A fossil palm bruchid, *Caryobruchus dominicanus* sp. n. (Pachymerini: Bruchidae) in Dominican amber

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The first fossil palm bruchid, *Caryobruchus dominicanus* sp. n. (Coleoptera; Bruchidae) is described from Dominican Republic amber. This species is closely related to extant Central American-West Indian members of the genus, all of which develop in the seeds of palms. Aside from providing indirect evidence of fan palms, especially those of the genus *Sabal*, in the original Dominican amber forest, the present find shows that seed predation by *Caryobruchus* spp. was established in the West Indies some 15-45 million years ago.

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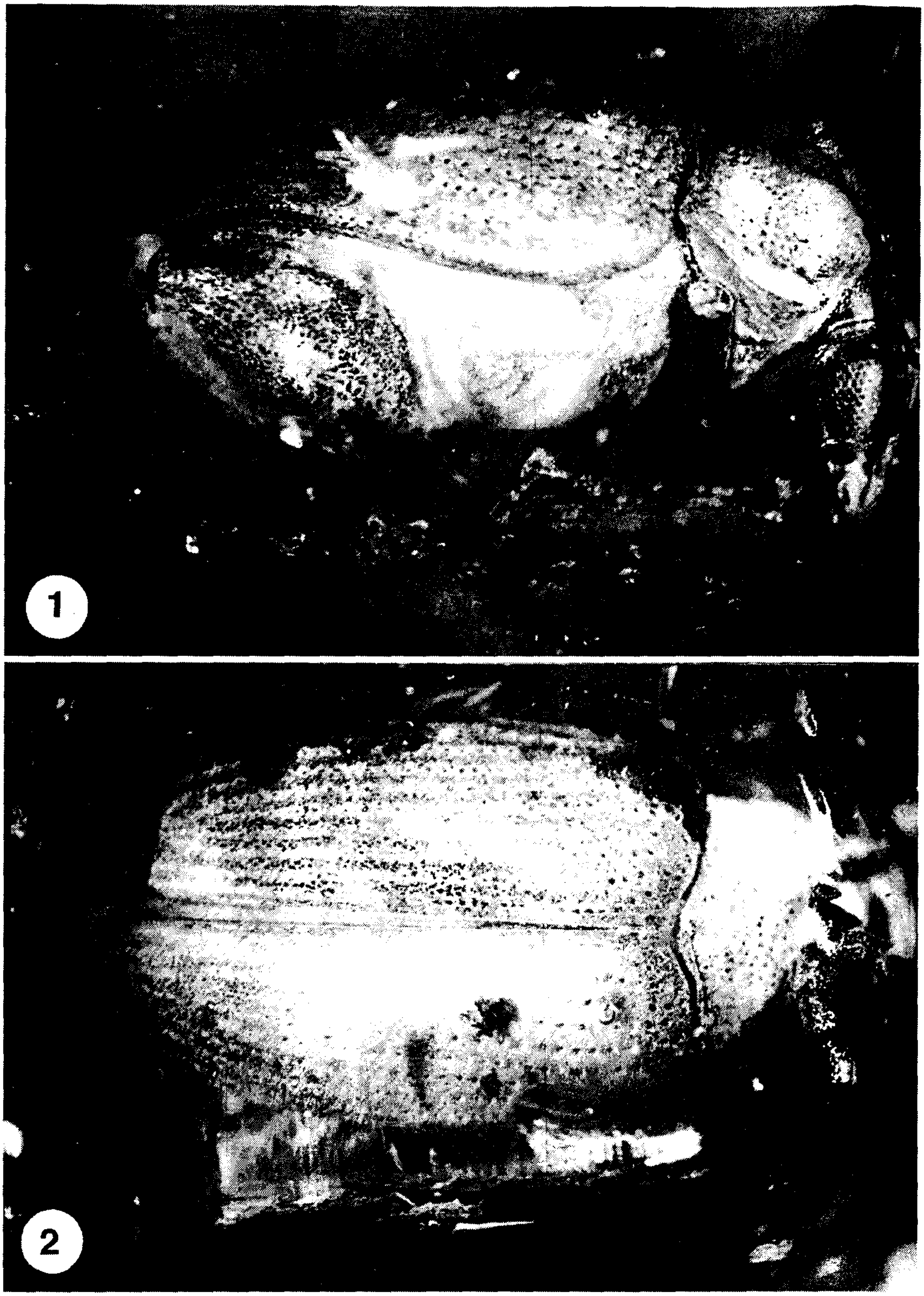
Introduction

