

***Castoraeschna corbeti* sp. nov. from Floresta Nacional de Carajás, Pará state, Brazil (Odonata: Aeshnidae)**

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Key words: Odonata, dragonfly, Aeshnidae, *Castoraeschna*, new species, larva, taxonomy, South America, Amazon Forest.

ABSTRACT

Castoraeschna corbeti sp. nov. is described and diagnosed based on four males (holotype: Brazil, Pará State, Floresta Nacional de Carajás [6°06'13.9"S, 50°08'13.1"W, ca 600 m a.s.l.], 28 ix 2007 to be deposited in Museu Nacional, Universidade Federal do Rio de Janeiro, Rio de Janeiro). This species is similar to *C. longfieldae* and *C. coronata* but can be distinguished mainly by the absence of medio-dorsal spots on S8; postero-dorsal spots on S8–9 very narrow; cerci external margin almost straight in lateral view, without a distinct angulation between stem and base of lamina; cerci apex blunt. The probable ultimate stadium larva is described based on two individuals, male and female, collected at the type locality. Adults were observed flying along margins of a small shaded second-order stream where the larvae were taken. The surrounding forest is under impact of iron ore extraction and will probably disappear in the next years.

INTRODUCTION

The South American genus *Castoraeschna* Calvert, 1952 is currently composed of eight species: *C. castor* (Brauer, 1865), *C. colorata* (Martin, 1908), *C. coronata* (Ris, 1918), *C. decurvata* Dunkle & Cook, 1984, *C. januarua* (Hagen, 1867), *C. longfieldae* (Kimmins, 1929), *C. margarethae* Jurzitza, 1979, and *C. tepuica* De Marmels, 1989 (Garrison et al. 2006: 45). These are large and very conspicuous dragonflies, being active during the day over lotic environments (e.g. Santos 1970), reproducing in streams and rivers in mountains and lowland forested areas from sea level to 1,300 m a.s.l. (De Marmels 1989; Carvalho et al. 2006; Garrison et al. 2006). Larvae of five species were described and diagnosed (Carvalho et al. 2006). *Castoraeschna* species clearly constitute a monophyletic group, closely related to genera *Coryphaeschna* Williamson, 1903 and *Remartinia* Navás, 1911 (Carvalho 1995; von Ellenrieder 2002).

There are three keys available for identification of adult *Castoraeschna*. Calvert's (1956) taxonomic revision "Neotropical species of the 'Subgenus *Aeschna*' sensu Selysii 1883" presented the first key including only the five species known at that time. Some of Calvert's descriptions appear to be composites of more than one species, as observed at species level in other taxa considered in that reference (Carvalho 1989; von Ellenrieder 2003). The key proposed by Dunkle & Cook (1984) is not efficient in separating species such as *C. coronata*, *C. decurvata*, and *C. januaria* because of the use of intraspecific variable characters, especially those based on the definition of a T-spot on postfrons. Heckman's (2006: 460) key, the only one including all eight described species, was erected exclusively from literature data and published illustrations, but unfortunately repeated several mistakes of the preceding references. No comparative diagnoses were provided apart from those keys.

Therefore, identification of all species of this genus is not assured and new species will probably be detected and described. Mentions of at least three undescribed species appeared in the literature (Carvalho et al. 2006; Garrison et al. 2006: 46). Studying a collection of Odonata from Floresta Nacional de Carajás, Pará State, Brazil, some new species were detected (e.g. Garrison 2009), including the new *Castoraeschna* described in this paper. Forthcoming articles presenting a synopsis, diagnostic keys, and cladistic analysis of the genus are in preparation.

METHODS

Descriptions, illustrations, and measurements were made with the aid of a stereoscopic microscope equipped with a camera lucida. For measurements greater than 10 mm a manual calliper was used. All measurements in the text are in millimetres. Larvae were fixed and preserved in 80% ethanol.

Terminology for wing venation followed primarily Riek & Kukalová-Peck (1984) and Fleck et al. (2003), and for abdominal colour pattern of adults Walker (1912). Segments of vesica spermalis were named after Pfau (2005). Structures of labium and mandibles of larvae followed Corbet (1953) and Watson (1956) respectively. Larval diagnostic characters were largely based on those used in Carvalho et al. (2006: table I). Specimens examined shall be deposited in Museu Nacional (MNRJ) and Instituto de Biologia (DZRJ), Universidade Federal do Rio de Janeiro (UFRJ), Rio de Janeiro.

Castoraeschna corbeti sp. nov.

Figs 1, 2; Plate VI

Etymology

The species is named in honour of Dr Philip S. Corbet, who devoted his fruitful research lifetime to the study of dragonflies.

