllenhal)	0	0	0	4	0	0	12	2	6	0	7	31	1.64	5	45	H	T	B
I. biguttulus (Germar)	0	19	9	0	3	6	63	4	18	6	12	140	7.41	9	82	N	E	B
I. discedens Sharp	0	0	0	0	0	0	4	0	1	0	0	5	0.26	2	18	N	T	B
I. ignarus (LeConte)	2	2	0	3	1	0	0	0	0	0	0	8	0.42	4	36	N	E	B
I. pleuriticus (LeConte)	0	4	0	0	0	0	19	0		0	3	26	1.38	3	27	N	T	B
***Laccophilus* Leach**	**0**	**31**	**3**	**0**	**0**	**0**	**146**	**4**	0	**4**	**0**	**73**	**3.86**	**6**	**55**			
L. maculosus Say	0	31	3	0	0	0	13	4	**17**	4	0	72	3.81	6	55	N	T	Tp
L. proximus Say	0	0	0	0	0	0	1	0	17	0	0	1	0.05	1	9	N	E	Tp
***Laccornis* Des Gozis**	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	0	**0**	**0**	2	0.11	2	18			
L. latens (Fall)	1	0	0	0	0	0	1	0	**0**	0	0	2	0.11	2	18	N	E	Tp
***Liodessus* Guignot**	**0**	**6**	**6**	**1**	**6**	**0**	**33**	**14**	0	**51**	**6**	**136**	**7.20**	**9**	**82**			
L. affinis (Say)	0	6	6	1	6	0	31	13	**13**	13	6	95	5.03	9	82	N	T	B
L. fuscatus (Crotch)	0	0	0	0	0	0	2	1	13	38	0	41	2.17	3	27	N	E	B
***Neoporus* Guignot**	**0**	**5**	**2**	**0**	**4**	**0**	**28**	**0**	0	**5**	**2**	46	2.43	6	55			
N. undulatus Say	0	5	2	0	4	0	28	0	**0**	5	2	46	2.43	6	55	N	T	B
***Rhantus* Dejean**	**2**	**0**	**0**	**3**	**6**	**1**	**27**	**23**	**5**	**2**	**13**	**82**	**4.34**	**9**	**82**			
R. binotatus (Harris)	2	0	0	2	4	1	17	23	3	1	9	62	3.28	9	82	N	T	B
R. sinuatus (LeConte)	0	0	0	1	2	0	1	0	2	0	4	10	0.53	5	45	N	T	B
R. suturellus (Harris)	0	0	0	0	0	0	5	0	0	0	0	5	0.26	1	9	N	T	B
R. wallisi Hatch	0	0	0	0	0	0	4	0	0	1	0	5	0.26	2/2	18	N	T	B
***Uvarus* Guignot**	**0**	**0**	**0**	**0**	**0**	**3**	**13**	**0**	**2**	**41**	**2**	**61**	**3.23**	**5**	**45**			
U. granarius (Aubé)	0	0	0	0	0	3	13	0	2	41	2	61	3.23	5	45	N	E	Tp

Following Hilsenhoff (1985), two different sampling methods were used to ensure maximum representation of species present: D-framed sampling net (mesh size = 0.5 mm) and bottle traps (Schaeflein 1983). Whereas both methods were used for sampling the E1–E5 sites, only the sampling net was used at the C1–C6 sites. The sampling net was used in a semi-quantitative fashion based on a catch per unit effort (Landin 1976). Each pond was swept for a period of 2 hours (including picking and sorting time) for all eleven sites. Ten traps were submerged at the periphery of the pond for a period of 24 hours. Specimens are deposited in the insect research collection of the junior author (Laurentian University, Sudbury, Ontario, Canada).

Results and Discussion

A total of 1,890 specimens representing 47 species in 17 genera was collected during this study (Table 2). Some species were abundant and collected at most of the sampled sites: *Hygrotus sayi* Balfour-Browne (90.90% of the sites; 15.77% of the total number), *Agabus anthracinus* Mannerheim (90.90% of the sites; 4.23% of the total number), *Hygrotus picatus* (Kirby) (72.73% of the sites; 8.10% of the total number), *Ilybius biguttulus* (Germar) (81.82% of the sites; 7.41% of the total number); *Liodessus affinis* (Say) (81.82% of the sites; 5.03% of the total number), *Rhantus binotatus* (Harris) (81.82% of the sites; 3.28% of the total number), and *Desmopachria convexa* (Aubé) (63.64% of the sites; 2.70% of the total number). Some species were collected frequently but in a lower abundance: *Colymbetes sculptilis* Harris (63.64% of the sites; 0.90% of the total number), *Acilius semisulcatus* Aubé (45.45% of the sites; 0.63% of the total number).

Liodessus fuscatus (Crotch) differs from the two previous collected groupings being fairly abundant (2.17% of the total number) although it was found in a lesser number of sites (27.27% of the sites).

Based both on abundance and number of sites at which a species was found, 22 additional species could be viewed as representing common elements in cattail ponds of northeastern Ontario. These are in descending order: *Hygrotus impressopunctatus* (Schaller) (0.55% of the sites; 6.88% of the total number), *Hydroporus striola* (Gyllenhal) (0.55% of the sites; 6.67% of the total number), *Laccophilus maculosus* Say (0.55% of the sites; 3.81% of the total number), *Hygrotus laccophilinus* (0.45% of the sites; 3.39% of the total number), *Uvarus granarius* (Aubé) (0.45% of the sites; 3.23% of the total number), *Hydroporus signatus* Mannerheim (0.55% of the sites; 2.59% of the total number), *Neoporus undulatus* Say (0.55% of the sites; 2.43% of the total number), *Hydroporus dentellus* Fall (0.55% of the sites; 2.38% of the total number), *H. notabilis* LeConte (0.36% of the sites; 1.90% of the total number), *Agabus subfuscatus* Sharp (0.36% of the sites; 1.80% of the total number), *Ilybius angustior* (Gyllenhal) (0.45% of the sites; 1.64% of the total number), *Hydroporus tristis* (Paykull) (0.36% of the sites; 1.59% of the total number), *Agabus ambiguus* (Say) (0.45% of the sites; 1.53% of the total number), *Ilybius pleuriticus* (LeConte) (0.27% of the sites; 1.38% of the total number), *Agabus semipunctatus* (Kirby) (0.45% of the sites; 0.63% of the total number), *Coptotomus longulus* LeConte (0.27% of the sites; 1.01% of the total number), *Hydroporus niger* Say (0.45% of the sites; 1.01% of the total number), *Hydroporus paugus* Fall (0.18% of the sites; 0.69% of the total number), *Hydaticus aruspex* Clark (0.36% of the sites; 0.63% of the total number), *Agabus inscriptus* (Crotch) (0.27% of the sites; 0.53% of the total number), *Hydro-*

porus tenebrosus LeConte (0.45% of the sites; 0.53% of the total number), and *Rhantus sinuatus* (LeConte) (0.45% of the sites; 0.53% of the total number).

Finally, 16 species were neither frequently collected nor abundant: *Ilybius ignarus* (LeConte) (0.36% of the sites; 0.42% of the total number), *Rhantus suturellus* (Harris) (0.09% of the sites; 0.26% of the total number), *Hydroporus badiellus* Fall (0.18% of the sites; 0.26% of the total number), *Ilybius discedens* Sharp (0.18% of the sites; 0.26% of the total number); *Rhantus wallisi* Hatch (0.18% of the sites; 0.26% of the total number), *Hydroporus columbianus* Fall (0.18% of the sites; 0.16% of the total number), *Agabus seriatus* (Say) (0.09% of the sites; 0.11% of the total number); *A. bifarius* (Kirby) (0.18% of the sites; 0.11% of the total number), *Graphoderus occidentalis* Horn (0.18% of the sites; 0.11% of the total number), *Laccornis latens* (Fall) (0.18% of the sites; 0.11%of the total number), *Acilius mediatus* (Say) (0.09% of the sites; 0.05% of the total number), *Dytiscus verticalis* Say (0.09% of the sites; 0.05% of the total number), *Graphoderus perplexus* Sharp (0.09% of the sites; 0.05% of the total number), *Hydroporus fuscipennis* Schaum (0.09% of the sites; 0.05% of the total number), *Laccophilus proximus* Say (0.09% of the sites; 0.05% of the total number). It is hypothesized that these species represent either accidental or rare elements in cattail ponds of northeastern Ontario.

On a larger biogeographical scale, most species collected are Nearctic while nine [*A. bifarius, H. fuscipennis, H. aruspex, H.notabilis, H. tristis, H. striola, H. impressopunctatus, I. angustior, H. tenebrosus* (Larson 1997; Alarie 1985; Persson 1985; Galewski 1961)] have holarctic distributions. Most species collected represent typical boreal elements characterized by a transcontinental distribution whilst *H. niger, A. mediatus, H. laccophilinus A. subfuscatus, L. proximus, I. biguttulus, L. latens, L. fuscatus, U. granarius, I. iganarus* and *D. verticalis* are generally recognized as eastern elements (Table 2). The finding of *Laccophilus proximus* Say among the species collected is noteworthy. This species occurs throughout most of the United States east of the Rocky Mountains. Whereas the Canadian and American border closely marks the northern limit of the range, its presence in northeastern Ontario must be viewed as an extended northern distribution.

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A NEW SPECIES OF *VIRIDIMICUS* JAMESON FROM HONDURAS (SCARABAEIDAE: RUTELINAE)

MARY LIZ JAMESON
University of Nebraska
Division of Entomology
W436 Nebraska Hall
Lincoln, NE 68588-0514, U.S.A.
mjameson@unlinfo.unl.edu

Abstract

Viridimicus omoaensis Jameson is described from Honduras. This species extends the distribution of the genus from Guatemala southwards in Mesoamerica. The characters that define the genus are expanded to include *V. omoaensis*. A key to the seven species in the genus is provided as well as additional locality notes for *V. aurescens* (Bates) and *V. cyanochlorus* Jameson.

Resumen

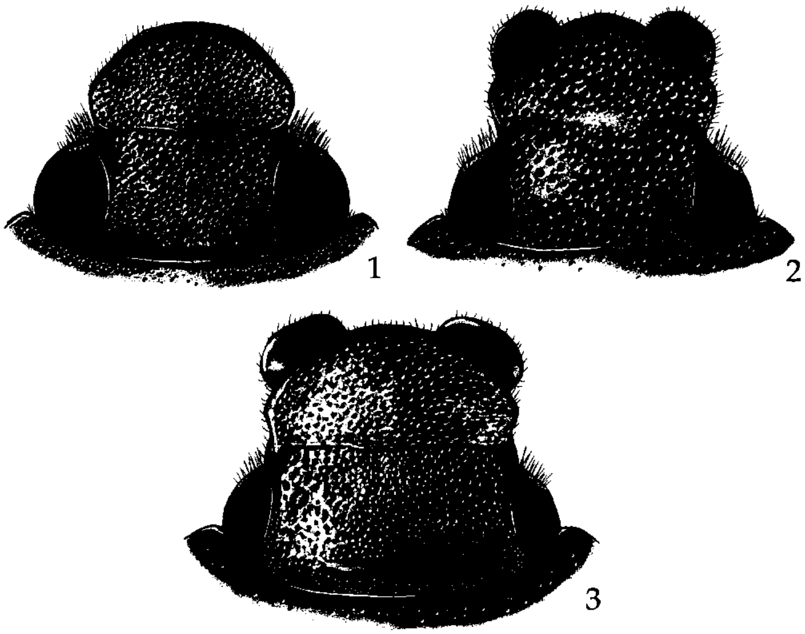
Se describe *Viridimicus omoaensis* Jameson de Honduras. Esta especie extiende la distribucion del genero de Guatemala hacia el sur en Mesoamerica. Se amplian los caracteres que definen el genero para incluir *V. omoaensis*. Se proveen una clave para las siete especies en el genero y notas de localidades adicionales para *V. aurescens* (Bates) y *V. cyanochlorus* Jameson.

Species in the genus *Viridimicus* Jameson are large (about 25 mm in length) leaf chafers and were previously known to occur from central Mexico to Guatemala. The new species, *V. omoaensis* Jameson, as well as new records for *V. aurescens* (Bates), extend the distribution of the genus to Honduras. Species in the genus *Viridimicus* are distributed in mid-elevation, montane forests and have been collected at lights during rain or just prior to rain. Members of the genus are sexually dimorphic for color: males are metallic green and females are brown or black. The genus *Viridimicus* now includes seven species.

The parabolic form of the clypeal apex in *V. omoaensis* requires that the generic characteristics and limits of *Viridimicus* be redefined. All remaining species in the genus possess a semicircular clypeal apex. Because this character state overlaps with the sister genus *Parabyrsopolis* Ohaus, the key to genera of Areodina (Jameson 1990) is altered.

Viridimicus omoaensis Jameson, **new species**
Figs. 1–4

Type Series. Holotype male labeled "Honduras: Cortés, Parq Nac Cusuco, 5 k. W Bs Aires, 26–27 August 1994, RD Cave collector." Genitalia and left wing card-mounted beneath specimen. Allotype female labeled as holotype. Holotype and allotype deposited at the University of Nebraska State Museum (Lincoln, Nebraska). Sixty paratypes (44 males, 16 females) with the following data: "Honduras: Cortés Dept., Cusuco National Park, Visitor Center, 1550 m, 20–22.viii.1998, D. C. Hawks, MV light during rain" (18 males, 4 females); "Honduras: Cortés, Parq Nac Cusuco, N15°29′, W88°13′, 21–22 August 1998,



Figs. 1–3. *Viridimicus* spp., head, dorsal view showing form of clypeus and mandibles. **1)** *V. aurescens* (Bates) (mandibles hidden, clypeal apex semicircular); **2)** *V. omoaensis* Jameson (mandibles exposed, clypeal apex parabolic); **3)** *V. ratcliffei* Jameson (mandibles exposed, clypeal apex semicircular).

