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A SYNOPSIS OF THE GENUS *AREODA*
(COLEOPTERA: SCARABAEIDAE: RUTELINAE)

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ABSTRACT

The three species in the genus *Areoda* are reviewed for the first time. The genus is characterized, a key to species is provided, each species is described, spatial and temporal distributions are given, and the biogeography is discussed. We consider their distribution to be isolated and relictual in the Atlantic coastal forests of southeastern Brazil.

RESUMO

As três espécies do gênero *Areoda* são revisadas pela primeira vez. O gênero é caracterizado, é dado uma chave para as espécies, cada espécie é descrita, distribuições espaciais e temporais são dadas, e um comentário breve discute a biogeografia destes besouros. Nós consideramos suas distribuições sejam isoladas e relictuais na costa da floresta Atlântica no sueste do Brasil.

The genus *Areoda* Macleay is comprised of three species: *A. banksi* Laporte, *A. espiritosantensis* Ohaus, and *A. leachi* Macleay. These distinctive beetles are found only in the Atlantic coastal forests of southeastern Brazil from the states of Bahia in the north to Santa Catarina in the south. The genus *Areoda* is placed in the subtribe Areodina (of the Rutelini) because it has a complete frontoclypeal suture and externally rounded mandibles. In appearance, these highly convex beetles are similar to some species of *Platycoelia* Burmeister (Neotropical) and *Anoplognathus* Leach (Australian), both of the latter belonging, however, to the tribe Anoplognathini. *Oplognathus* Macleay (not *Hoplognathus* as in Burmeister 1844; Ohaus 1918, 1934; Blackwelder 1944) consists of three species, occurs in the same area, is an areodine, and is somewhat similar to *Areoda*. *Oplognathus* is smaller and has other characters (including clypeus, color, and pattern) that separate it from *Areoda*. Some sympatric species of *Byrsopolis* Burmeister closely resemble *Areoda*, but they may be separated by the absence of a mesosternal peg in *Byrsopolis*. Moreover, *Areoda* is the only genus of New World Areodina with highly asymmetrical parameres (Figs. 2-4).

Specimens of *Areoda* are not well represented in collections, especially those in North America. There has never been a published key to the species of *Areoda* nor have the species had a modern description. Until now, there has been no reliable or convenient way to identify them. Ohaus (1934) provided the most recent key to genera in the subtribe Areodina, but in that work, several genera now considered valid are parts of the genus *Cotalpa* Burmeister (*Byrsopolis*, *Parabyrsopolis* Ohaus, and *Paracotalpa* Ohaus). *Areoda magnifica* Nonfried (1891), allegedly from Brazil, was assigned to the Australian species, *Anoplognathus analis* Dalm, by Ohaus (1905) after he examined the type. Laporte (1840) referred to an *Areoda lanigera* F., but this is *Cotalpa lanigera* (L.).

GENUS *AREODA* MACLEAY

Areoda Macleay 1819:158.

TYPE SPECIES. *Areoda leachi* Macleay by monotypy.

DESCRIPTION. Scarabaeidae, Rutelinae, Rutelini, Areodina. *Form*: Ovate, robust, dorsum very convex, apex of elytra broadly rounded. Length 19–31 mm. Width across humeri 11–20 mm; widest width 12–20 mm. *Color*: Preserved specimens dorsally testaceous to reddish brown, with brassy or metallic green reflections; ventrally piceous with metallic green reflection; live specimens creamy white to opalescent, with golden or greenish reflections. *Head*: Clypeus subequal in length to frons; apex broadly, weakly rounded, narrowly reflexed. Eyes large, interocular width equals 3 transverse eye diameters in males, a little wider in females. Antenna with 3-segmented club; club slightly longer than segments 2–7. Labrum emarginate apically, densely setigerous. Mandibles broadly rounded externally, hidden in dorsal view. Mentum with apex weakly sinuate, length approximately 1.5 times width of apex. Maxillary palpi with terminal segment enlarged or not. *Pronotum*: Widest at base. Lateral margins broadly rounded. Marginal bead complete or effaced basomedially. Surface variably punctate. *Scutellum*: Parabolic, slightly wider than long; length $\frac{1}{10}$ – $\frac{1}{11}$ length of elytral suture. Surface variably punctate. *Elytra*: Surface with obsolete to distinct, punctate striae. Suture cariniform apically, apex right-angled. *Pygidium*: Surface densely rugulose, a few sparse setae present or not. *Venter*: Surface densely, setigerously punctate to rugopunctate; setae fine, moderate in length. Mesosternal process triangular, extending anteriorly to forecoxae or not. *Legs*: Foretibia tridentate, anterior tooth slightly removed from others, teeth becoming smaller posteriorly. Foretarsus in male with large claw 2–4 times wider than small claw (at widest points as seen from above). All claws simple. *Parameres*: Asymmetrical, bearing 3 projections.