Specimens studied

Holotype ♂: Brazil, Pará State, Floresta Nacional de Carajás, Parauapebas, "Buritizal I - parte baixa (riacho)" (6°06'13.9"S, 50°08'13.1"W, ca 600 m a.s.l.), 28 ix

2007, leg. NFJ, V. Alecrim (MNRJ); 3♂ paratypes: same data as holotype but all in DZRJ; ♂ ultimate stadium larva: same data as types but 25 ix 2007 (DZRJ); ♀ ultimate stadium larva: same data as types but VALE mine iron ore site 'N4D' (6°05'42.9"S, 50°11'29.3"W, 659 m), 27 ii 2008, leg. NFJ, A. dos Santos (DZRJ). All specimens were collected under IBAMA 008/2007-MAB/FAUNA license.

Male holotype

Head: Labrum, clypeus, frons, and base of mandibles orange, with yellow and green hues. Clypeo-labral and fronto-clypeal sutures not tinged. Dorsal surface of frons without a T-spot (Plate VIa); carina at junction of antefrons and postfrons surfaces black, little sinuous, anteriorly convex in the middle and little concave on each side; central region of antefrons near carina blackish. Vertex uniformly black. Eyes dark grey, laterally yellowish; limits of vertex, ocelli, base of antennae, and eyes embraced by a black stripe. Occipital triangle greenish with lateral margins black; rear of eyes dorsally black, ventrally orange.

Thorax: Ground colour reddish-brown (Plate VIa). Antehumeral, mesepimeral, and metepimeral stripes green, clearly delimited dorsally, less defined ventrally (Plate VIa; Fig. 1a); antehumeral 4.5 long, width at mid-length 1.2; mesepimeral stripe occupying less than width of mesepimeron, less sinuous, 7.8 long and 1.5 wide at mid-length, slightly narrowed medially and enlarged dorsally; metepimeral broad, triangular, 7.8 long and 2.2 wide, occupying more than half but less than $\frac{3}{4}$ of metepimeron. Femora reddish-brown basally, blackish on distal $\frac{1}{2}$ of profemora and mesofemora and distal $\frac{1}{3}$ of metafemora (Plate VIa); tibiae and tarsi black; all leg spines black. — Wings uncoloured; venation black; costal margin black, brown ventro-basally; pterostigma brown, darker dorsally, with parallel sides; brace vein distinct, S-shaped, obliquely positioned in relation to other Px, and perfectly aligned with proximal end of pterostigma; membranula dark grey. — Venation (left/right). — Ax in Fw 19; in Hw 13. Ax2 7th or 8th antenodal in four wings. Px in Fw before pterostigma 15/14; Hw 16/18. Discoidal triangles with 3 cells in four wings. Supratrangles with 4 cells in Fw, 3 in Hw. Anal triangles with 2 cells. Anal loop with 9 cells, with 1 central cell. Cubito-anal space with $\frac{5}{6}$ crossveins in Fw; 4 in Hw. Number of rows of cells between fork of IR₂ at level of distal end of pterostigma $\frac{3}{4}$ in all wings. Number of cells between point of origin of IR₂ fork and Rspl 6/5 in Fw; 6 in Hw. Two rows of cells between RP₁ and RP₂ begin under middle of pterostigma in all wings. Maximum rows of cells between MA and Mspl 3 in Fw; 4 in Hw. Maximum 1 cell between MP and (AA + CuA) a in all wings.

Abdomen: Ground colour reddish-brown (Plate VIa), darker from base to apex; carinae and posterior fields black. Ventral surface brown. Pale spots on tergites of S1-9 (Fig. 1a) green, disposed as follows (S1-2 in bad condition of preservation, obscuring pale spots): D and L present on S1, the latter very small and thin, occupying less than half of width and the height of tergite; AD not distinct; AL and ML present only on S2, being connected forming AML; MD present on S3-7, general form triangular to semicircular, elongate on S3, not connected to other spots, the pair almost confluent dorsally on S3-6, separated by dorsal carinae; PD present on S3-9, narrow, smaller than $\frac{1}{3}$ of distance between transversal carina and posterior limit of segment, the pair almost confluent on S3-8, separated by dorsal carina; PL absent. Mid-ventral tubercle of S1 bearing long setae anteriorly and without spinules posteriorly (Fig. 1b); postero-ventral projections of S1 twisted, apexes curved inward and internally to genital fossa, without spinules; postero-ventral projections and mid-