RD Cave collector" (11 males, 3 females); "Honduras: Cortés, Parq. Nac. Cusuco, N15°29', W88°12', 27–28 Ago 1998, rcol. J. Torres" (6 males, 2 females); "Honduras: Cortés, Parq Nac Cusuco, 5 k. W Bs Aires, 26–27 August 1994, RD Cave collector" (3 males, 2 females); "Honduras: Cortés, Cofradia, Cusuco, 26 Ago 1994, rcol R. Cordero" (1 male, 2 females); "Honduras: Cortés, PN Cusuco, N 15°30', W88°12', 21 Ago 1998, rcol J. Torres" (3 males); "Honduras: Cortéz Dept., P.N. Cusuco, 15 July 1995," "D.C. Carlson collection" (1 male, 1 female); "Honduras: Cortés, Parq. Nac. Cusuco, N15°29', W88°12', 21–22 Ago 1998, rcol R. Cave" (1 female); "Honduras: Cortés, Parq. Nac. Cusuco, 5 km W Buenos Aires, 24 September 1994, RD Cave collector" (1 male); "Honduras: Cortés, San Pedro Sula, Parque Nac. Cusuco, 24 Sep. 1994, rcol. R. Cave" (1 male). Paratypes deposited at the California Academy of Sciences, San Francisco, California (1 male, 1 female); Dave Carlson collection, Fair Oaks, California (1 male, 1 female); Ronald D. Cave collection, Zamorano, Honduras (13 males, 2 females); Daniel Curoe collection, Palo Alto, California (1 male, 1 female); Escuela Agricola Panamericana, Zamorano, Honduras (4 males, 1 female); Dave Hawks collection, Riverside, California (18 males, 4 females); Henry and Anne Howden collection at the Canadian Museum of Nature, Ottawa, Canada (1 male, 1 female); Mary Liz Jameson collection, Lincoln, Nebraska (1 male, 1 female); Miguel Moron collection, Xalapa, Mexico (1 male, 1 female); Brett C. Ratcliffe collection, Lincoln, Nebraska (1 male, 1 female); United States National Museum,

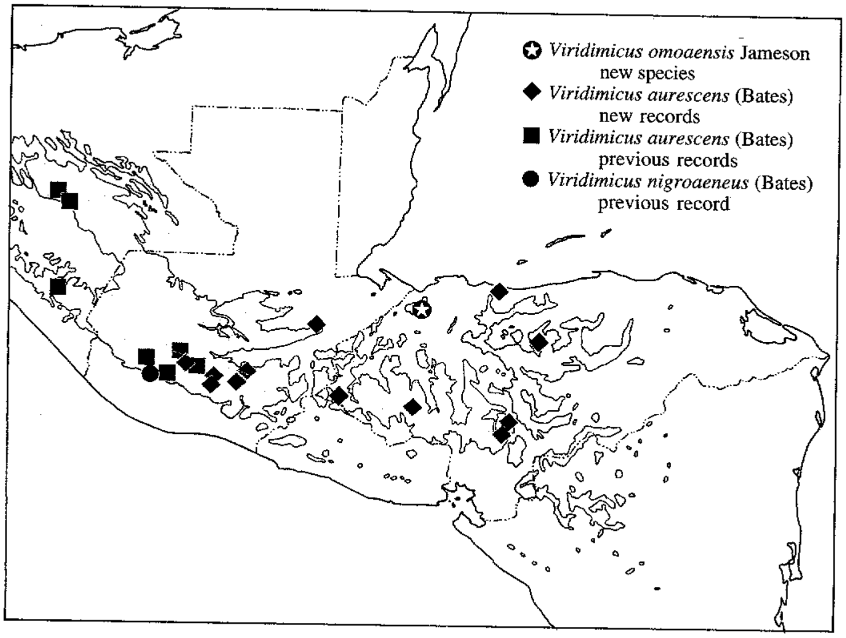


Fig. 4. Distribution of the species of *Viridimicus* south of the Isthmus of Tehauntepec (Chiapas, Mexico; Guatemala; Honduras; Nicaragua). Gray area equals 1,000 m.

Washington, D.C. (1 male, 1 female); University of Nebraska State Museum, Lincoln, Nebraska (1 male, 1 female).

Description. Holotype male. Length 26.5 mm; width across humeri 12.8 mm; greatest width 14.7 mm. *Head* (Fig. 2): Frons (with illumination and magnification) brassy, metallic green; clypeus castaneous. Surface of frons densely, confluently punctate (less so on disc); punctures moderate and moderately large, mixed, setigerous laterally; setae rufous, short. Frontoclypeal suture bi-arcuate. Clypeus declivous with respect to frons; sides divergent from base for one third length then converging apically to a weakly parabolic apex (Fig. 2); apex rounded, broadly reflexed; surface confluently punctate to coarsely rugopunctate, punctures moderately large. Interocular width 3.0 transverse eye diameters. Mandibles exposed in dorsal view (Fig. 2), weakly concave. *Pronotum*: Color (with magnification and illumination) reddish brown with brassy, metallic green reflections. Surface convex, with poorly defined, irregular concavities (for internal muscle attachment). Surface of disc moderately densely punctate, punctures moderate and small. Surface at margin, apex, and base moderately densely to densely punctate, punctures confluent or not at middle and apical margin; punctures moderate and small. *Scutellum*: Color (with magnification and illumination) reddish brown with brassy, metallic green reflections. Shape parabolic, width subequal to length. Surface moderately densely punctate, punctures moderate and small. *Elytra:* Color (with illumination and magnification) as pronotum. Surface with variably impressed, punctate striae; 1 line of punctures next to suture (poorly impressed), 3 in center of disc (weakly impressed, not reaching apex or base), 1 laterad of humerus (weakly impressed, not reaching apex or base); punctures small. Intervals broad, moderately densely punctate; punctures small and moderate in diameter, sparsely setigerous at margins of elytra, moderately setigerous at apex; setae rufous, moderate in length. *Pygidium:* Color as elytra. Surface densely punctate, less so at apex; punctures moderate (with setae) and small; setae rufous, moderately long to long. *Legs:* Pro- and mesotarsi each with 1 claw enlarged, cleft, 2 times as wide as smaller claw. Metatarsus with 1 claw distinctly cleft, 1.5 times as wide as smaller claw. Protarsus with third tarsomere apically emarginate, with stout seta in emargination. *Venter:* Densely clothed with moderate to moderately long, rufous setae; sternites 1–6 less densely pilose. *Male Genitalia*: Symmetrical, apex rounded; internal sac cylindrical in shape, densely clothed with short, tawny setae.

Allotype Female. Length 28.7 mm; width across humeri 13.9 mm; greatest width 15.9 mm. Differs from holotype in the following respects: *Head*: Color castaneous, without metallic reflections. *Pronotum*: Color castaneous, with weak metallic green reflections at margins. Surface densely punctate, some punctures confluent at margins and apex, punctures large to moderate in diameter. *Elytra*: Color as pronotum. Intervals moderately densely punctate; punctures moderate in diameter. *Pygidium*: Color as pronotum. Surface from base to disc finely rugopunctate, at apex confluently punctate to moderately densely punctate, punctures at base and mid-disc minute and small, at apex small and moderate, mixed, some setigerous; setae rufous, moderately long. *Legs*: Protarsus with claws of equal size and width, not cleft. Meso- and metatarsi with claws of equal size and width, 1 claw weakly cleft. *Female Genitalia*: Ventral gonocoxites with apices broadly rounded, medial apices quadrate.

Paratypes (44 males, 16 females). Variation in measurements of males is as follows: length 22.8–26.4 mm; width across humeri 11.1–13.2 mm; greatest width 12.8–14.6 mm. Variation in measurements of females is as follows: length 27.1–30.0 mm; width across humeri 13.5–14.3 mm; greatest width 15.3–16.5 mm. Males and females differ from the holotype and allotype in the following respects. *Head*: Surface of frons with punctures separated by 1 puncture diameter. *Elytra:* Surface with 3 to 4 weakly impressed discal striae, additional weakly impressed stria laterad of humerus, not reaching apex or base.

Diagnosis. *Viridimicus omoaensis* is easily separated from other species in the genus by the following combination of characters: clypeal apex parabolic (divergent from base, laterally sinuate, apex rounded) (Fig. 2); dorsal coloration in the male brassy green; pygidium with disc densely, confluently punctate; mandibles in dorsal view exposed and weakly concave (Fig. 2).

Viridimicus omoaensis resembles *V. ratcliffei* Jameson in the exposed, flattened mandibles and brassy green coloration of the male. However, *V. omoaensis* is easily separated from *V. ratcliffei* by its parabolic clypeal apex (Fig. 2) (semicircular in *V. ratcliffei* [Fig. 3]). In addition, *V. ratcliffei* is known only from Puebla, Mexico.

Viridimicus aurescens is here recorded from Honduras. It is distinguished from *V. omoaensis* by its semicircular clypeal apex (Fig. 1) (parabolic in *V. omoaensis* [Fig. 2]), dark green metallic coloration of the male (brassy green in *V. omoaensis*), and concave mandibles that are hidden in dorsal view (Fig. 1) (exposed and flattened in *V. omoaensis* [Fig. 2]).

Distribution (Fig. 4). *Viridimicus omoaensis* occurs in the northwest corner of Honduras in the Sierra de Omoa. Specimens were collected between 1560 and 1650 m elevation.

Temporal Data. July (2), August (58), September (2).

Deposition of Types. The Escuela Agricola Panamericana (Zamorano) and the Universidad Nacional Autonoma de Honduras maintain the largest insect collections in Honduras, but neither maintains primary types. For this reason, the primary types were deposited at the University of Nebraska State Museum, U.S.A., where other types and specimens in the genus *Viridimicus* are deposited.

Etymology. This species is named for the Sierra de Omoa, the type locality.

Remarks. *Viridimicus omoaensis* occurs in the small, isolated mountain region of Sierra de Omoa in northwestern Honduras. Specimens were collected in Parque Nacional Cusuco in wet, montane, cloud forest. Dominant tree species include *Liquidambar styraciflua* L. (Hamamelidaceae), *Podocarpus oleifolius* Don. (Podocarpaceae), *Billia hippocastanum* Peyritsch (Hippocastanaceae), *Clusia* sp. (Guttiferae), and *Pinus* spp. (Pinaceae) (D. Hawks, pers. comm. 1995 and pers. obs.). Specimens were collected at light just prior to rain or during rain and before midnight. Parque Nacional Cusuco is unusual in Honduras for having a high number of undescribed species of Rutelinae and probably many other undescribed plant and animal species. The isolated nature of the Sierra de Omoa has resulted in a high rate of endemism including *Plusiotis cusuquensis* Curoe (Rutelinae: Rutelini) and a new genus and species of Ithonidae (Neuroptera) (Penny 1996).

Taxonomic Considerations

Viridimicus omoaensis expands the definition of the genus and requires an emendation to the key to genera in the subtribe Areodina (Jameson 1990). Previously, the genus *Viridimicus* was characterized as having a clypeus that is semicircular, diverging slightly from the base and being widest at the middle. The parabolic form of the clypeal apex in *V. omoaensis* requires a modified definition of the clypeus for the genus *Viridimicus*. The generic description for *Viridimicus* should be amended to include a clypeus that is semicircular (diverging slightly from the base and widest at the middle) *or* a clypeus that is sinuate laterally and converging apically toward a parabolic apex. The parabolic form of the clypeal apex is also observed in some populations of *Parabyrsopolis chihuahuae* (Bates), the taxon most closely related to species of *Viridimicus* (Jameson 1990). In some populations of *P. chihuahaue* (*e.g.*, those in Arizona, USA) the clypeal apex is rounded, and in other populations (*e.g.*, those in Jalisco, Mexico) the clypeal apex is truncate. Although there is overlap between the two genera for this character, the genera are separated based on the following characters: (1) presence of metallic green coloration in males in *Viridimicus* (absent in *Parabyrsopolis*), and (2) form of the male genitalia that are rounded at the apex (truncate in *Parabysopolis*). Due to the expanded definition of the genus, the key to the genera of Areodina (Jameson 1990) requires alteration at couplet 9:

9\. Males metallic green; females metallic green, dark brown, or black. Parameres rounded apically. Central Mexico to Honduras .... *Viridimicus* Jameson

9′ Males and females reddish-brown, brown, or black. Parameres truncate apically. Southern Arizona to central Mexico ..... *Parabyrsopolis* Ohaus

Key to the Species of *Viridimicus*

(Modified from Jameson 1990)

1 Protarsus with inner claw enlarged and apically split. Abdomen ventrally flat or concave (Males) 2

1′ Protarsus with inner claw not enlarged or apically split. Abdomen ventrally swollen or convex (Females) ... (known for only three species) 8

2 Protarsus with apex of third tarsomere ventrally emarginate; stout seta arising from emargination 3

2′ Protarsus with apex of third tarsomere ventrally entire, not emarginate; stout seta arising from ventral disc of tarsomere .... *V. cyanochlorus* Jameson

3 Mandibles broadly exposed and flattened (not concave) in dorsal view (Fig. 2–3) 4

3′ Mandibles narrowly exposed or hidden and weakly concave in dorsal view (Fig. 1) 5

4 Clypeus with apex semicircular (Fig. 3) .... *V. ratcliffei* Jameson

4′ Clypeus with apex parabolic (Fig. 2) .... *V. omoaensis* Jameson, new species

5 Pronotum laterally with large and confluent punctures or rugopunctate. Color of pronotum reddish-brown with brassy green reflections (under illumination and magnification) .... *V. unitus* Jameson

5′ Pronotum laterally with punctures moderate or moderately large, punctures not confluent; not rugopunctate. Color of pronotum dark metallic green to brassy green (under illumination and magnification) 6

6 Disc of pronotum sparsely punctate, punctures small .... *V. impunctatus* Jameson

6′ Disc of pronotum moderately densely punctate, punctures moderately large (dense) and small (sparse) 7

7 Disc of pygidium finely, confluently punctate. Discal regions of clypeus and frons with large punctures generally separated by 1 puncture diameter .... *V. nigroaeneus* (Bates)

7′ Disc of pygidium moderately, densely punctate, not confluent. Discal regions of clypeus and frons confluently punctate .... *V. aurescens* (Bates)

8 Mandibles narrowly exposed or hidden, concave in dorsal view (Fig. 1) 9

8′ Mandibles broadly exposed and flat in dorsal view (Fig. 2–3) 10

9 Disc of pronotum sparsely punctate, punctures small. Color of pronotum shining dark green; color of head opaque, black .... *V. impunctatus* Jameson

9′ Disc of pronotum moderately densely punctate, punctures moderately large. Color of pronotum and head piceous to brown with weak metallic green reflections .... *V. aurescens* (Bates)

10 Clypeus with apex semicircular (Fig. 3) .... *V. ratcliffei* Jameson

10′ Clypeus with apex parabolic (Fig. 2) .... *V. omoaensis* Jameson, new species

Biogeographic Considerations

With the addition of *V. omoaensis*, the genus *Viridimicus* is now composed of seven species. Species in the genus are distributed from the Transverse Volcanic Belt in central Mexico to Honduras (the genus was previously recorded only as far south as central Guatemala). They inhabit pine-oak forests from elevations of 1,500 to 2,300 m. Three species, *V. aurescens*, *V. nigroaneus*, and *V. omoaensis*, occur south of the isthmus of Tehuantepec in Mexico. Three species, *V. ratcliffei*, *V. cyanochlorus*, and *V. impunctatus*, occur north of the isthmus of Tehuantepec. The locale for *V. unitus* in Mexico remains unknown but is probably north of the isthmus of Tehuantepec. From Tehuantepec to Honduras, the mountain regions that comprise the Central American Nucleus form a fairly continuous mountain system, especially from southern Mexico to southeastern Guatemala. From southeastern Guatemala to eastern Honduras the Central American Nucleus is dissected, and, in the northern and eastern portions of Honduras (as well as northern Nicaragua), there are several small, isolated mountain "islands." One of these "islands" is the Sierra de Omoa (2,242 m) in the northwesternmost portion of Honduras. The Sierra de Omoa is part of the Cordillera del Norte, one of the oldest geological zones in Honduras that includes three ranges: Sierra de Espiritu Santo, Sierra de Omoa, and Sierra de Nombre de Dios (Portillo 1984). Unlike the Cordillera Central that was formed during the Cretaceous era, this region was formed during the Paleozoic and Mesozoic eras (Portillo 1984). Within the Cordillera del Norte, the Sierra de Omoa is isolated by the valleys of the Rio Motagua (to the west), Rio Ulúa (to the east), and Gulfo de Honduras to the north. Three mountains lie to the south: Cerro Santa Barbara (2,835 m) about 40 km to the south, Sierra Gallinero (2,285 m) about 50 km to the southwest, and Cerro Pico Pijol (2,282 m) about 65 km to the southeast. The distances between these mountains and the deep river valleys serve to isolate the Sierra de Omoa. The isolated nature of the Sierra de Omoa probably promoted divergence from the ancestral populations of *Viridimicus*.