DIAGNOSIS. *Areoda* may be distinguished from other Rutelinae on the basis of the following characters: 10-segmented antennae, labrum separated from clypeus and horizontal with respect to clypeus, mandibles rounded externally with apexes not reflexed, complete frontoclypeal suture, a forward-projecting mesosternal process, and a broadly rounded clypeal apex.

Males can be recognized by their relatively concave abdominal sternites, whereas females have sternites slightly convex or tumescent. Males have an enlarged foreclaw that is 2–4 times wider than the smaller claw, whereas females have these claws subequal in size. Males have the last sternite apically emarginate, and females have the last sternite entire. Finally, males are generally smaller than females.

KEY TO THE SPECIES OF *AREODA*

1. Mesosternal process extending anteriorly to between forecoxae (with forelegs in normal position). Males with terminal segment of labial palpi not enlarged, not wider than scape of antenna. Parameres as in Figures 3 or 4 2
- 1'. Mesosternal process short, extending forward only slightly beyond mesosternal coxae. Males with apical segment of labial palpi enlarged, wider than antennal scape. Parameres as in Figure 2 *banksi* Laporte
2. Elytra lacking well-defined or impressed striae. Color of pygidium weakly metallic, dark olive green to unaided eye. Parameres as in Figure 3 *spiritosantensis* Ohaus
- 2'. Elytra with well-defined striae. Color of pygidium bright metallic green to unaided eye. Parameres as in Figure 4 *leachi* Macleay

Areoda banksi Laporte
(Figs. 1, 2, 5)

Areoda banksii Laporte 1840:128.

DESCRIPTION. Length 25.3–28.6 mm; width across humeri 13.5–16.9 mm; greatest width (mid-elytra) 15.1–19.4 mm. *Head*: Color of frons testaceous or brassy green with metallic reflection; clypeus reddish brown. Frons with surface densely punctate; punctures small posteriorly, becoming moderately large, deep, and dense anteriorly. Clypeus with surface densely punctate, punctures moderately large, deep; apex broad, weakly rounded, narrowly reflexed. Labial palpus in male with terminal segment large, wider than scape of antenna; female with palpus narrower. *Pronotum*: Color reddish brown to testaceous with dull metallic or brassy green reflection. Surface with small and moderate punctures mixed, punctures becoming denser and larger laterally. Marginal bead complete. *Elytra*: Color testaceous to reddish brown, with shining or brassy green reflection. Surface with variably defined punctate striae: 1 adjacent to suture, 2 on center of disc, 2 just mesad of humerus, 2 near lateral margins; punctures of striae large. Intervals shagreened, irregularly and moderately punctate, punctures small. *Pygidium*: Color weakly metallic, dark olive-green. Surface densely rugulose with a few small setae apically. *Venter*: Color piceous with light to dark metallic green reflection. Mesosternal process triangular, not elongate, not extending to between forecoxae when legs in normal position. *Legs*: Foretarsus in male with large claw 3–4 times thicker than narrow claw (at widest points as seen from above). *Parameres*: Figure 2.

REMARKS. *Areoda banksi* is easily recognized because of its short mesosternal process, distinctive parameres, and males with the terminal segment of the labial palpi greatly enlarged.

The type specimen for *A. banksi* is probably lost (R. P. Dechambre, pers. comm. 1987). Nomenclatural stability would not be enhanced in this genus by designation of a neotype, and we refrain from doing so.