The 'palm bruchids' belong to the tribe Pachymerini of the subfamily Pachymerinae (Bruchidae: Coleoptera) (this taxon is included in the family Chrysomelidae by Lawrence & Newton 1995) and comprise some 20 species of medium to large seed predators which are considered the most primitive group of the Bruchidae. The subfamily is divided into the tribes Caryedini, Caryopemini, and Pachymerini. The former two tribes are restricted to the Old World with reliable plant hosts in the families Leguminoseae and Combretaceae. The Platymerini are New World and with the exception of one *Pachymerus* species that develops in *Diopyros* sp. (Ebenaceae), they all utilize palms as their food source (Johnson et al. 1995).

The fossil record of the bruchids is quite sparse. Several taxa were described from the Florissant shales in North America (approximately 35 mya) by Wickham (1914) and Kingsolver (1965) placed these species in the fossil genus *Oligobruchus* Kingsolver, which now includes the taxa *O. scudderi* (Wickham), *O. haywardi* (Wickham), *O. wilsoni* (Wickham), *O. submersus* (Wickham) and *O. primoticus* (Wickham). Several other reports of putative, undescribed bruchids, most published in the nineteenth century from the Brown Coal deposits of Germany, have been summarized by Carpenter (1992) under his section of 'doubtfully assigned species'. There is mention of bruchids in Baltic and Dominican amber (Spahr 1981; Poinar 1992), however none of these have been carefully examined or described. A fossil Eocene bruchid from British Columbia that appears to belong to the Caryopemini still awaits investigation (Archibald & Mathewes *in press*). The present study provides the first description of an amber bruchid, the first fossil palm bruchid and establishes the first fossil record for the genus *Caryobruchus*.

Materials and methods

The fossil is in a rectangular piece of amber weighing 7 grams with a length of 19 mm and a width and depth of 5 mm, respectively. The amber originated from the northern mountain ranges in the Dominican Republic. The exact age of these deposits is controversial with estimates based on macrofossils and chemical analyses providing ranges from 15-20 Myr (Iturralde-Vincent & McPhee 1996) to 30-45 Myr (Cepek *in* Schlee 1990). The adult bruchid fossil is nearly complete; only some portions of the legs are missing, however most of the essential taxonomic characters are



Figs 1-2. *Caryobruchus dominicanus* sp. n. from Dominican amber: (1) Lateral view of entire specimen; (2) dorsal view of thorax and elytra.

present, including all of the head and antennae, one complete metafemur, the elytra and pygidium. The amber piece also contains portions of two flying ants (Formicidae), two gall midges (Cecidomyiidae) and a parasitic wasp.

Taxonomy

The head concealed from above, prolonged into a short beak, hind femur enlarged dorso-ventrally, with spines on the ventral margin. 11 segmented antennae, 10 striated-elytron and exposed pygidium place the specimen in the family Bruchidae. The non-metallic body, small metatrochanter, presence of a pecten with denticles on the metafemur and a surrounding impressed marginal line around the pronotal disc place the specimen in the subfamily Pachymerinae. The vague ocular sinus, coarsely faceted eyes, vestiture of uniform color, prosternal process completely separating the procoxae and the body length align the specimen in the tribe Pachymerini. The tibia positioned on the lateral side of the pecten when the leg is flexed, the absence of apical calcaria on the metatibia and the strongly converging sides of the submentum between the eyes indicates the fossil belongs to the genus *Caryobruchus* Bridwell 1929. The specimen could not be identified in the revised key to the world specimens of *Caryobruchus* by Nilsson & Johnson (1993) and is described below as a new species.

Caryobruchus dominicanus sp. n.