In comparison to the Cordillera de Norte, the Cordillera Central forms a relatively contiguous mountainous region from southern Mexico to Honduras. Rather than isolating populations (as with *V. omoaensis*), these mountains have served to maintain lineage cohesiveness in populations of *Viridimicus*. I have studied many specimens of *Viridimicus* from the areas of Mexico (Chiapas), Guatemala, and Honduras in the Central American Nucleus. In comparison to the description of *V. aurescens* provided in Jameson (1990), I have noted variations in: form of the clypeal apex (semicircular to semiovate and weakly reflexed to moderately reflexed), punctation of the discal regions of the clypeus and frons (confluently punctate or nearly so), punctation of the pronotum (moderately dense to densely punctate [not confluent]), punctation of the elytral intervals (moderately densely punctate, punctures small to moderate, some transverse or weakly transversely rugose), distribution of the setae on the lateral edge of the elytra (extending from mid-elytra to elytral apex or at apex only), density and length of the setae on the lateral edge of the elytra (moderately dense to dense; moderately long to long), the form of the sculpturing of the pygidium (moderately to densely punctate, punctures not confluent), and the density and length of the pygidial setae (moderately dense to dense; moderately long to long). These character variations are not substantial or consistent differences. I believe that these variations reflect subpopulations of *V. aurescens* and do not warrant designation of new species or subspecies. All specimens that I studied appear to be conspecific with *V. aurescens*. This hypothesis is further substantiated by the geography of the area that allows for gene flow within and between subpopulations of *V. aurescens*.

The possibility exists that populations of ancestral *Viridimicus* may have become isolated in regions such as the Sierra de Dipicto y Jalapa (on the border between Honduras and Nicaragua), Cordillera Nombre de Dios (northernmost Honduras), Sierra Gallinero (western Honduras near the border of Guatemala), or other regions in Mesoamerica. These regions and many others are still largely unexplored entomologically. Knowledge of the flora and fauna of these regions is needed to supplement our relatively poor understanding of biodiversity and evolutionary patterns throughout Mesoamerica.

New Locality Notes on *Viridimicus* Species

Viridimicus aurescens (Bates)

Viridimicus aurescens is distributed from Chiapas, Mexico to Honduras in pine-oak forest from 1,850 to 2,300 m elevation. In addition to localities provided in Jameson (1990), *Viridimicus aurescens* also occurs in the following newly recorded localities. The record of this species from the coastal, lowland location of Lancetilla in Honduras (Fig. 4) may be in error or may refer to a locality near Montaña del Tiburón approximately 15 km from Lancetilla.

Guatemala. *Baja Verapaz*: Cerro del Mono (8 rd. km N. of San Lorenzo, 2150m), Posada Montana del Quetzal [hotel at La Union Barrios], Purulhá (8 km S., 1,600 m; 5 km E.), Salamá (17 km N., 1,700 m, flight intercept trap), Zacapa Biotopo de Quetzal. *El Quiché*: Chugeza, Chopol. *Sacatepéquez*: Cerro Alux (2,260 m, 2,300 m), Sn. Lucas, Vol. Agua (N. slope, 7,000 ft.).

Honduras. *Atlantida*: Lancetilla. *Francisco Morazán*: Tegucigalpa (30 km E.), Cerro Uyuca (1,800 m), Zamorano (12 km W.), Cerro Uyuca (1,870 m, 14°92′N, 87°05′W, ex. flight intercept trap), P.N. La Tigra. *Intibucá*: El Tabor, La Esperanza (~2,000 m). Ocotepeque: R.B. Guisayote. *Olancho*: Parq. Nac. La Muralla (1,450 m). New Country Record.

Viridimicus cyanochlorus Jameson

The female of *V. cyanochlorus* remains undescribed. An additional male specimen was collected under logs in the following locality:
Mexico. Oaxaca: San José del Pacifico (Rte. 175, 3.2 km S., 2,440 m).

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A NEW GENERIC SYNONYM IN THE AUSTRALIAN LUCANIDAE (COLEOPTERA)

C. A. M. REID
Centre for Biodiversity and Conservation Research
Australian Museum, 6 College street
Sydney, NSW 2000
Australia

Abstract

The Australian lucanid genus *Eucarteria* Lea is placed in junior **new synonymy** with *Cacostomus* Newman. The sister-taxon of *Cacostomus* is identified as *Casignetus* Macleay, from South America. A new name, Casignetini, is given for the tribe Pholidotini Kikuta, which is based on a junior homonym. A key is provided for the species of *Cacostomus*.

Recent collecting of Lucanidae in New South Wales, Australia, allows reassessment of some taxa. In this paper the status of two endemic genera is revised and the recently discovered female of one species diagnosed.

Status of the genus *Eucarteria* Lea

Eucarteria Lea was erected for a single small lucanid species differentiated from *Cacostomus* Newman by the latter's "very different mandibles and a scaly body" (Lea 1914:252). Lea was only describing the male mandibles and a second species of *Eucarteria* has recently been described which has prominent dorsal scales (Moore 1994). Both Lea and Moore have noted that *Eucarteria* is most closely related to *Cacostomus.*

I have examined all three species associated with these names and, apart from the normal characteristics of the Lucaninae, the following attributes are shared: (i) broad adpressed scales present, at least adjacent to eyes and on ventral surfaces; (ii) eye split into two by narrow lobe which meets triangular extension of hind margin of eye; (iii) female head without prominent dorsal tubercle; (iv) antennae with broad, densely setose three-segmented club; (v) male mandibles feebly or greatly elongated, but asymmetric; (vi) female mandible keeled on outer upper edge, almost to base; (vii) female mandible with 1–2 internal subapical teeth; (viii) mentum sclerotised and semicircular; (ix) submentum slightly reflexed at apex; (x) pronotum strongly expanded at middle, excavate or sharply attenuated at hind angles; (xi) sides of pronotum crenulate and entirely margined; (xii) prosternal process strongly arcuate between coxae, with narrow postmedian ridge; (xiii) apex of prosternal process trilobed around tips of hypomera; (xiv) mesosternum not excavate anteriorly and not abruptly raised; (xv) mid and hind tibiae canaliculate, with several longitudinal grooves; (xvi) male mid and hind tibiae without spines on outer edge; (xvii) outer edges of female mid and hind tibiae without or with short triangular median spines; (xviii) male mid tibia with strongly curved broad apical spur; (xix) tarsal empodium short, only just projecting beyond tibial apex; (xx) everted endophallus with broad strap-like flagellum much longer than aedeagus; (xxi) dorsal edge of parameres deeply excised.

The male of *E. floralis* Lea has dense setae on the internal faces of the mandibles, absent from the other species, but similar to species of *Lamprima* Latreille and *Rhyssonotus* Macleay. There are no obvious differences between *Eucarteria* and *Cacostomus* apart from length (<13 mm in *Eucarteria* and >10 mm in *Cacostomus*) and male mandibular shape, both notoriously useless characters in Lucanidae. Therefore the following classification is proposed, revised from the most recent catalogue of Australian lucanid species (Moore and Cassis 1992).

Cacostomus **Newman**

= *Eucarteria* Lea, **new synonymy**
C. floralis (Lea), **new combination**
C. squamosus Newman
C. subvittatus (Moore), **new combination**

The sister-taxon of *Cacostomus* is probably *Casignetus* Macleay, from South America (both sexes of *C. spixi* (Perty) and *C. humboldti* (Gyllenhal) examined), which was redescribed by Weinreich (1963). Kikuta (1986) placed *Cacostomus* together with the South American genus *Casignetus* Macleay (as *Pholidotus* Macleay, nec Brisson) in a new tribe, Pholidotini, the name of which is based on a junior homonym and therefore unavailable (Martinez and Martinez 1974). If this is a valid tribe, the correct name should be Casignetini (**new name**). The morphological evidence strongly supports placement of these genera as sister-taxa, but I see no compelling reason for isolating them as a tribe.

The species of *Casignetus* have the following attributes not found in *Cacostomus*: posterior margin of the eye not triangularly produced; female head medially raised on anterior margin; mesosternum strongly excavate anteriorly; outer edge of female mid and hind tibiae with short spine ⅔ from base; empodium elongate, projecting well beyond apex of tibia; parameres parallel-sided, without deep excision. These differences may be considered sufficient for discrimination of *Casignetus* and *Cacostomus* as separate genera, but clearly the *Cacostomus-Casignetus* generic pair is yet another Gondwanan link between Australian and South American Lucanidae.

Female of *Cacostomus subvittatus* (Moore)

Moore (1994), in describing this species, noted that all of the material at his disposal was male. The female has recently been described (Krake 1998) from two specimens, one of which I have examined. It differs from the male by several characters, including the following: body black to dark reddish-brown, with paler sides of elytra but overall dark brassy-green reflection; antennae, palpi, tibiae and tarsi dark red, the latter with black apices; scale-like setae suberect, but parallel-sided, much longer than broad, not conspicuous, present at eyes, anterior margin and posterior corners of pronotum, scutellum, anterior of epipleura, prosternum, hypomeron, meso- and metepimera; mandibles shorter, outer edges gently curved towards apex from sharp basal angulation, each with single median tooth on inner edge; sides of pronotum less strongly crenulate and hind angles evenly constricted to base, not excavate; anterior tibia much shorter, greatest breadth equal to half length. The specimen is 6mm long.

The female of *C. floralis* is similar, but differs in its paler, shinier and less densely punctured pronotum and elytra, which lack scales.

Key to species of *Cacostomus* Newman

1 Male mandibles with at least 5 elongate blunt tubercles on inner margins; female mandibles with broad double-pointed blunt tubercle in inner margins; canthus (ridge dividing eye) tapering posteriorly, thus head almost parallel-sided; both sexes with upper surfaces covered in adpressed broad scales (may be partly worn off); length 11–25 mm; northern New South Wales to north Queensland .... *C. squamosus* Newman

1′ Male mandibles with 1–3 sharp tubercles on inner margins; female mandibles with single sharp tooth on inner margins; canthus broad throughout, head broadest at eyes; without broad scales on elytra, or scales sparse and suberect; length 6–12 mm; central New South Wales 2

2(1) Male: broad scales absent from pronotum and elytra; upper surface shining, more finely punctured and paler brown, with clear yellowish vitta on each elytron; female: without scales on pronotum or elytra ... . *C. floralis* (Lea)

2′ Male: broad suberect scales present on pronotum and elytra; upper surface dull, more coarsely punctured and darker brown, with vague paler vitta on each elytron; female: scales present on anterior margin and posterior corners of pronotum and at least edges of elytra .. .. *C. subvittatus* (Moore)

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A NEW *CALATHUS* BONELLI (COLEOPTERA: CARABIDAE: PTEROSTICHINI) FROM THE RIF MOUNTAINS (MOROCCO)

FRANCISCO NOVOA
Departamento de Biología Animal, Facultad de Biología
Universidad de Santiago de Compostela
15706 Santiago de Compostela
Spain

Abstract

A **new species** of *Calathus* Bonelli, *C. atitari*, is described from the Rif Mountains (Morocco). The type locality is: Telassemtane Wood, Bab Taza (Chefchauen). Among Moroccan *Calathus*, *C.atitari* is close to *C. opacus* Lucas considering that both share small pubescence in antennomere 3, rectangular pronotal hind angles and internal sac of penis armed with a tooth. On the other hand, *C. atitari* is differentiated from *C. opacus* by the slightly sinuated sides of pronotum and the structure of penis, with apex clearly curved downwards. The species was found under stones in a wood of *Abies maroccana* Trabut.

Resumen

Se describe una nueva especie de *Calathus*, *C. atitari*, de las Montañas del Rif (Marruecos). La localidad típica es: Bosque de Telassemtane, Bab Taza (Xauen). Entre los *Calathus* marroquíes, *C. atitari* es próximo a *C. opacus* Lucas porque ambos tienen pubescencia diminuta en el antenómero 3, los ángulos posteriores del pronoto rectangulares y el saco interno del pene armado con un diente. Por otro lado, *C. atitari* se diferencia de *C. opacus* por los lados del pronoto ligeramente sinuados y por la estructura del pene, con el ápice claramente recurvado ventralmente. La especie apareció bajo piedras en un bosque de *Abies maroccana* Trabut.

Among the Carabidae collected by the author in 1995 and 1996 in the western part of the Rif Mountains, near Bab Taza (Morocco), were several specimens of *Calathus* Bonelli belonging to an unknown species, the description of which is the object of this paper.

Calathus atitari, new species

Type Series. Holotype: Morocco. Telassemtane Wood, Bab Taza, Chefchauen, 35°8′ North latitude, 5°8′ West longitude. A male, collected by F. Novoa on 23rd April 1996, 1,700 m altitude. Deposited in the Museo Nacional de Ciencias Naturales, Madrid (Spain). Paratypes: same locality and collector: a male, collected on 21-5-95; 4 males collected on 23-4-96; a male on 26-4-96; a female on 21-5-95; 3 females on 23-4-96; 2 females on 26-4-96. Deposited in F. Novoa collection in the Departamento de Biología Animal, Universidad de Santiago de Compostela, Spain.