Ohaus (1908) reported that *A. banksi* was sympatric with *A. leachi*, but that *A. banksi* preferred moist forests. He observed caged adults feeding on bananas and the flowers of *Inga* and *Bohemeria*. Ohaus also noted that this species hid during the day, but was active at night. He was unsuccessful in getting them to copulate or produce young.

LOCALITY RECORDS (Fig. 5). Specimens examined (28). **Minas Gerais** (1): Entre Rios. **Rio de Janeiro** (12): Petropolis, no data. **São Paulo** (2): no data. No data (13).

TEMPORAL DISTRIBUTION. January (1), April (1), September (1), November (1). Ohaus (1908) collected great numbers of them from the beginning of January to mid-February (1898) at electric lights. The first specimen was taken on 6 November, and only a few specimens were found after mid-February.

Areoda espiritosantensis Ohaus
(Figs. 3, 5)

Areoda espiritosantensis Ohaus 1905:322.

DESCRIPTION. Length 23.5–30.9 mm; width across humeri 13.1–17.0 mm; greatest width (at or just behind middle) 15.2–19.5 mm. *Head*: Color of frons reddish brown with metallic olive green or brassy green reflection; clypeus colored as frons in males, piceous (non-metallic) in females. Surface of frons densely punctate; punctures small to moderate in size near vertex, becoming moderately large, deep, nearly confluent at frontoclypeal suture. Clypeus with surface completely, densely punctate to rugopunctate; punctures moderately large, deep; apex broad, subtruncate to faintly emarginate medially, narrowly reflexed. Last segment of labial palpus normal, not as wide as scape of antenna; narrower in female. *Pronotum*: Color light yellowish brown, weakly shining to occa-