(Figs 1-6)

Etymology. – The specific name pertains to the specimen in Dominican amber.

Type material. – Holotype in a piece of amber from the Dominican Republic; catalogued under accession number C-7-104A and deposited in the Poinar collection of amber maintained at Oregon State University, Corvallis, Oregon, USA.

Description. – Integument dark brown, pubescence golden-yellow; Holotype, length (pronotum and elytron) = 8.0 mm, greatest width (across greatest part of elytra) = 4.0 mm, maximum thoracic depth = 3.3 mm.; eyes approximate, antennal segments 4-10 serrate, longer than wide; disk of pronotum wider than long (length/width ratio = 0.67 mm); metafemur wide, (length/width ratio = 1.6 mm) pecten short with 6 denticles, denticle 1 acuminate and longer than the others; prepectenal ridge longer than pecten, with at least 8 small spines.

Vestiture: Setae absent (lost?) on parts of body; dorsal and ventral body surfaces with golden, short, fine recumbent, dense setae of two types, elongate and circular; fine setae on antennae and legs including metafemur; tarsomere 1 with moderately dense, coarse, golden setae, ventral side of tarsomere 3 with dense, coarse, golden setae; pygidium covered with minute, dense, golden setae.

Head: Covered with powdery deposit, with thin hardened film surrounding mouth area; head as long as pronotum; frons and vertex with prominent median glabrous carina; ocular sinus vague, eyes approximate on dorsal side, postocular lobe medium-sized; antennae shorter that elytron, segments 4-10 serrate, longer than wide, maxillary palp segment 1 about same length as segment 2 but narrower; eyes intermediate on ventral side; sides of submentum converging triangularly between eyes.

Prothorax: Disk wider than long (length/width ratio = 0.67); sparsely punctate, all sides with strong, impressed marginal line, anterior margin convex, angles obtuse; medial dorsal surface flattened, sides depressed (more toward apex); angles of lateral margin at base produced about 90°, posterior margin arcuate, strongly produced medially.