Diagnosis. Appearance between a *Calathus* and a small *Laemostenus* (Bonelli); pronotum with rectangular hind angles; elytrae with smooth external surface, without setigerous punctures on 5th stria; penis with apex spatulate, curved downwards in side view.

Description. Length 10–12 mm. Body dark brown, almost black, with antennae, palps, legs and pronotal sides paler. Elytra dull, with smooth aspect. Hind wings absent. Dorsal habitus as in Figure 1. Antennae with antennomere 1 and 2, except for the ordinary apical setae, glabrous. Antennomere 3 with 2–3 small setae located in the middle, apart from the apical setae. The other segments with oblique pubescence. Pronotum trapezoi-

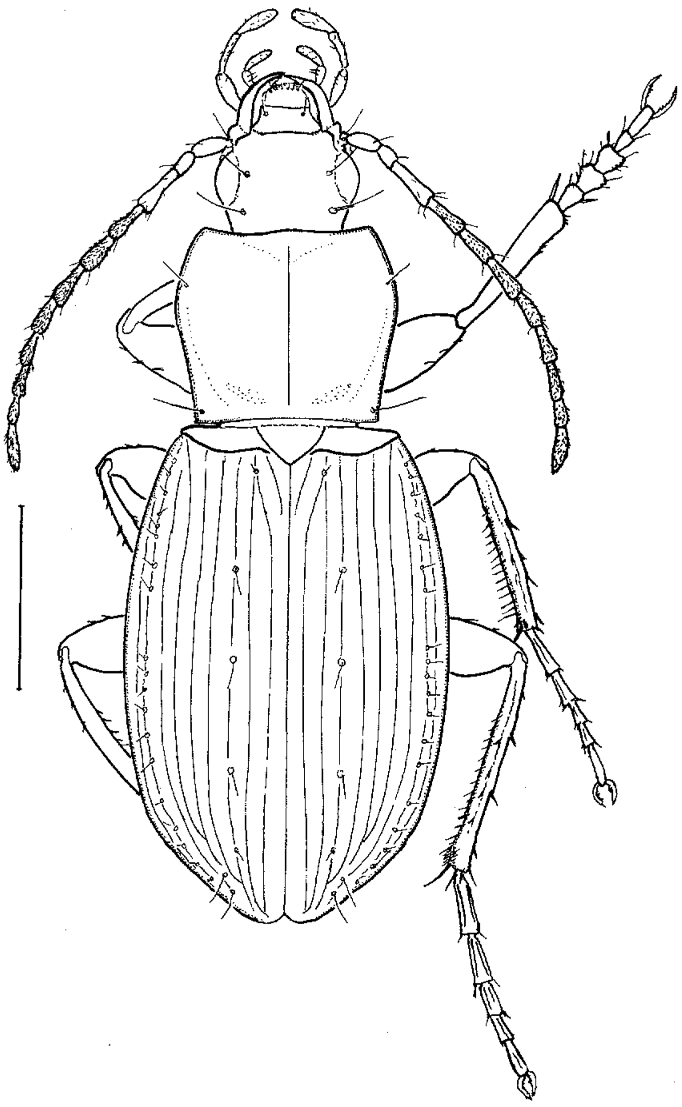
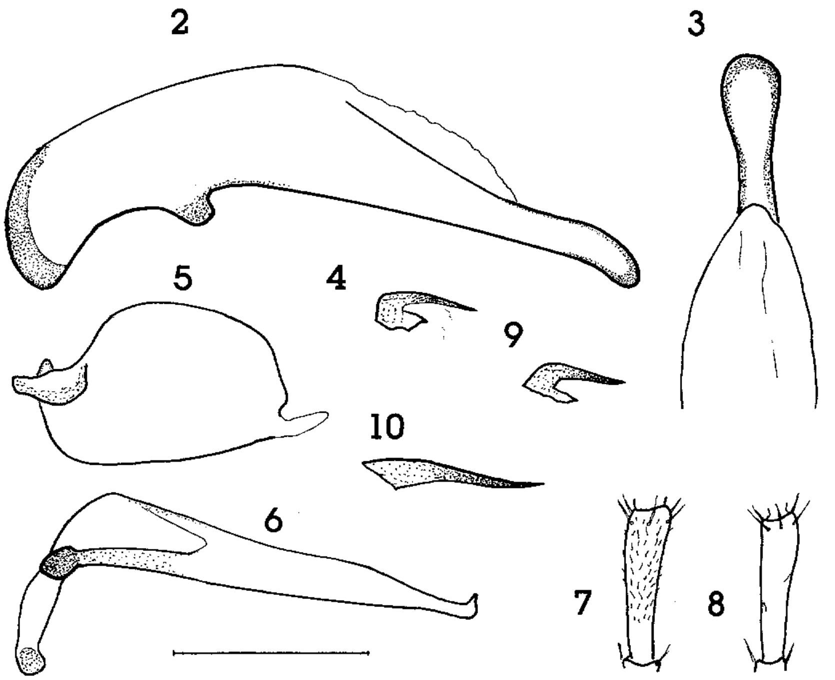


Fig. 1. Dorsal habitus of *Calathus atitari*, paratype. Scale bar: 2 mm.

dal, 1.2 times as broad as long; little prominent front angles; sides little rounded in their anterior part, slightly convergent in basal half, greatest width before middle, slightly sinuate before the sharp, almost rectangular, hind angles. Basal foveae of pronotum clearly impressed, slightly wrinkled, not punctate. Elytra wider than pronotal base, elliptic in outline, 1.7 times as long as wide, its greatest width after middle, then progressively narrower toward apex. Elytral surface with isodiametric microreticulation and silky appearance in both sexes. Humeral angles not projecting forward, with a minute tooth. Striae thin and intervals flat. Scutellar stria in the first interval; one basal seta near the



Figs. 2–10. **2**) Penis (left lateral view) of *Calathus atitari,* paratype; **3**) apex of penis (dorsal view), same; **4**) tooth of internal sac, same; **5**) Left paramere, same; **6**) right paramere, same; **7**) antennomere 3 of *Calathus opacus* (Telassemtane, Maroc); **8**) antennomere 3 of *C. atitari,* paratype; **9**) tooth of internal sac of *Calathus granatensis* (Zamora, Spain); **10**) tooth of internal sac of *C. opacus* (Telassemtane, Maroc). Scale bar: 1 mm.

origin of first stria; 3 setigerous punctures, sometimes 4, on third stria; stria 7 with 2 setae in apical part and a umbilicate series on stria 8. Middle and hind tibiae with a row of fine spines on inner border. Male protarsi with first three segments dilated, carrying two rows of scales underneath. Tarsomere 1 triangular, 1.6 times longer than wide in distal border; tarsomeres 2 and 3 pentagonal. Middle and hind tarsi with first three segments furrowed in both sides. Metaepisterna with anterior border longer than internal one. Ratio: 1.1. Penis with keeled basal bulb and spatulated apex bent ventrad (Figs. 2–3). Internal sac provided with minute spines and a sclerotized tooth, the latter in a base with a right-angled directed spine (Fig. 4). Left paramere oval (Fig. 5). Right paramere long and slender, hooked at apex (Fig. 6).

Distribution. The species is known only from Telassemtane Wood, located on the sides of Jbel Lacraa, in the West Rif Mountains. It is possibly a hypsobiont species, typical from the upper limit of wood.

Etymology. This species is named for Mustafa Atitar, veterinary surgeon living in Tangier, who first introduced me to the Chefchauen Mountains.

Ecological Note. The species was found in a wood of *Abies maroccana* Trabut. The specimens were living under stones, together with other Carabidae species, as *Calathus opacus* Lucas, and were especially abundant in the melting snow during spring.

Discussion

According to Antoine (1957), eight *Calathus* species live in Morocco. Kocher (1963) reduces them to seven, considering *C. rhaticus* Antoine of subspecific rank.

Among Moroccan *Calathus*, *C. atitari* is clearly differentiated from *C. fuscipes* by the lack of punctures on stria 5, and from *C. circumseptus* by the presence of a bifid tooth in the anterior border of the mentum. By the presence of a straight elytral base, with humeral angles not projecting forward, *C. atitari* is differentiated from *C. semisericeus* Fairmare and *C. solieri* Bassi, although it shares with them the appearance of a small *Laemostenus*. *Calathus atitari* is differentiated from the Moroccan *C. melanocephalus* group of species, that is, *C. melanocephalus* (Linnaeus), *C. mollis* (Marsham) and *C. rhaticus*, by the well marked and rectangular pronotal hind angles, and by its length, up to 9 mm.

The main differences between *C. atitari* and *C. opacus* are given in the following couplet.

1 Sides of pronotum not sinuated in front of hind angles. Antennomere 3 with diminute pubescence, apart from distal end setae (Fig. 7). Male protarsi with segments 2 and 3 triangular. Penis with spatulate apex slightly bent ventrad (Antoine 1957, Fig. 48). Appearance of a typical .. *C. opacus*

1′ Sides of pronotum slightly sinuated in front of hind angles. Antennomere 3 with only 2–3 diminute setae located in middle, apart from distal end setae (Fig. 8). Male protarsi with segments 2 and 3 pentagonal (Fig. 1). Penis with spatulated apex clearly curved downwards (Fig. 2). Slight appearance of *Laemostenus* .... *C. atitari*

Because no attempt was made to subdivide West Palearctic *Calathus* into subgenera, it is difficult to establish the relationships of new taxa. Nevertheless, *C. atitari* is close to *C. opacus* considering that both share rectangular pronotal hind angles, middle and hind tibiae with a row of fine spines on inner border and internal sac of penis armed with a sclerotized tooth. Indeed, Antoine (1957) noted the presence of a small pubescence in the middle and apical part of antennomere 3 in *C. opacus* as a specific feature. *Calathus atitari* also presents small pubescence in antennomere 3 though limited to 2–3 setae.

On the other hand Putzeys (1873) considered *C. opacus* close to the Iberian *C. granatensis* Vuillefroy, based on the pronotal form and the arrangement of setae on stria 3. In addition the penis type is similar in both species, with a spatulated apex. The penis of *C. atitari* is specific, but is spatulated at the apex and toothed on the internal sac as *C. granatensis* (Fig. 9) and *C. opacus* (Fig. 10).

The presence of a tooth on the internal sac of the penis and the absence of external furrows on female protarsi in *C. atitari* set this species apart from *Lauricalathus* Machado, that live in the Canary Islands and Madeira.

Acknowledgments

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BOOK REVIEW

P. JOLIVET AND M. COX, EDITORS. 1996. **Chrysomelidae Biology.** SPB Academic Publishing bv. Volume 1: 444 pp. ($175 US). Available from SPB Academic Publishing, P.. Box 11188, 1001 GD Amsterdam, The Netherlands, Fax: (31-20) 6 38-0524, Email: kugler@pi.net. For USA/Canada: c/o Demos Vermande, Order Dept., 386 Park Ave. South, Suite 201, New York, NY 10016 USA, Fax: (212) -68333-0118.

This is the third and most comprehensive compilation about the Chrysomelidae edited by Dr. Jolivet and others. It reflects the renaissance biologist approach to a group of organisms typified by the career of the senior editor and the organizational and editorial talents of the junior editor. Each volume features a general area of biology and is further divided into parts according to the subject matter of the papers. Many of the papers are review articles and some are comprehensive, while some concern restricted topics. Some representative chapters are reviewed below.

Volume 1: The Classification, Phylogeny and Genetics: Classification section is a good comprehensive historical review of the literature pertaining to chrysomelid classification (Suzuki). It is sometimes confusing to understand this author's comparison of traditional Linnaean classification and his own polyphyletic origin theories of the chrysomeloids as well as comparisons between ranking and classification. The **Phylogeny** section begins with another review chapter with helpful perspectives and interpretations on the phylogenetic systems of the Chrysomelidae (Schmitt) contained in past publications on chrysomelid classification and interpreted in a phylogenetic context, often based on information contained in the keys of older works. Schmitt points out problems in phylogenetic interpretations such as weighting of characters, subjectivity, polarizing characters, hiding the lack of knowledge by changes in names or ranks, etc. This section also contains a disappointing treatment (Crowson and Crowson) of the Galerucinae and Alticinae "phylogentic relations" based on few exemplars of these large and diverse subfamilies using speculation about polarity of a few characters. Although they seem to prefer to lump these two large subfamilies, they actually conclude by saying the distinction between Galerucinae and Alticinae is based on too few genera of both adults and larvae. Cox provides a useful review of pupal characters for 25 bruchid and 382 chrysomelid species. **Genetics and evolution** has a good review of insecticide resistance in the Colorado Potato Beetle (Bishop and Grafius) which stresses that resistance evolves rapidly and independently, especially in local populations. This versatile and pestiferous chrysomelid can retain previously-evolved mechanisms for resistance while evolving new ones, thus increasing its resistance capabilities through time. Chrysomelinae distribution and origin are discussed and a new genus described by Daccordi. The description of a new genus (*Palaeomela*) described from a single specimen is unusually brief and does not provide much information. It is not explained why he compares endemic Chrysomelinae and Galerucinae (including Alticinae) in an attempt to show Gondwanian origins of the Chrysomelinae. Some selected morphologically unusual genera from each zoogeographic region are listed and used to explain zoogeographic patterns through shared morphology. Ancestral characters are used to explain ancestral distributions and the center of origin is presumed to be where there are the most taxa with primitive characters; however, these kind of assumptions are often not true [reviewer].

David G. Furth. *Department of Entomology, Smithsonian Institution, Washington, D. C. 20560-0165 USA.*

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A NEW SPECIES OF *LIGNYODES* DEJEAN (SUBGENUS *CHIONANTHOBIUS* PIERCE) FROM COSTA RICA (CURCULIONIDAE)

ROBERT S. ANDERSON
Research Division
Canadian Museum of Nature
P.O. Box 3443, Station D,
Ottawa, ON. K1P 6P4
Canada

Abstract

A new tychiine weevil, *Lignyodes* (*Chionanthobius*) *ripleyi*, **new species,** from Guanacaste Conservation Area in Costa Rica is described and illustrated. The new species closely resembles *L.* (*C.*) *schwarzi* (Pierce) from the eastern United States of America. This is the first recorded species of the subgenus *Chionanthobius* from Central America. No information is available on the natural history of *L.* (*C.*) *ripleyi* although it is suspected to be associated with Oleaceae.