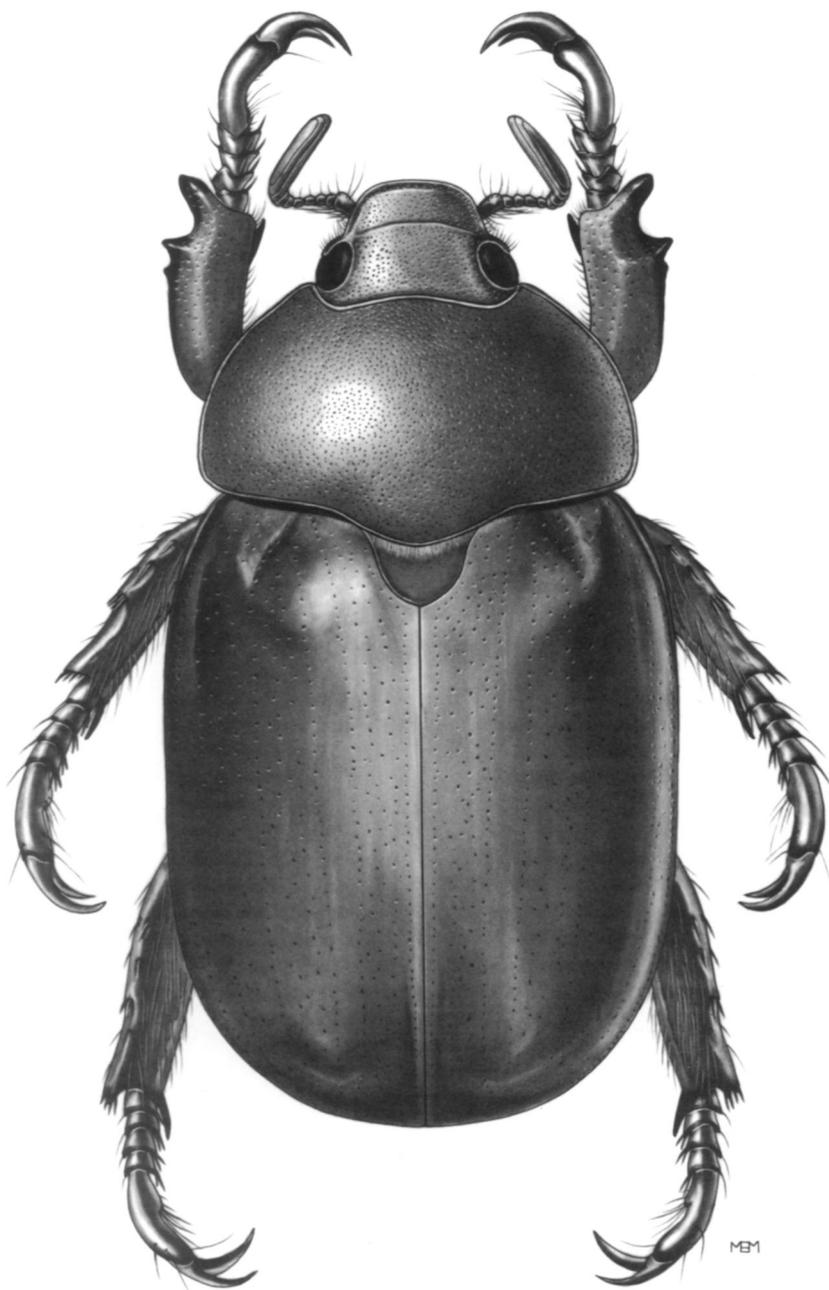
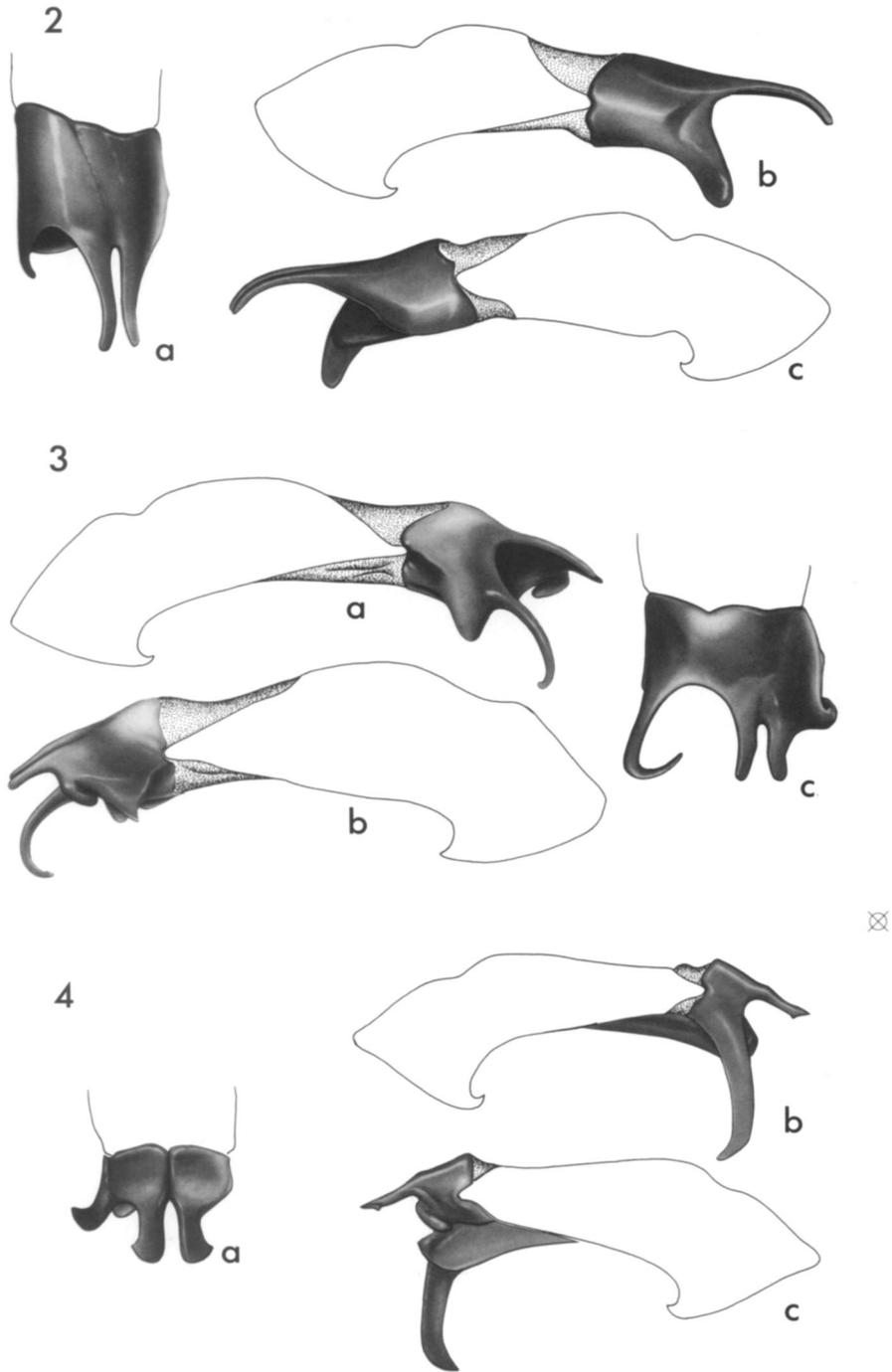