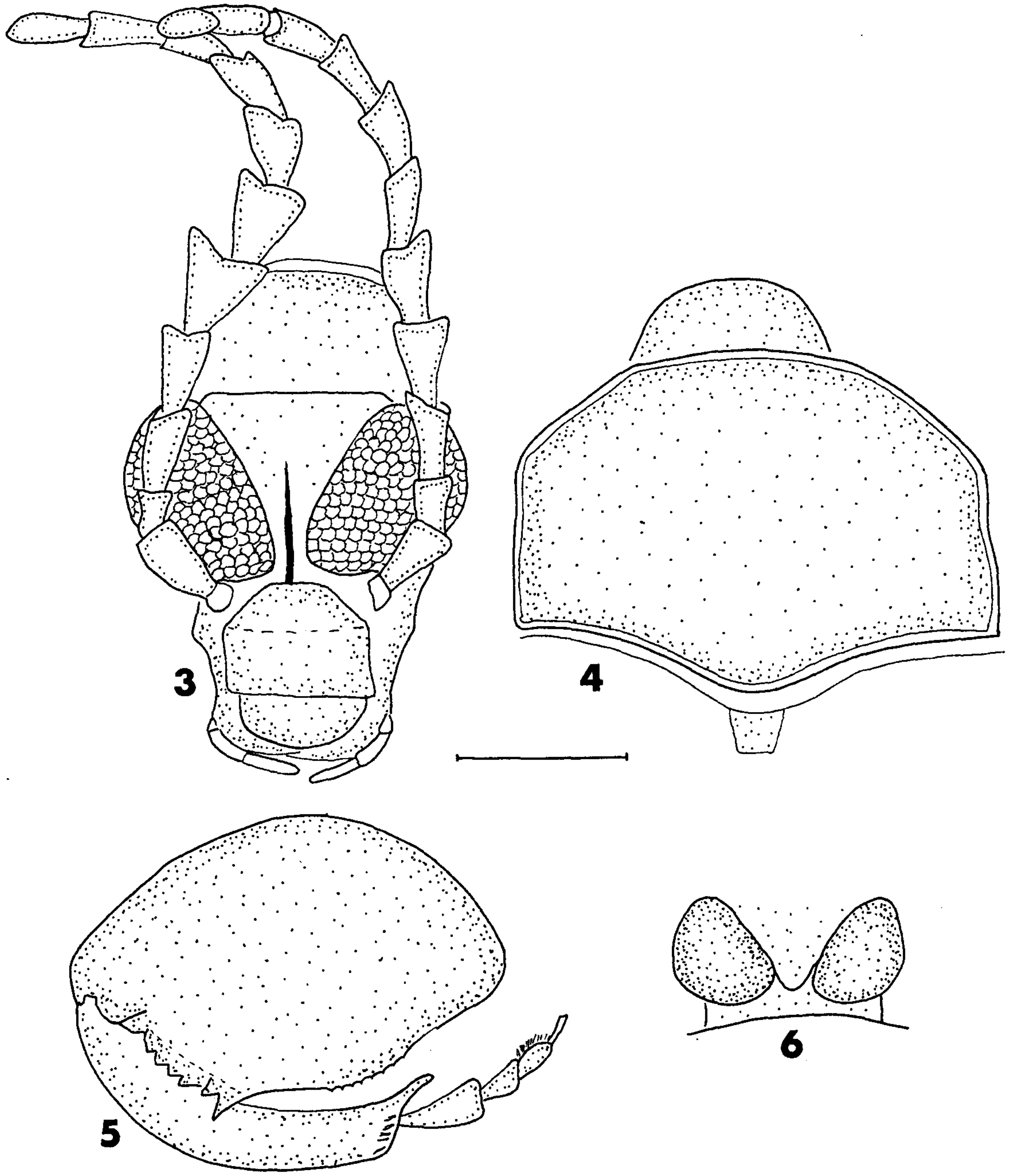
Thorax: Scutellum small, subquadrate, dorsal surface of elytron convex between humerus and mesal margin, depressed laterally and apically; striae round punctate. Metafemur incrassate, maximum width slightly closer to base, length/width ratio 1.60; ventral side of pecten armed with 6 denticles, denticle 1 largest, acuminate, closer to femora apex than base, each following denticle slightly smaller, with denticle 6 the smallest; tibia positioned on lateral side of pecten when leg flexed; prepectenal ridge longer than pecten with a series of spines (only 8 could be seen, but more may be present); metatibia evenly arcuate, carinae not evident, mucro medium in size; several dark, long scales on lateral apical surface of metatibia

Abdomen: Pygidium covered with dense, fine elongate setae; feebly convex in lateral view; length/width ratio 0.51; punctures, if present, covered by scales.

Discussion

Characters or combinations of characters that *C. dominicanus* sp. n. does not share with any extant species of *Caryobruchus* are as follows: metafemur length/width ratio (1.6), subequal lengths of maxillary palps 2 and 3 with the latter long and slender, posterior margin of pronotum strongly produced medially, medial carina not extending to dorsal border of eyes, absence of metatibial carina, and presence of 6 denticles on the pecten.

The sex of the specimen could not be determined since neither of the protarsi was present and thus it is not known if protarsus 1, which is indicative of males (sexual dimorphism), was widened or not (Nilsson & Johnson 1993).



Figs 3-6. *Caryobruchus dominicanus* sp. n. from Dominican amber: (3) Face view with antennae, median carina, frons, clypeus, vertex, labrum and maxillary palps; (4) dorsal view of pronotum showing marginal line and posterior margin strongly produced medially; (5) lateral view of hind leg (metatibia opened slightly and positioned on mesal side of pecten to show denticles); (6) ventral view of head showing submentum converging triangularly between eyes. Scale bar = 1.0 mm.