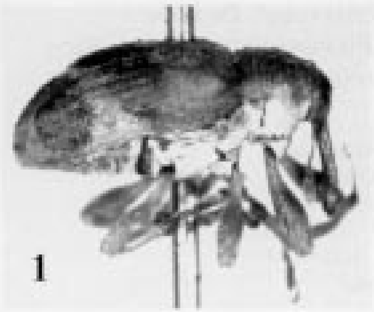
The genus *Chionanthobius* was proposed by Pierce (1912) to accomodate *Chionanthobius schwarzi* Pierce from the eastern United States of America. Clark and Anderson (1981) and Clark (1981) added two additional species, *C. autumnalis* Clark from Texas and *C. darlingtoni* Clark from Cuba. Subsequently, Clark (1982) reclassified *Chionanthobius* as a subgenus of *Lignyodes* along with *Neotylopterus* Hustache and *Lignyodes,* s.s.

In the process of sorting and curating the extensive collections of Costa Rican Curculionidae in the collections at the Instituto Nacional de Biodiversidad (INBio) in 1995 and 1996, specimens of a fourth species of the subgenus *Chionanthobius* were discovered. The purpose of this paper is to describe this new species and to discuss its relationships to the three previously described species in this subgenus.

Lignyodes (*Chionanthobius*) *ripleyi* Anderson, **new species**

Figs. 1–3

Description. Male, length 5.1–5.3 mm, width 2.5–2.9 mm. Female, length 5.5–5.8 mm, width 2.9–3.0 mm. Head. Eyes separated by diameter of 1–2 eye facets in male, 2–3 eyes facets in female. Rostrum of male slender, straight; in dorsal view apical ⅓ slightly wider than basal ⅔. Rostrum of female slender, very slightly curved ventrally throughout length; in dorsal view very slightly wider apically. Rostrum of both sexes with row of fine, distinct punctures immediately dorsad of antennal scrobe, punctures extended onto dorsum of rostrum only near base, otherwise rostrum with only scattered very fine punctures or impunctate. Rostrum lacking sulci or carinae, smooth and evenly rounded dorsally; yellowish recumbent fine elongate setae present near base only. Antennae inserted at apical ⅓ in male, apical ⅖ in female. Pronotum slightly wider than long, strongly constricted subapically; dorsally with vestiture of golden-yellow elongate-narrow recumbent scales; flanks with scales similar but white in color. Elytra in dorsal view with humeri prominent; lateral margins convergent from humeri to elytral apices. Posterior tubercles prominent; intervals flat, with vestiture of elongate-narrow recumbent (suberect in posterior ½ of sutural interval) scales. Scales of striae more oval in form, recumbent. Scales white, dark golden brown, light golden brown, and black; black scales



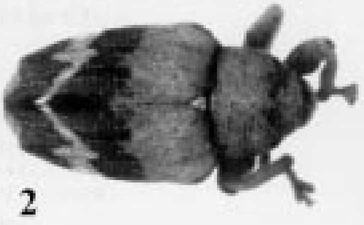


Fig. 1. Lateral habitus (male) of *Lignyodes ripleyi.*
Fig. 2. Dorsal habitus (male) of *Lignyodes ripleyi.*

concentrated in posterior ⅓ of sutural interval, otherwise intermixed with dark golden brown scales in two zig-zag transverse bands, separated at apical ⅓ by narrow zig-zag band of mixed white and light golden brown scales. Scales at elytral apex uniformly light golden brown. Legs with femora stout; front femora unarmed, middle and hind femora with small subacute swelling or tooth on inner margin at apical ⅓; vestiture of mixed recumbent light golden brown and white scales. Metatibia with moderately long, acute apical uncus. Genitalia of male with median lobe subequal in width throughout length; apex somewhat produced and evenly rounded; internal sac with two rows of large laminate spines interconnected anteriorly by small sclerotized "tube-like" structure. Genitalia of female not dissected.

Type Series. Holotype male labelled "Estac. Cacao, 1000–1400m/SW side Volcan Cacao/Guanac. Pr. COSTA RICA/Malaise Tp, 1988–1989/GNP Biodiv. Survey/323300,375700" and barcode label 40809 (INBio). Allotype female labelled "Estac. Cacao,1000–1400m/Lado suroeste del Volcan/Cacao Prov. Guan./COSTA RICA, II curso/Parataxon., Jun 1990./L-N 323300,375700" and barcode label 255018 (INBio). Paratypes (2 males, 4 females). Two males, 2 females labelled as holotype (one label in Spanish), and barcode labels 75452, 40618, 40812, 258341 (CMNC, INBio). Two females labelled "Est. Maritza, 600m, lado/O Vol. Orosi, Prov./Guanacaste, Costa Rica/Tp. malaise, Ene a abr/1992, L-N 326900,373000" and barcode labels 377556, 377557 (INBio).

Derivation of Specific Name. This species is named for Catherine G. Ripley on the occasion of her departure from the Publishing Division of the Canadian Museum of Nature.

Relationships. *Lignyodes ripleyi* appears closely related to *L. schwarzi* as the two species share large size, similar elytral scale patterns, "toothed" femora, and similar shape of the aedeagus and sclerotization of the internal sac. *Lignyodes ripleyi* can be distinguished from *L. schwarzi* by its disjunct geographical distribution; rostrum evenly rounded and smooth, lacking dorsal sulci; pronotum with scales on flanks white; elytra with posterior tubercles prom-

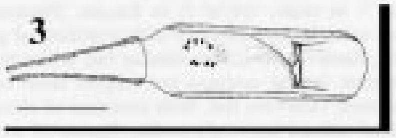


Fig. 3. Dorsal view of aedeagus of *Lignyodes ripleyi.* Scale line = 0.5 mm.

inent; apex of the aedeagus rounded and produced, and "tube-like" sclerotization of the internal sac.

Natural History. There is no information available on the natural history of *L. ripleyi*. Some species in the subgenus *Chionanthobius* are associated with species of Oleaceae. Host plants of *Lignyodes schwarzi* are *Chionanthus virginica* L. and *Osmanthus americanus* (L.) Benth. and Hook. f. ex. Gray, while *Forestiera ligustrina* (Michx.) Poir. is the host of *L. autumnalis*. No hosts are known for the Cuban *L. darlingtoni* although it is suspected that it may prove to be a species of *Forestiera* (Clark 1981).

Revised key to species of *Lignyodes* (*Chionanthobius*)

1 At least middle and hind femora with tooth (tooth may be small); body length greater than 4.0 2
1′ All femora lacking tooth; body length less than 4.0 mm 3
2 Pronotum with flanks with dense white scales; elytra with posterior tubercles well-developed; male with aedeagus with apex produced, rounded .... *L. ripleyi* Anderson
2′ Pronotum with flanks with dense golden brown scales; elytra with posterior tubercles slightly developed; male with aedeagus with apex truncate .... *L. schwarzi* (Pierce)
3 Dorsal and ventral scrobal margins lacking carinae; pronotum with lateromedian vittae of fulvous to fulvoferruginous scales .... *L. autumnalis* (Clark)
3′ Dorsal and ventral scrobal margins carinate; pronotum with pallid whitish scales .... *L. darlingtoni* (Clark)

Acknowledgments

I thank Angel Solis of the Instituto Nacional deBiodiversidad (INBio) in Costa Rica for the loan of specimens. François Genier prepared the line drawing.

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Clark, W. E. and. D. M. Anderson. 1981. The genus *Chionanthobius* Pierce (Coleoptera: Curculionidae): Descriptions of a new species on *Forestiera* (Oleaceae) and of the larva and pupa of *C. schwarzi* Pierce. Proceedings of the Entomological Society of Washington 83:185–197.

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SCIENTIFIC NOTE

New Information on the Natural History of Diabrotica scutellata Jacoby (Chrysomelidae: Luperini)

Knowledge of host plant relationships in the genus *Diabrotica* Chevrolat, especially for the Neotropical species, is scarce since the larval stage is root feeding, and adults and larvae do not necessarily have the same host plants (T. F. Branson and J. L. Krysan, 1981. Environmental Entomology 10:826–831; J. L. Krysan, and R. F. Smith, 1987. Entomography (5):375–484; A. Eben and M. E. Barbercheck, 1996. Acta Zoologica Mexicana 67:47–65). An important ecological trait shared by *D. scutellata* with many other species in the group is the association of adult beetles with certain Cucurbitaceae (reviewed by R. L. Metcalf, 1994 [pp. 153–166], In: Novel Aspects of the Biology of Chrysomelidae. [M. L. Cox, editor] Kluwer, Dordrecht). Based on a bioassay, using field collected beetles, I concluded that both, larvae and adults of *D. scutellata* are potentially feeding on bitter cucurbits. In the field, beetles are seasonally abundant on wild *Cucurbita martinezii* L. Bailey, and seldom found on other hosts (A. Eben and M.E. Barbercheck, 1996. *loc cit.*). Furthermore, I collected *D. scutellata* repeatedly (1993, 1995, 1996, 1998, early 1999) from *C. martinezii* during the winter months in several locations in Veracruz, Mexico. Occasionally, during the winter, I found *D. scutellata* in the flowers of *Brugmansia candida* Pers. (Solanaceae) together with various species of the multivoltine, polyphagous, *fucata* group. This indicates that adults of this species are present throughout the year. These observations together with results of earlier bioassays (A. Eben, M. E. Barbercheck and M. Aluja, 1997. Entomologia experimentalis et applicata 82:53–62) suggest that the life history traits of *D. scutellata* are not typical for a species in the *virgifera* group (*i.e.*, univoltinism and oligophagy on Gramineae). It might rather be a multivoltine species, with polyphagous feeding habits in the adult stage and potential larval development on the roots of cucurbits. The species in the *virgifera* group were assigned using exclusively morphological characters (J. L. Krysan and R. F. Smith, *loc cit.*). These authors, however, had biological information only for six species distributed in the U.S.A. Information on larval hosts was available for four of them (J. L. Krysan, pers. comm.). Based on the four best known species it was concluded that univoltinism and feeding on Gramineae might be common traits for the entire *virgifera* group (J. L. Krysan, pers. comm.). Instead, the *virgifera* group might be comprised of both univoltine, oligophagous and multivoltine, polyphagous species.

With their review Krysan and Smith (1987, *loc cit.*) provided a reference for species which seem to fit in the *virgifera* group. Further studies on larval host plants, voltinism and diapause stages for this and other Mexican species of the *virgifera* group will be necessary to confirm my hypothesis. A phylogeny of the group is needed to definitely decide the systematic placement of *D. scutellata* and other Neotropical Diabroticite species.

I am grateful to Dr. James L. Krysan for providing valuable comments on my ideas.

***Astrid Eben**, Instituto de Ecología, A.C., Km 2.5 Carretera Antigua a Coatepec, 91000 Xalapa, Veracruz, Mexico*

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TWO NEW SAPRININE HISTERIDAE FROM SOUTHWESTERN NORTH AMERICA (COLEOPTERA: HYDROPHILOIDEA)

PETER W. KOVARIK
Entomology/Biocontrol
Florida A&M University
Tallahassee, FL 32307-4100, U.S.A.

DAVID S. VERITY
7346 West 83rd Street
Los Angeles, CA 90045-2452, U.S.A.

AND

JOHN C. MITCHELL
M.A.R.C. The Ohio State University
125 South Oval Mall
Columbus, OH 43210-1397, U.S.A.

Abstract

Two new saprinine histerids are described and illustrated for the first time: *Pachylopus rossi*, **new species,** a wrack-inhabiting species from Baja California and Sonora, Mexico, and *Geomysaprinus saulnieri*, **new species,** a rodent burrow-inhabiting species from California, Arizona, and Texas.

In a paper in which he described four species new to North America, Mazur (1991) commented that the North American histerid fauna "is still not recognized completely." This is truly an understatement. The widespread use of modern passive trapping techniques, such as the flight intercept and Lindgren funnel traps, have yielded many undescribed species of hister beetles, some literally in the yards of collectors. Also, a resurgence of interest in sampling insects inhabiting the burrows of mammals and reptiles has likewise yielded a number of undescribed species.

The existence of both species described in this paper has been known for quite some time. In the case of *P. rossi*, specimens were collected nearly 60 years ago. Both species are distinctive but can be assigned to existing genera with only a slight degree of difficulty. Problems regarding generic placement are covered in the discussion.

Materials and Methods

Select male specimens of both species were dissected for the purpose of examining and illustrating the fine structure of the terminalia. Terminalia were cleared in lactic acid, dissected apart and mounted in depression slides with Hoyers' medium. Terminalia were studied and illustrated with a Wild M-20 compound microscope fitted with camera lucida. Specimens intended for SEM were cleaned by sonication in Windex®. Specimens were then transferred to 100% ethanol and subsequently air dried on filter paper. Specimens were then attached with white glue to the flattened and bent end of a #000 insect pins cut to the length of about a centimeter. The mounted beetles were then secured in micro clips mounted on a large aluminum stub. Adjustments in specimen orientation were made via a surgical clamp. Specimens were gold/palladium sputter-coated and photographed using a J.E.O.L. Model JSM-820 S.E.M., operating at 20 kV.