Fig. 1. Habitus of *Areoda banksi* Laporte.



Figs. 2-4. *Areoda* spp., parameres: caudal (2a, 3c, 4a) and lateral views. 2, *A. banksi*. 3, *A. espiritosantensis*. 4, *A. leachi*.

sionally faintly metallic. Surface minutely shagreened laterally, entire surface densely punctate; punctures minute and small mixed. Marginal bead complete. *Elytra*: Color same as or slightly paler than pronotum. Surface minutely shagreened, with 2 discrete sizes of punctures: minute punctures dense, small punctures moderate in density. Punctate striae nearly obsolete, instead represented by faintly impressed striae next to suture, in center of disc and behind humerus. *Pygidium*: Color weakly metallic, dark olive green to unaided eye. Surface densely rugulose. *Venter*: Color weakly metallic, dark olive green. Mesosternal process elongate, triangular, extending anteriorly to between front coxae (when legs rotated anteriorly). *Legs*: Foretarsus in male with large claw 2 times thicker than narrow claw (at widest points as seen from above). *Parameres*: Figure 3.

REMARKS. *Areoda espiritosantensis* is the only species in the genus with nearly smooth elytra due to the nearly obsolete striae. It shares the dark olive green pygidium with *A. banksi*, but has a long mesosternal process and lacks an enlarged apical segment on the labial palpus.

The types for *A. espiritosantensis* are probably at the Museum für Naturkunde in Berlin. Paratypes (a male and a female) were examined from the U.S. National Museum.

LOCALITY RECORDS (Fig. 5). Specimens examined (10). **Espirito Santo** (8): Timbuhy, Mpio. Linhares (Lagoa Mucucu). **Santa Catarina** (1): no data. No data (1).

TEMPORAL DISTRIBUTION. October (5), December (2).

Areoda leachi Macleay
(Figs. 4, 5)

Areoda leachii Macleay 1819:159.

DESCRIPTION. Length 19.5–28.6 mm; width across humeri 10.8–15.6 mm; greatest width (mid-elytra) 12.0–17.8 mm. *Head*: Color testaceous with brassy or metallic green reflection, clypeus often darker. Frons with surface densely punctate, punctures small to moderate in size. Clypeus with surface densely punctate to rugopunctate, punctures small to moderate; apex broad, weakly rounded, narrowly reflexed. Labial palpus with terminal segment not enlarged, not wider than scape of antenna. *Pronotum*: Color as head. Surface with disc moderately densely punctate, punctures small and moderate mixed, becoming confluent laterally. Marginal bead complete except basomedially where obsolete. *Elytra*: Color testaceous yellow to occasionally reddish brown, with metallic or brassy green reflection, reflection less pronounced than pronotum (due to coarser punctation of elytra). Surface with loosely defined punctate striae: 1 adjacent to suture, 2 on center of disc, 2 just mesad of humerus, 2 near lateral margin; punctures on striae moderately large. Intervals finely shagreened, irregularly, moderately punctate, punctures small. *Pygidium*: Color usually bright metallic green to unaided eye. Surface densely rugulose with a few small setae at apex. *Venter*: Color piceous with strong metallic green reflection (metallic green to unaided eye). Mesosternal process elongate, triangular, extending anteriorly to between forecoxae (when legs in normal position). *Legs*: Color reddish brown with metallic green reflection. Foretarsus in male with large claw 2 times thicker than narrow claw (at widest points as seen from above). *Parameres*: Figure 4.