Phylogenetic relationships

There are no previously described fossil palm bruchids since members of the genus *Oligobruchus* from the Eocene of the Florissant beds in Colorado (Kingsolver 1964) have been assigned to the tribe Caryopemini (Nilsson 1992). The present species differs from members of this genus in lacking a densely foveolate prothoracic disc, deeply emarginate eyes, and metatibial carinae. The present fossil does share with *Oligobruchus* a subquadrate scutellum, a deeply and broadly lobed posterior margin of the prothoracic disc and a broadly triangular pygidium. The following appear to be primitive characters of the Platymerinae in general: a smooth external face of the metatibia, a reduced number of teeth on the pecten (*Oligobruchus* has 5, the present fossil 6; all extant forms have 7 or more), a submarginal groove on the prothoracic disc, swollen metafemora with corresponding arcuate metatibia, unmodified elytral striae and shallowly emarginate eyes. The carina on the metatibia is difficult to interpret and although Kingsolver (1965) reported their presence on *Oligobruchus*, he felt it was a specialized character. However the presence of metatibial carinae on an undescribed Pachymerinae from the Lower Eocene beds in British Columbia suggests that this feature may be a primitive character (Archibald & Mathewes *in press*). This latter fossil also possesses elongate, rather than circular fossae on the elytral striae and has a widely exposed pygidium, all of which separate it from *C. dominicana* sp. n.

Biogeography and plant hosts

The genus *Caryobruchus* as defined by Nilsson & Johnson (1993) contains 6 extant species which occur in Mexico (including Baja California), Central America, southern United States and the West Indies. The location of the fossil is compatible with this distribution. One extant species, *C. gleditsiae* has a broad range that includes the Dominican Republic as well as Cuba, Jamaica, Central America and the southern United States. The present fossil suggests that the *Caryobruchus* lineage is an old one in the West Indies, extending back at least to the mid-Tertiary.

Reliable host records indicate that palms are the only plant hosts for *Caryobruchus* spp. (Johnson et al. 1995). Apparently female beetles deposit eggs on the developing palm fruit or seeds. Upon hatching, the highly modified first stage 'carabiform' larva enters a palm seed, molts into a grub with rudimentary legs and develops on the seed endosperm, eventually pupating in the empty seed and emerging as an adult. The adults are reported to feed only on pollen and nectar (Johnson et al. 1995).

A list of palms and their reported frequency as hosts for the six extant species of *Caryobruchus* compiled by Johnson et al. (1995) are summarized in Table 1. Representatives of three of the eight fan palm genera in Table 1 occur in the Dominican Republic today (Jones 1995). Since bruchids are known to be host specific (at least to a genus of plants) it is probable that *C. dominicanus* sp. n. developed in one of these three genera. On the basis of the data in Table 1, it is suggested that the fossil species fed on members of the genus *Sabal*, since that is obviously the preferred host genus for extant species of *Caryobruchus*. This agrees with the principle of behavior fixity, which implies that a fossil insect would have exhibited host selection behavior similar to its descendants at the generic level (Boucot 1990). Palms first appear in the Cretaceous and fossil *Sabal* have been reported in the Cretaceous Medicine Bow flora in southcentral Wyoming (Tidwell 1998). While the presence of *C. dominicanus* sp. n. is indirect evidence of fan palms and probably *Sabal* spp. in early Hispaniola, the earlier discovery of a palm bug (Hemiptera: Thaumastocoridae) in Dominican amber provides indirect evidence of pinnate palms (*Roystonea* spp.) in the ancient amber forest (Poinar & Santiago-Blay 1997; Poinar & Poinar 1999).

Table 1. New World endemic palm genera and number of reported host citations for *Caryobruchus* spp. (Data taken from Johnson et al. 1995). Those genera with a * occur in the Dominican Republic today according to Jones (1995).

Genera	Number of host records
Brahea Mart. (= *Erythea* S. Wats.)	7
Chamaedorea Willd.	4
**Coccothrinax* Sargent	2
**Copernicia* Mart.	7
**Sabal* Adans. (= *Inodes* O. W. Cook)	62
Serenoa Hook.	1
Thrinax L.	2
Washingtonia H. Wend.	2

The purpose of the enlarged metafemora with their spine-armed pectens has never been determined. However palms are well known for various water-conserving surfaces, such as glossy and waxy leaves with a thick cuticle (Jones 1995). It is likely that such smooth surfaces would be difficult to grasp and that the spines on the metafemora would play an important role in adhering to these surfaces, especially when alighting.

Acknowledgments

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