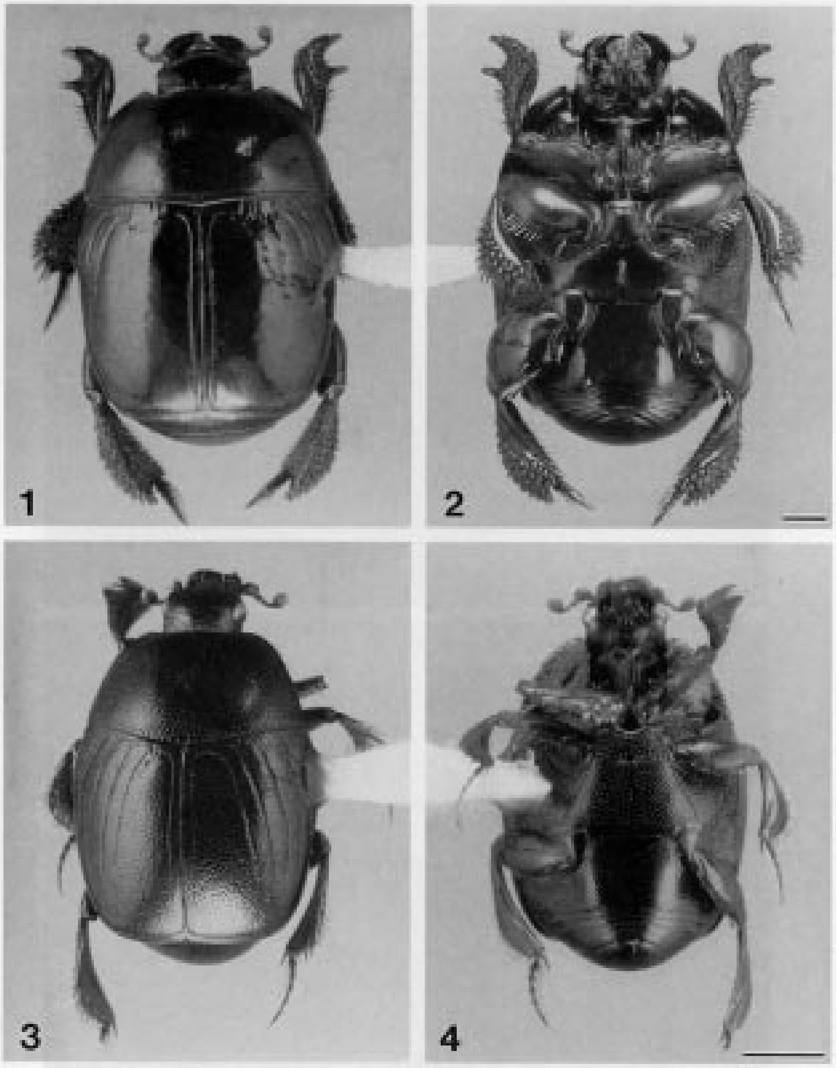
Most morphological terminology for external features essentially follows Wenzel (1941, 1944). Terminology used for surface sculpture was adopted from Harris (1979). Aedeagal terminology follows Lawrence and Britton (1991). Some terminology for the component structures of the male internal abdominal segments VIII and IX is new. In male histerids, segment VIII is typically composed of a relatively large tergite (TE) and a pair of ventral distally articulated processes or coxites (CX). Coxites often bear minute setae laterally, longer setae apically, and in some taxa styli are present. In some taxa, coxites are extremely elongate and appear to play a role in mating by embracing the pygidial area of the female abdomen during copulation. Paired inflatable pubescent (velar) membranes are borne on the inner surface of coxites in *Onthophilus* Leach and some saprinine genera. When inflated, these structures apparently assist males in gaining purchase during copulation. The morphology of the male tergite is variable. The posterior margins are occasionally emarginate and in some cases the emargination is extreme, producing lateral tergal extensions or tails. The tergite often bears minute setae and cuticular cavities.

The segment IX of male histerids may or may not resemble the general structure of the preceding segment. A notable difference is the repositioning and apparent fusion of the coxites which form a dorsal coxal carapace (CC). This structure is longitudinally bisected by a suture in *Onthophilus* and is notably absent in some taxa. The carapace generally bears prominent setae along its distal margin and occasionally a velar membrane. The morphology of tergite IX is variable. In saprinines this structure is proximally emarginate and tailed. In most histerines and some tribalines, this tergite is dorsomesally subdivided with the resulting plates variably reduced. Segment IX has a ventral sclerite, or spiculum gastrale (SG), which is variable in structure. This structure is commonly long and slender and expanded at one or both ends.

Geomysaprinus saulnieri Kovarik and Verity, **new species**

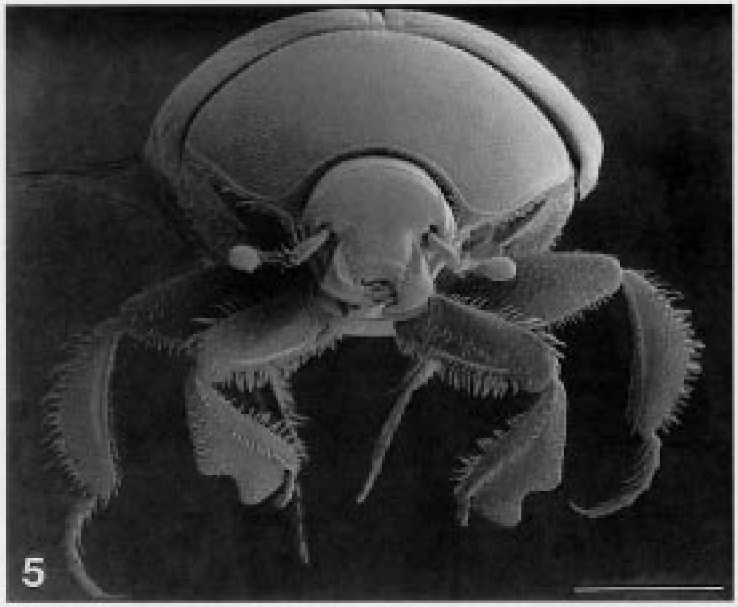
Figs. 3–5, 7–15

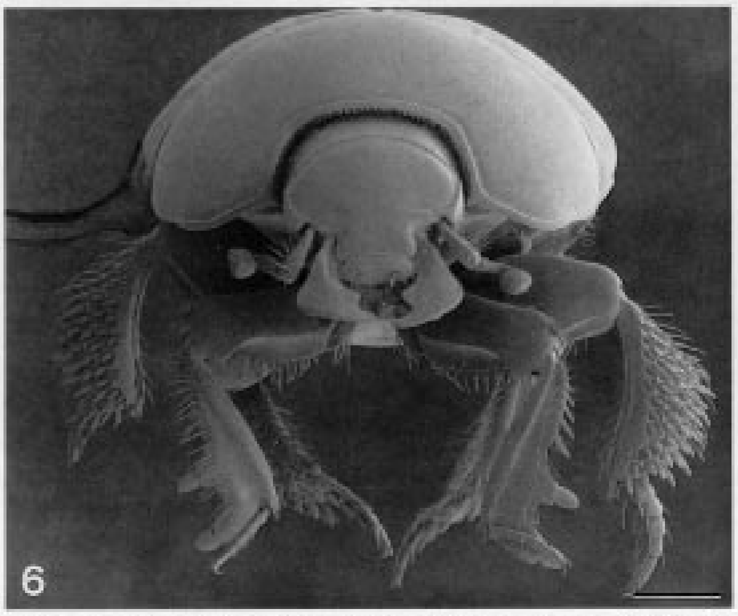
Description. Length: 3.53 mm, range 4.10–2.70; width 2.79 mm, range 3.20–2.00; (n = 49). Body outline (dorsal) oval. Color: Body piceous, appendages reddish brown. Head: Surfaces finely punctate; punctures on vertex, each bearing very short, squamiform amber setae. Frontal stria interrupted mesally, appearing as 2 short, weak, lateral carinae; supraorbital stria present but weak. Pronotum: Disk punctate, punctures along the posterior margin coarser and deeper than remainder; marginal pronotal stria present and complete; lateral stria absent. Elytra: Surface more or less finely punctate; dorsal striae 1–4 distinct and extending posteriorly approximately 0.33 elytral length and curving strongly mesad anteriorly; sutural stria distinct, complete, and forming an arch anteriorly in conjunction with dorsal stria 4; oblique humeral stria distinct and complete; external subhumeral distinct and incomplete, slightly less than 0.50 elytral length and roughly centered along longitudinal axis; marginal elytral stria distinct and very short, extending posteriorly slightly less than 0.25 elytral length; marginal epipleural stria complete, extending mesad both anteriorly and posteriorly; scutellar mirrors undifferentiated. Propygidium: Densely punctate. Pygidium: Coarsely and densely punctate. Prosternum: Anterior margin slightly convex; cuticle between carinal and lateroprosternal stria finely strigulate with dash-like punctures; carinal striae anteriorly convergent, nearly reaching



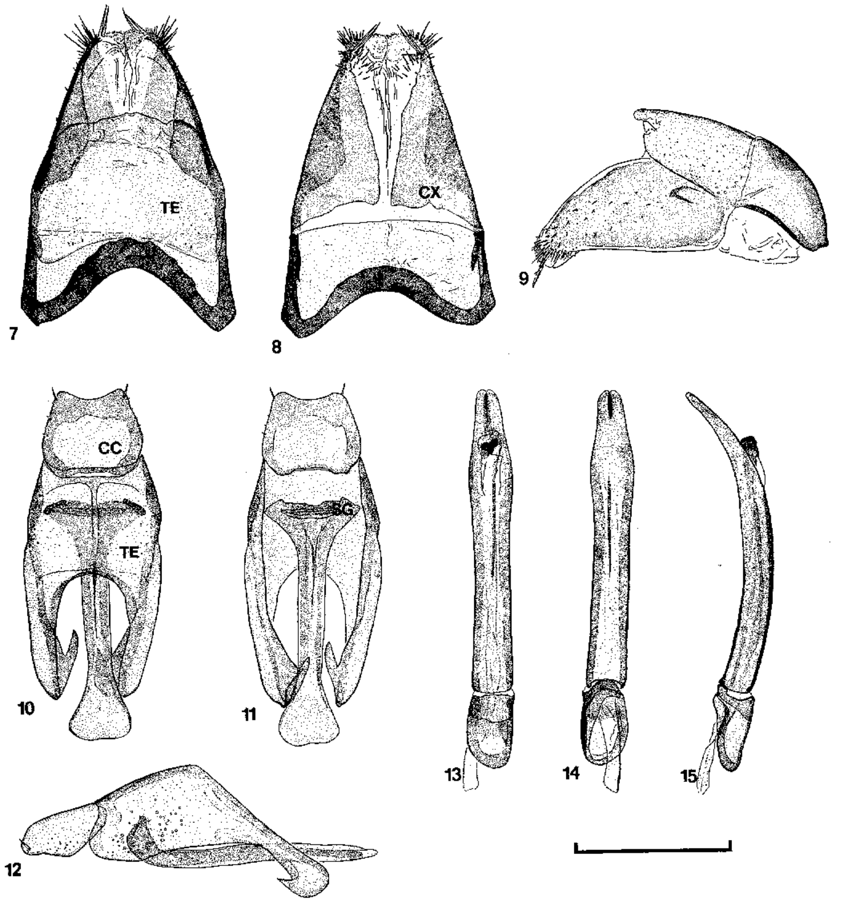
Figs. 1–4. *Pachylopus rossi* and *Geomysaprinus saulnieri*. **1)** *P. rossi* dorsal habitus; **2)** ventral habitus. **3)** *G. saulnieri* dorsal habitus; **4)** ventral habitus. Line scales = 1.0 mm.

the anterior margin of the prosternum; cuticle between striae punctate; antennal cavities relatively well-developed; hypomera finely strigulate and bearing elongate shallow punctures, some joined and each with a moderately long recumbent amber seta. Mesosternum: Approximately 4× as wide as long, trapezoidal with anterior margin slightly emarginate; nearly uniformly coarsely punctate, punctures bearing scale like amber setae; marginal mesosternal stria distinct and posteriorly arcuate; meso-metasternal stria transverse. Mesepimeron: Somewhat areolate and sparsely setose. Metasternum: Nearly uniformly coarsely punctate; longitudinal metasternal stria distinct and complete; lateral metasternal





Figs. 5–6. *Geomysaprinus saulnieri* and *Pachylopus rossi*. **5**) *G. saulnieri* head on habitus; **6**) *P. rossi* head on habitus. Line scales = 1.0 mm.



Figs. 7–15. *Geomysaprinus saulnieri,* ♂ terminalia. **7**) Eighth segment, dorsal view; **8**) ventral view; **9**) lateral view. **10**) Ninth segment dorsal view; **11**) ventral view; **12**) lateral view. **13**) Aedeagus, dorsal view; **14**) ventral view; **15**) lateral view. Line scale = 0.5 mm.

stria distinct, complete, and nearly reaching metacoxae; post-mesocoxal stria complete. Metepisternum and metepimeron: Uniformly foveolate, punctures shallow and generally bearing short to moderately long recumbent amber setae. Abdominal sternites: Area between lateral abdominal striae punctate; areas laterad of these sutures obscurely variolate, depressions usually with short recumbent amber setae; remaining sternites mesally punctate and laterally variolate, lateral depressions each bearing very short recumbent amber seta. Legs: Procoxa strigulate. Profemur roughly rectangular; anterior surface strigulate and posterior surface obscurely variolate with each shallow depression bearing short recumbent amber seta; anteroventral surface with several short recumbent amber setae and with minute amber setae anterodorsally; dorsal margin bearing fringe of relatively long, evenly spaced, curved amber setae; dorsal margin of femoral groove fringed with fine, evenly spaced amber setae; ventral margin of profemur and trochanter densely fringed with straight and somewhat thickened amber setae. Protibia broad, somewhat right triangulate, and with outer margin obtusely notched; anterior surface immediately laterad to tarsal groove smoothly and finely strigate; remainder of anterior surface obscurely variolate with most of the pits bearing short to relatively long recumbent amber setae, lateral margin with two obtuse projections bearing small circular spines apically which do not protrude beyond tibial margin; surface just mesad of tarsal groove bearing fringe of relatively short setae; posteromesal margin with fairly dense fringe of short erect amber setae. Tarsal claws of all legs unevenly developed with outer claw very small and inconspicuous and about a fifth as long as inner claw; inner claw relatively long and curved. Meso- and metafemora elongate-oval and obscurely variolate with each depression bearing very short or minute amber seta; ventral margin fringed with short and straight amber setae; dorsal margin with quasi fringe of minute, curved, amber setae. Meso- and metatibia somewhat crescent shaped with inner margin finely strigate and other areas somewhat variolate. Male Terminalia (Figs.7–15): Eighth segment (Figs. 7–9), tergite dorsum about as long as broad, emarginate proximally, somewhat membranous distally, and armed with minute setae dorsolaterally and laterally, coxites about as long as tergite, ventrally contiguous and membranous ventromesally, each bearing minute lateral setae and a cluster of short ventroapical setae, two apical setae on each side longer and more stout than others; velar membrane present apically. Ninth segment (Figs. 10–12) distinctly capsular; tergite entire, deeply emarginate proximally, armed dorsolaterally and laterally with minute setae and associated cuticular cavities; proximal tergal processes with terminal barb-like extensions; coxal carapace relatively short, about as long as wide; lateral margin armed with minute setae and with two short setae just shy of apex. Spiculum gastrale elongate, greatly expanded distally and slightly expanded proximally. Aedeagus (Figs. 13–15) relatively elongate and narrow with tubular phallobase; parameres about 5× as long as phallobase, parallel-sided except towards apex where a slight expansion is followed by slight tapering; apex superficially bisected.

Diagnosis. The obtusely notched outer margin of the protibia coupled with its ciliate hypomera are sufficient to separate this species from all known *Geomysaprinus* Ross.