REMARKS. Aside from distinctive parameres, *A. leachi* is the only species of *Areoda* with a bright metallic green pygidium. Ohaus (1908) stated that live specimens were a beautiful milky white or opalescent color with metallic reflections of copper, gold, or green. After death, a dirty yellow color replaced the white.

We consider the only specimen of *A. leachi* in the Macleay Museum at the University of Sydney in Australia to be the holotype, and we have so labeled it. George Masters, curator of the collection from 1872 to 1912, relabeled many

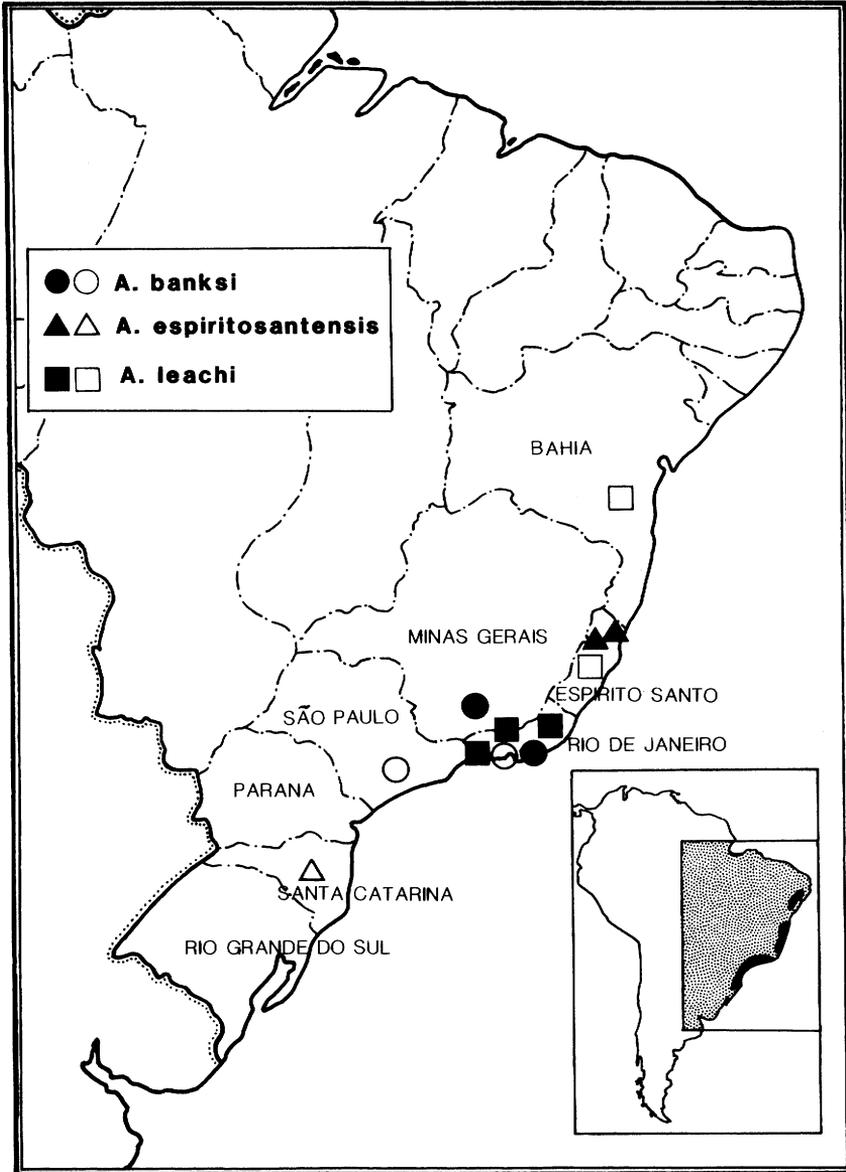


Fig. 5. *Areoda* spp. distribution map. Inset shows area enlarged (stippled) and Serra do Mar refugia (black). Dark symbol equals point data, open symbol indicates state record only.

of those insects and destroyed the original labels making it difficult or impossible to ascertain type material (D. S. Horning, pers. comm. 1987; Arnett *et al.* 1986). The specimen is a male, but it lacks any internal organs in the abdomen; the genitalia were apparently removed previously.

Label data indicate that specimens have been taken at mercury vapor lights at elevations of 900–1,000 meters. Ohaus (1908) observed that this species, unlike *A. banksi*, preferred the hot coastal valleys from Rio de Janeiro to São Paulo or the higher, hot and dry mountains near Petropolis. He indicated that during the day adults hide in the ground or beneath the leaves of low bushes. At dusk they become active. With about 30 caged male and female specimens he observed frequent copulation, but no eggs were produced. Caged specimens fed on the flowers of *Inga* and *Bohemeria* and on bananas.

LOCALITY RECORDS (Fig. 5). Specimens examined (35). **Bahia** (1): no data. **Espirito Santo** (1): no data. **Rio de Janeiro** (14): Teresopolis, km 50 estrada Contorno-Petropolis; no data. **São Paulo** (3): no data. No data (16).

TEMPORAL DISTRIBUTION. January (1), September (1), November (13), December (1). Ohaus (1908) collected his first specimen on 28 October (1888), and large numbers were taken between 31 October and 19 November in the high mountains near Petropolis.

BIOGEOGRAPHY

The forest associations in Brazil belong to two distinct main groups: Amazon forest and Atlantic forest (Bigarella and Andrade-Lima 1982). The genus *Areoda* is found exclusively in the Atlantic forests on the southeastern coast of Brazil in a region known as the Serra do Mar. *Areoda* is a biogeographical relict that has become isolated because of past geological and climatological events. It is not a phylogenetic relict in the sense of its being the lone survivor of more primitive forms; there are, in fact, other closely related areodine genera in northern South America.

The Serra do Mar was first postulated as a refugium by Vanzolini (1967), and evidence is continually increasing in support of his hypothesis. The southeastern coastal forests of Brazil are notable for a large number of endemic birds (Haffer 1974), reptiles (Müller 1973), primates (Kinzey 1982), and insects. The darkened areas on the inset map (Fig. 5) show these postulated refugia in the Serra do Mar region. Just within the scarab subfamilies Rutelinae and Dynastinae, for example, we note the following genera endemic to this region: *Areoda*, *Crathoplus*, and *Chalcentis* (Rutelini); *Mimogeniates* and *Microchilus* (Geniadini); *Aceratus* (Pentodontini); *Antodon* (Agaoccephalini); and *Trioplus* and *Platyphileurus* (Phileurini). A lengthy list of additional insect genera could be formulated. The point is, of course, that the Serra do Mar is a distinct center of endemism. The distribution of the species of *Areoda* coincides with this center. Inasmuch as endemism suggests geographic isolation of the taxa involved, we need to now consider why or how this isolation occurred.

We suggest that climatic fluctuations during the Pleistocene were directly responsible for the isolated populations seen today in the genus *Areoda*. Pleistocene fragmentation of formerly continuous ranges by climatic and subsequent vegetational changes has been frequently discussed in the literature (Brown 1977; Brown *et al.* 1974; Endler 1982a, b; Haffer 1969, 1978, 1982; Livingstone 1982; Mayr and O'Hara 1986; Müller 1973; Prance 1973, 1982). Fragmentation and isolation of biotas can cause extinction, survival without change, or opportunities for speciation. In the case of what we observe in *Areoda* today,

past changes in habitat, consisting largely of increased aridity during glaciations, have restricted the species to the coastal forests of the Serra do Mar.

The southeastern coastal forests of Brazil, especially in southern Bahia and Espírito Santo, are being rapidly destroyed by mankind's activities. This tragedy is ironic since the Serra do Mar has served as a *refuge* through the millennia for its endemic and little-known biota. In our view, the species of *Areoda*, along with many other unique plants and animals of the region, are in imminent danger of extinction.

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