Type Series. Holotype ♂: Deposited in the Field Museum of Natural History Collection labeled: USA:AZ: Maricopa County, Bush Hwy. at bridge over Salt River, i.2–7-1995, sand dunes, human dung trap in *Thomomys* bottae burrow, W. B. Warner, leg. Paratypes (76): United States: **Arizona:** Maricopa County, Bush Hwy. at bridge over Salt River, 15–20.I.1995, B. C. & W. B. Warner, sand dunes, *Thomomys bottae* burrow (10, PWKC); 2–7.I.1995 (5, FMNH); 26.II–4.III.1995 (7, PWKC); 12–19.II.1995 (9, PWKC) 4–11.III.1995 (1, PWKC); 1–2.I.1995 (1, PWKC); 19–26.II.1995, ex. black pitfall trap in gopher pushup (1, PWKC). **California:** Riverside Co: Bautista Canyon 7 mi SE Hemet, 29.II.1972, J. Saulnier, ex. gopher burrow (4, DSVC); Rt. 10, 22.9 mi. from San Bernardino County line, 7.IV.1973, *Thomomys bottae* burrow (2, DSVC); 1.5 mi. W. Jct. Rt. 31 & Riv. Rd., 25.XI.1972, R. Anderson, D. Frack, J. Saulnier, *Thomomys bottae* burrow (3, DSVC); La Quinta, 30.IX.1984–17.III.1985, D. S. Verity, ethylene glycol pit trap (1, DSVC); 1.I–18.II.1996, ethylene glycol pit trap at top of dune (1, DSVC); 1–15.XI.1998, ethylene glycol pit trap at top of mesquite dune (2, DSVC); 15–26.XI.1998, ethylene glycol pit trap at top of mesquite dune (10, DSVC) 26.XI–24.XII.1998, ethylene glycol pit trap at top of mesquite dune (5, DSVC). San Bernardino County: vineyards east of Ontario, 27.I.1973, J. Saulnier, *Spermophilus beecheyi* burrow (6, DSVC); vineyards E of Ontario, 16.I.1974, J. Saulnier, *Thomomys bottae* burrow (2, DSVC); Arrowhead Lake Rd., 5 mi SE Hesperia, 23.III.1973, *Thomomys bottae* burrow (1, DSVC); 9 mi. N, 10 mi. E Ridgecrest, 3000', 15.II–12.IV.1981, D. Guiliani, antifreeze pit trap on sand dune among *Oryzopsis* (1, CDAE); San Diego Co: Rt. 78, 70 mi. fr. Jct. Rt. 5 (Scissors X-ing), nest chamber of *Thomomys bottae,* R. F. Anderson, coll. (1, DSVC); Mason Valley, 8.XII.1974, J. Saulnier, collector, *Thomomys bottae* burrow (1, DSVC). **Texas:** El Paso Co: Borderland Rd. 0.3 mi W Hwy. 20, 12.III.1997, Godwin & Wappes, ex. *Geomys* nest/dung chambers (2, JWC).

Etymology. This species is named in honor of aphodiine scarab specialist Jim Saulnier who collected the first specimens of this species. Jim's intensive sampling of mammal burrows in the western U.S. has yielded significant information concerning the insects inhabiting this unusual microhabitat.

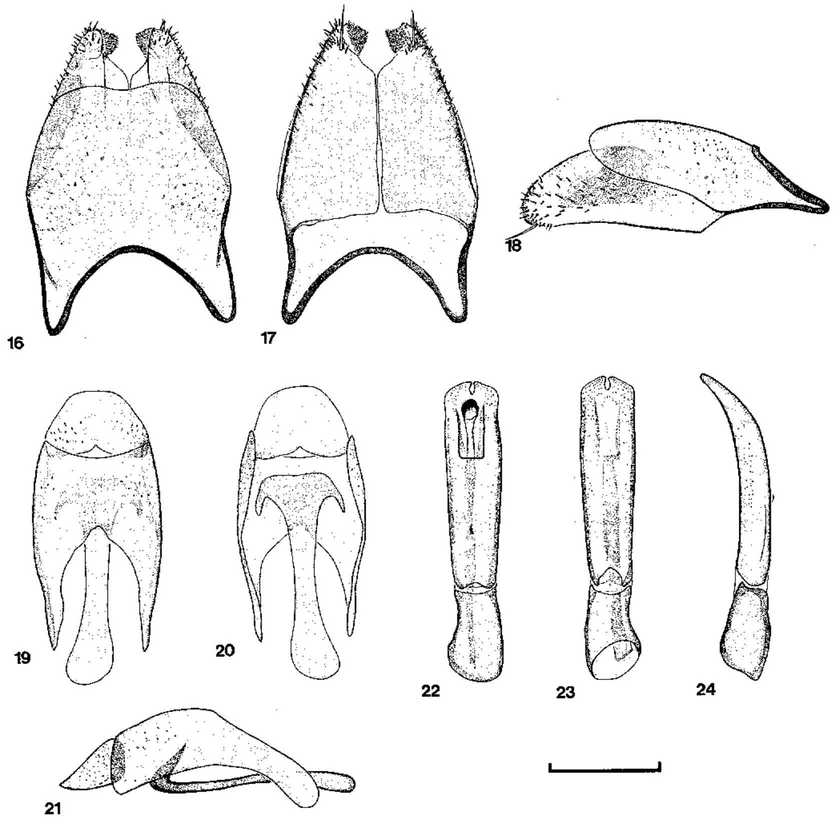
Biology/Ecology. In Maricopa County, Arizona, *G. saulnieri* occurs in *Thomomys bottae* (Eydoux and Gervais) burrows in sandy loam in unconsolidated riparian sand dunes bordering the Salt River. *Geomysaprinus saulnieri* was apparently absent from *T. bottae* burrows in the vicinity of Sunflower, AZ. This latter site is slightly higher in elevation and has granitic gravel or clay-like soils. It was also absent from *T. bottae* burrows in loamy soil in yards in Phoenix and Glendale (W. B. Warner, pers. comm.). In El Paso, County, Texas, *G. saulnieri* inhabits the burrows of *Geomys arenarius* Merriam (W. Godwin, pers. comm.). Although commonly found in pocket gopher burrows, *G. saulnieri* appears not to be restricted to this microhabitat. Four specimens of this species were collected from burrows of the ground squirrel *Spermophilus beecheyi* (Richardson) in San Bernardino County, California, by J. Saulnier.

Remarks. The collection localities of *G. saulnieri* are shown in Figure 25.

Pachylopus rossi Kovarik and Verity, **new species**

Figs. 1, 2, 6, 16–24

Description. Length: 4.93 mm, range 5.80–4.00; width 3.86 mm, range 4.50–3.20; (n = 13). Body outline (dorsal) oval. Color: Light to dark brown. Head: Frons generally glabrous; post occiput setigerously punctate. Frontal stria mesally interrupted, appearing as 2 short, weak, lateral carinae; supraorbital stria complete. Pronotum: Disk generally glabrous, but occasionally punctate along marginal pronotal stria; marginal pronotal stria variable but generally nearly complete with short central interruption; lateral stria generally absent but faintly indicated in some specimens. Elytra: Glabrous; dorsal striae 0–4, if present striae generally indistinct and extending posteriorly approximately 0.25 elytral length; a short transverse stria is present along anterior margin of elytra in between dorsal striae 1 & 4; sutural stria complete, extending anterolaterally approximately 0.5 times elytral width, extending posterolaterally to unite with external subhumeral stria; oblique humeral stria present and complete; external subhumeral complete and extending anteromesally approximately 0.25 times elytral width; scutellar mirrors undifferentiated. Propygidium: Shallowly punctate. Pygidium: Generally shallowly punctate. Prosternum: Anterior margin generally acutely protruding mesally; keel finely strigulate and medially bisected by an acute and anteriorly sloping ridge; antennal cavities relatively shallow; lateral prosternal and carinal striae absent; hypomera glabrous. Mesosternum: Approximately as wide as long, roughly quadrate, laterally emarginate, and with anterior margin outwardly angulate; area anterior to marginal mesosternal stria finely strigulate; area posterior to suture occasionally punctate in anterior half; marginal mesosternal stria straight; meso-metasternal stria outwardly angulate. Mesepimeron: Strigulate and foveolate, each fovea bearing short seta at ventral margin. Metasternum: Mostly glabrous with some punctures posterolaterally along metacoxal border; longitudinal metasternal stria forming furrow bisecting metasternum; lateral metasternal stria relatively short, slightly shorter than meso-metasternal stria; post-mesocoxal stria present but extremely abbreviated. Metepisternum and metepimeron: Strigulate and foveolate. Abdominal sternites: Area between lateral abdominal striae glabrous; areas laterad of these striae strigulate and foveolate; remaining sternites with some lateral foveolation. Legs: Procoxae strigulate. Profemora approximately rectangular with anterior surface strigulate and posterior surface rugose and strigulate, dorsal and ventral margins of profemora and ventral border of protrochanter fringed with relatively long, flexible, amber setae. Protibia some-



Figs. 16–24. *Pachylopus rossi,* ♂ terminalia. **16**) Eighth segment, dorsal view; **17**) ventral view; **18**) lateral view. **19**) Ninth segment, dorsal view; **20**) ventral view; **21**) lateral view. **22**) Aedeagus dorsal view; **23**) ventral view; **24**) lateral view. Line scale = 0.5 mm.

what flattened and distally expanded; anterior surface strigulate and posterior surface strongly rugose with uniform covering of regularly spaced, short, stout amber spines; tibia fringed laterally with relatively long flexible amber setae arising on upper surface near margin, proximal half of lateral margin bearing stout regularly spaced amber spines increasing in length and diameter distally; distal half of lateral margin with two large, ovoid, amber spurs; tibia fringed mesally with flexible amber setae increasing in length and diameter distally as well as four stout amber spines near mesoapical margin; distal margin bearing four stout amber spines, the lateral most is larger and egg shaped. Protarsomeres of ♂ each bearing a single elongate, flattened, squamiform hair ventrodistally; ♀ tarsomeres each bearing 2 minute spinules ventrodistally. Meso- and metafemora swollen and ovoid, glabrous and bearing fringe of long, flexible, amber setae along ventral margin. Meso- and metatibia thickened and expanded distally, thus appearing sub-triangulate; outer surface foveolate and echinate; inner surface strigate and bearing some relatively long and fine setae; outer margin with two setal fringes; fringe along margin consisting of slender and regularly spaced amber spines increasing in length and diameter distally; second fringe just behind margin consisting of very long, fine and relatively widely spaced amber setae; inner margin with fringe of progressively lengthening fine amber setae. Male Terminalia (Figs. 16–24): Eighth segment (Figs. 16–18). Tergite dorsum slightly longer than broad and emarginate proximally, feebly emarginate distally, and armed with minute setae dorsolaterally and laterally. Coxites slightly shorter than tergite and ventrally contiguous; coxites each bearing minute lateral and apical setae; one apical setae on each side relatively long and stout; velar membrane present apically. Ninth segment (Figs. 19–21) distinctly capsular. Tergite entire and deeply emarginate proximally; surface sparsely covered both dorsolaterally and laterally with minute setae and associated cuticular cavities; proximal tergal processes apically rounded. Coxal carapace relatively short, longer than broad and armed laterally and dorsolaterally with minute setae. Spiculum gastrale elongate, expanded distally and slightly expanded proximally; apices of distal expansion recurved. Aedeagus (Figs. 22–24) somewhat broad and short with tubular phallobase; parameres about 2× as long as phallobase and parallel-sided except at apex where they taper abruptly; apex notched.

Diagnosis. The only New World species that *P. rossi* might be confused with is *Neopachylopus sulcifrons* (Mannerheim); indeed, *P. rossi* shares many characters in common with *Neopachylopus* Reichardt, including the acutely carinate knife-like prosernal keel and the reduction or lack of carinal striae. However, *N. sulcifrons* differs from *P. rossi* by virtue of having a complete frontal stria on the head and an additional arcuate stria above the frontal (supraorbital stria) as well as a punctate pronotum and elytra. *Pachylopus rossi* resembles the Afrotropical *P. dispar* Erichson with its glabrous pronotum and elytra but *P. dispar* differs from it in having a complete frontal and suprafrontal striae, reduced flattened spurs at the apex of the protibial teeth, and a setose prosternal keel. Perhaps the most obvious difference between *P. rossi* and *P. dispar* is that the latter species is sexually dimorphic. The females of *P. dispar* differ from the males in having a truncate projection on the posterior margin of the first apparent abdominal segment that overlies the remainder of the abdominal segments. In addition, the posterior margin of each elytron of female *P. dispar* bears an acute mesad extension. These characters are absent in males of this species.

Type Series. Holotype: male in the California Academy of Sciences Collection labeled: "La Paz, L. Cal., 18.VII.1938, E. S. Ross," and an additional label with "on beach dry sea lettuce." Paratypes (14): Mexico: **Baja California:** Bahia Santa Maria, 24 mi. S. San Felipe, 24.II.1970, under dead sea bird at high tide line, D. S. Verity (1, DSVC); 1 mi. S. Bahia de Los Angeles, 12.VI.1967, E. L. Sleeper and E. M. Fisher (2, CASC); Bahia de Los Angeles, 13.VI.1977, D. S. Verity, under decayed seaweed (1, DSVC). **Baja California Sur:** 12mi. S. Santa Rosalia, 27.VI.1928, Michelbacher & Ross (one of these with "under stone on beach" label) (3, CASC); **Sonora:** Cholla Bay, 9.VI.1973, K. Stephan (1, FMNH); La Cholla, 29.V.1955, F. H. Parker (1, DSVC); Punta Chueca, 15.III.1981, Werner & Olson, under seagrass (3, UAIC); Punta Cirrio, 16.III.1981, D. B. Thomas, collector, sandy beach under sea-weed (1, UAIC). A paratype will be deposited in the collection of the Universidad Nacional Autónoma de México.

Etymology. This species is named in honor of Dr. Edward S. Ross of the California Academy of Sciences who collected *P. rossi* in the late 1930's and recognized that it was undescribed. A world renowned specialist on Embiidina, Dr. Ross began his entomological career working on histerid beetles.

Biology/Ecology. *Pachylopus dispar* is one of several histerid species which are apparently restricted to marine shorelines. The majority of the specimens of *P. rossi* were collected beneath wrack. It is likely that this species preys on wrack-associated dipteran larvae.

Fig 25. Collection localities for *Geomysaprinus saulnieri* and *Pachylopus rossi* in North America.

Remarks. The collection localities of *P. rossi* are shown in Figure 25.

Discussion

At one point the genus *Pachylopus* Erichson included a number of apparently unrelated species. The diagnostic character of the genus was an expanded and densely spinose meso- and metatibia. In revising this genus, Reichardt

(1926) was aware that nearly identical modifications of meso- and metatibiae occur in several unrelated species of psammophilous scarabs and a species of darkling beetle. Accordingly, he surmised that this character was likely convergent and selected other characters such as prosternal morphology, external sculpture and striation, and fimbriation of the body margin for his revision. He narrowly redefined *Pachylopus,* retaining only a single species, the South African *P. dispar*; all other species were moved to existing genera or to several new ones he established in his revision.

There are, however, problems with some of the characters Reichardt (1926) used in his revision of *Pachylopus.* Recent unpublished phylogenetic studies on the Onthophilinae and Tribalinae by one of the authors (Kovarik) and revisions of species groups in the genus *Hister* L. by Caterino (1998, 1999), indicate that external sculpture and striation often vary considerably within a genus. Likewise, fimbriation of the body margin is apparently an adaptation to psammophily and is a common feature among sand-dwelling beetles including histerids, tenebrionids, scarabs, and weevils. M. S. Caterino (pers. comm.) has found that ciliate hypomera has arisen numerous times in *Hister.* These factors invariably weaken support for Reichardt's (1926) classification and complicates placement of new species into existing genera with any confidence.

Our decision to place *P. rossi* in the formerly monotypic genus *Pachylopus* was based on a number of putative synapomorphies it shares with *P. dispar* and several of the former species of *Pachylopus* (unpublished data). These include an extremely reduced prosternal keel lacking both fovea and distinct carinal and lateral striae, similarities in protibial dentition, an elongate spatuliform process arising ventrally on the last segment of the middle and hind tarsi, and paired sensory plaques on the antennal club.

The genus *Geomysaprinus* is presently divided into two subgenera, *Geomysaprinus* and *Priscosaprinus* Wenzel. The subgenus *Geomysaprinus* is characterized by the presence of a lateral longitudinal rugulosity on the pronotum and a longitudinal sulcus on the pygidium. Since *G. saulnieri* has neither of these characters, it falls within the subgenus *Priscosaprinus.* However, Rupert Wenzel (pers. comm.) considers *G. saulnieri* sufficiently distinct from known species of either subgenus of *Geomysaprinus* to warrant the establishment of a new subgenus for this species. We decided that formal recognition of a new subgenus, if warranted, should wait until the group is revised.

Acknowledgments

We wish to thank the following institutions and individuals for the loan of specimens for this study: Rupert Wenzel, Field Museum of Natural History, Carl Olson, University of Arizona, Tucson, David Kavanaugh, California Academy of Sciences, and Fred Andrews, California Food and Agriculture Collection, and James Wappes. We also wish to thank Bill Warner for collecting the lion's share of paratypes, and reviewing this manuscript. Thanks are due to Kim Summers, Derek Sikes, and Mike Caterino for manuscript review.

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Lee Herman
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BOOK REVIEW

P. Jolivet and M. Cox, Editors. 1996. **Chrysomelidae Biology.** SPB Academic Publishing bv. Volume 2: 465 pp. ($184 US). Available from SPB Academic Publishing, P. Box 11188, 1001 GD Amsterdam, The Netherlands, Fax: (31-20) 6 38-0524, Email: kugler@pi.net. For USA/Canada: c/o Demos Vermande, Order Dept., 386 Park Ave. South, Suite 201, New York, NY 10016 USA, Fax: (212)-68333-0118.

Volume 2: Ecological Studies: This volume has three sections, plus miscellaneous some chapters. **Natural Enemies/Defenses/Control of population size:** Cassidine defenses and natural enemies (Olmstead) stresses that the selective pressures of predation and parasitism may have produced the large variety of defense mechanisms. A variety of defense mechanisms are discussed, such as in the egg (e.g., excrement coating, cases, maternal care), larvae (e.g., feces, aggregation, maternal care), pupae (e.g., fecal shield, cryptic colors), and adult (e.g., elytral shield structure with tarsal pads, apposematic color). There is a very helpful table of predators, parasites, and pathogens with references for the Cassidinae. She points out that the Cassidinae may be highly exposed to predation and parasitism due to their sedentary nature and predictable feeding habits. There are useful reviews of chrysomelid predators (Cox) and of fungal pathogens (Humber). Reviews of the life history of the alder Leaf Beetle (Bauer and Rank); cannabalism in Chrysomelidae (Mafra-Neto and Jolivet), and pyrrolizidine alkaloids in *Oreina* (Pasteels et al.) are of more specific interest. Chrysomelidae of the subfamily Clytrinae as models for mimicry complexes (Hespenheide) studied 21 species of clytrines with shared pattern aspects in Arizona together with beetles in several other families and in two groups: desert scrub/legume feeders and canyon/oak feeders. Mimetic Clytrinae (probably mostly distasteful, *i.e.*, Mullerian mimics) are more diverse in biodiverse areas (*i.e.*, subtropics) and their mimicry complexes undescribed. Understanding such complexes is beneficial for community ecology and taxonomy. **Population and community ecology:** Ecological characteristics of an arboreal community of Chrysomelidae in Papua New Guinea (Basset and Samuelson) points out that tropical forest canopy food plant associations are mostly lacking and difficult to obtain. They studied 10 tree species which yielded 134 chrysomelid species dominated by Galerucinae (diversity) and Eumolpinae (biomass) only 36 of which had proven host plants. Generalists were more abundant than specialists and canopy collections often greatly inflate the number of species associated with a particular tree. **Chrysomelid host associations and weed biocontrol:** Madeiros *et al.* treat the association of chrysomelid beetles with solanaceous plants on south Brazil. They provide detailed biology/natural history description (with photos) for 11 species, all but one monophagous, of Cassidinae, Chrysomelinae, Criocerinae which were heavily effected by predation and parasitism. **Miscellaneous:** Medvedev gives supposed effects on a few selected Chrysomelidae from the radiation of the Chernobyl disaster.

David G. Furth. *Department of Entomology, Smithsonian Institution, Washington, D. C. 20560-0165 USA*

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BOOK REVIEW

P. Jolivet and M. Cox, Editors. 1996. **Chrysomelidae Biology.** SPB Academic Publishing bv. Volume 3: 365 pp. ($156 US). Available from SPB Academic Publishing, P.. Box 11188, 1001 GD Amsterdam, The Netherlands, Fax: (31-20) 6 38-0524, Email: kugler@pi.net. For USA/Canada: c/o Demos Vermande, Order Dept., 386 Park Ave. South, Suite 201, New York, NY 10016 USA, Fax: (212)-68333-0118.

Volume 3: General Studies: This volume is the place for all the miscellany of the three volumes. **Zoogeography and host associations:** High altitude fauna of Chrysomelidae of Central Asia: biology and biogeography (Lopatin), based on 800 species lists 175 alpine species separated by their distribution. Most of these are Chrysomelinae, especially endemic *Chrysolina* and *Oreomela*. As in the arctic, Chrysomelinae/Galerucinae/Alticinae are dominant. The two subregions of the Central Asia mountains are composed of biogeographic elements primarily from the Palearctic and some from the Oriental Regions. Adaptations to these areas include dark metallic color to absorb solar radiation (88%), flightlessness, convex elytra, and polyphagy. Ecological and zoogeographic categorization of the Mediterranean *Longitarsus* species(Biondi) attempts to use ecology (host plants) and distribution. He lists 158 species with "known" hosts (but without references), ecological and distribution types. The categorization of the ecological types is somewhat unclear. Apparently eurytopic (polyphagous = 10%), oligotrophic (oliphagous = 50%), and stenotopic (monophagous = 40%) are the bases for the ecological groupings of species, the latter two groups are also classified into temperature-affected subgroups dominated by thermophiles (37%) and mesophiles (ca. 40%). It is not surprising that these *Longitarsus* are found primarily in Mediterranean climatic zones on 15 plant families, especially Boraginaceae (25%), Asteraceae (14%), Plantaginaceae (10%), and Scrophulariaceae (10%). More discussion and comparison of the host families relative to distribution patterns may have been informative. **Collecting and Rearing Larvae** includes two reviews by Steinhausen on larvae. The first offers references on morphology for the 380 species (22% of the West Palearctic fauna). The second lists hints on rearing immatures of species in middle Europe. **Embryonic Development and Reproduction:** Spermiogenesis in *Coelomera lanio*: ultrastructure and cytochemical studies (Bao) discusses structures which may be involved in cellular motility, protection of the genome, sperm-oocyte interaction and which may contribute to taxonomic or phylogenetic studies. This study uses electron microscopic and cytochemical techniques to analyze morpho-functional aspects of spermiogenesis. There are no unique aspects attributable to this species or its group, but this type of study has not been conducted with many taxa. Cox provides a review of parthenogenesis in the Chrysomeloidea. **Biological Studies in Various Subfamilies:** Kuschel and May treat the Palophaginae, their systematic position and biology by providing morphological and bio-ecological descriptions of the adults and larvae which feed on *Araucaria* male cones in Australia and Chile. Interestingly most morphological similarity comparisons are to Cerambycidae rather than Chrysomelidae and none with Megalopodinae to which they are supposedly most related. There are good figures of many adult and larval morphological characters. Life history and description of early stages of *Spondylia tomentosa* (Schulze) gives limited morphological larval description, details of the biology and behavior presumably based on many years of repeated observations at a specific site, but many details of the methods are unclear.

David G. Furth. *Department of Entomology, Smithsonian Institution, Washington, D. C. 20560-0165 USA*

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NEEDED. Aphodiidae, esp. Eupariinae (not *Ataenius*) and termitophile taxa, for molecular study. Also Aulonocnemidae; live or preserved in 95% ethanol. Will identify or consider offers of exchange. Jason F. Maté, Molecular Systematics Laboratory, Entomology Dept., The Natural History Museum, Cromwell Rd., London SW7, 5BD, UK. E-mail: j.mate@nhm.ac.uk

CETONIIDAE OF THE WORLD-CATALOGUE PART I. (incl. Goliathini, Cetoniini, Gymnetini, Diplognathini, Phaedimini, Taenioderini.) This catalogue is a continuation of the Junk-Schenkling Coleopterorum Catalogus (1921). The suprageneric classification of the Cetoniidae is mainly created after J. Krikken (1984). Regionally filed taxa after biogeographical regions are listed in alphabetical order. Type depositories and type localisation are given. 2 130 sp., 641 ssp., 277 g. are taxed. Price 30 US$ (incl.postage).

WANTED. Specimens of Cetoniidae from North, Central and South America and information on the family. Robert Alexis, 5 rue Georges Willame, B 1400, Nivelles, Belgium. Tel & fax: 00.32.67.21.13.58

PINS. Quality Morpho-type insect pins #000-#5, black U.S. $1.50/100; stainless $2.00/100. Orders of any size filled within 30 days; prices do not include shipping. Order from Mr. Petr Kabatek, 200 Pagha, U trojskeho zamku 120/3, CZ-170 00 Praha 7, Czech Republic, Fax 420-2-426942. E-mail: hulovcov@nlkdec.nlk.anet.cz

PTILIIDAE WANTED FOR RESEARCH. Specimens of Cephaloplectinae (=Limulodidae) for ongoing worldwide revision. Still accepting specimens of Nanosellinae for continuing worldwide revision. Also accepting other ptiliid groups for work on subfamily relationships and revisionary work on various genera. Please contact me concerning terms of loan. e-mail: wehall@ag.arizona.edu. Address starting 1 June 1998: W. Eugene Hall, Collections Manager, Division of Entomology, W-436 Nebraska Hall, University of Nebraska State Museum, Lincoln, NE 68588-0514.

PTILIIDAE. Wanted worldwide, determined and not determined. Please send offers together with prices to: Guenter G. Hoffmann, Wachstrasse 29, D-46045 Oberhausen, Germany. e-mail: hoffmann-oberhausen@t-online.de

ENTOMOLOGICAL MATERIAL. DMHF for mounting genitalia, Insect Pins (Austrian and Czech), traps and special devices (Heath, Malaise, Blendon, Winkler, Mocsarsky). Entomological books. http://www.redestb.es/personal/entomo-praxis. E-mail: entomo-praxis@mx2.redestb.es. Fax: 34-3-323 08 77. Entomopraxis, Barcelona, Spain.

WANTED. Cerambycidae of the world, especially Australia, Africa, China, and Pacific Islands, exchange of purchase. Jim Cope, 6689 Mt. Holly Dr., San Jose, CA 95120, U.S.A.; e-mail montana@webtv.net.

FOR SALE. Lucanidae and other Coleoptera from Sulawesi. Albert Dalmau, Mariano Estrada 14, 08378, Alella (Barcelona), Spain.

WANTED. Exchange of Cetoniinae (esp. African); also Cerambycidae. Danial Moore, USAID, P.O. Box 7007 Kampala, Uganda. dmoore@usaid.gov.

FOR SALE. New flight intercept trap; light, nestable, economical, easy set-up and transport. Fieldworks, 60 Aspen Lane, Stony Brook, NY 11790.

WANTED FOR RESEARCH. Specimens of *Eudesmula undulata* (Colydiidae) for distributions and biological study will be examined and returned promptly; Michael A. Goodrich, Department of Zoology, Eastern Illinois University, Charleston, IL 61920

CRYPTOPHAGIDAE: Leschen, R., 1996, Phylogeny and revision of the genera of Cryptophagidae (Coleoptera: Cucujoidea), University of Kansas Science Bulletin 55:549–634 available for $5.95 (US); send check and this citation to Exchange Librarian, University of Kansas Libraries, Lawrence, KS 66045.

WANTED FOR RESEARCH: Specimens of flightless Scarabaeina, especially *Mnematium cancer, M. ritchiei, M. silenus, Neomnematium sevoistra* and *Scarabaeus* (*Scarabaeolus*) *scholtzi*. Will identify and return promptly. Will also exchange the above for southwestern African Pachysoma. Send to Prof. C. H. Scholtz, Department of Zoology & Entomology, University of Pretoria, Pretoria, 0002, SOUTH AFRICA. Email: harrison@scientia.up.ac.za or clarkes@scientia.up.ac.za.

SULCOPHANAEUS: Request correspondence from persons willing to loan specimens for revisionary study of this New World genus of dung beetles. W. D. Edmonds, Department of Biological Sciences, California State Polytechnic University, Pomona, CA 91768; (909) 869-2116; e-mail: wdedmonds@csupomona.edu.

ENTOMOLOGICAL MATERIAL: Insect pins (Austrian and Czech), french drawers, traps (light, Heath, Blendon, Malaise . . .), special devices (Winkler, Mocsarsky . . .). Free catalogue. ENTOMOPRAXIS, Apartat 36.164, 08080 Barcelona, Spain. Fax: 34-3-323 08 77.

LITERATURE WANTED: G. J. Arrow. 1917. Fauna of British India, Lamellicornia Part II (Rutelinae, etc.). R. Miksic, Monographie de Cetoniinae der Paläarktischen un Orientalischen Region, Band 2 (1977), Band 3 (1982) and Band 4 (1987). R. M. Young, Absaroka Natural History Trust, 2236 Greever St., Cody, WY 82414. Ph. 307-527-7326.

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