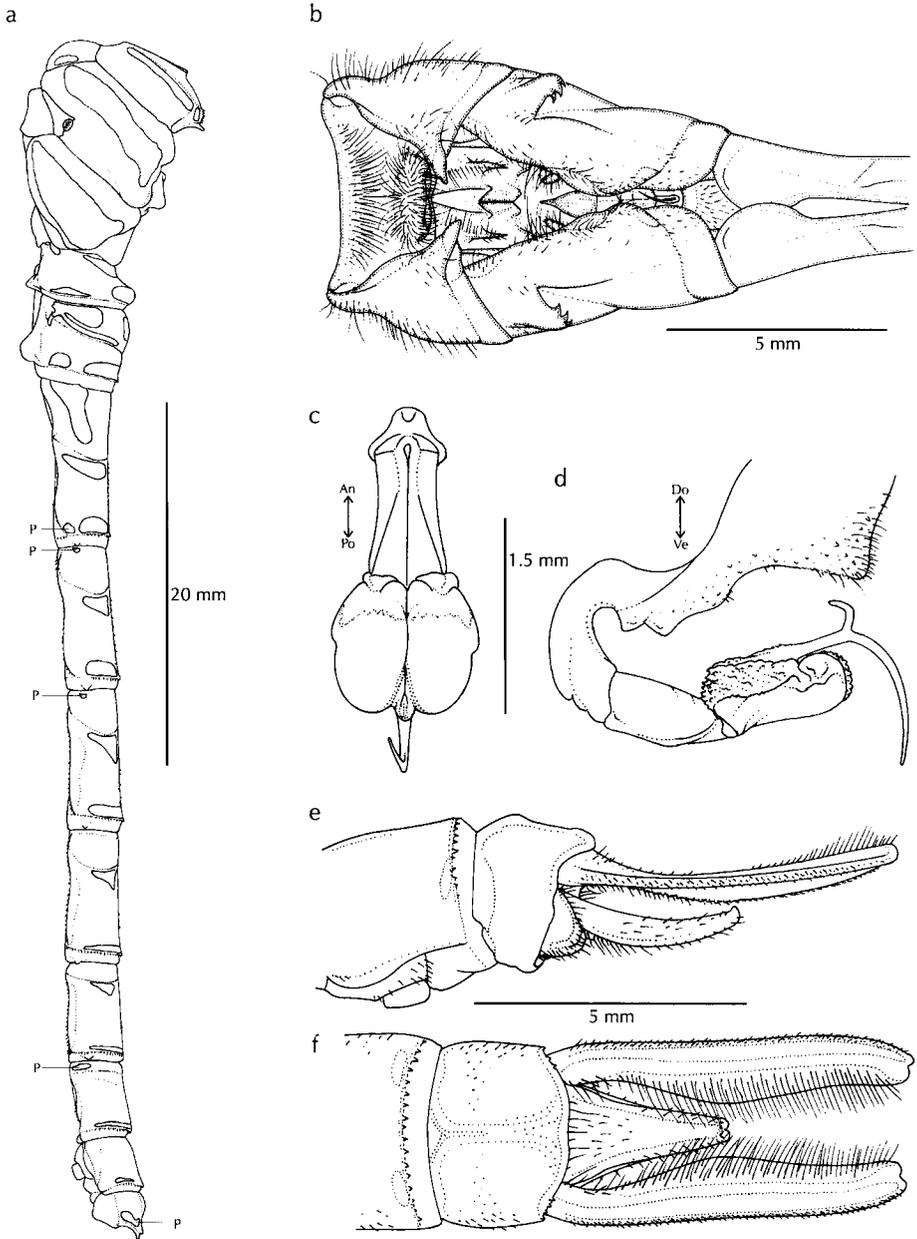


Figure 1: Adult ♂ of *Castoraeschna corbeti* sp. nov. — (a) diagrammatic colour pattern, in lateral view, of synthorax and abdomen (appendages excluded); (b) holotype S1-3, ventral view; (c-d) paratype vesica spermalis, (c) ventral view of V3–V4, (d) lateral view; (e-f) holotype S10 and anal appendages, (e) lateral view, (f) dorsal view. All bars are in mm; spots labelled 'P' are present only in one paratype. An: anterior; Do: dorsal; Po: posterior; Ve: ventral.

ventral tubercle similar in height in lateral view. Auricles with three distal teeth, curved inward (Fig. 1b). Genital lobe poorly developed ventrally, smooth and rounded, with a distinct and projected carina not covered with spinules. Anterior lamina broad (Fig. 1b); spines of anterior lamina slender, distinctly shorter than length of medial cleft. Mesal margins of hamular processes distinctly parallel, posterior margins diverging at an angle of about 90° in ventral view (Fig. 1b). Posterior portion of sub-basal concavity of first article of vesica spermalis (V1) with borders not inflated (Fig. 1d); dorso-medial process present on V4 (flagellum sensu von Ellenrieder 2002), basally with a pair of lateral lobes covered with microtrichia (Fig. 1d); dorso-medial process elongated, curved ventrally, with a blunt thumb-like branch distal to apex of article, curved dorsally (Fig. 1d). Spines on dorsal carina absent on segments S1-2 and S8-10, present only posterior to transverse carina on S3-7; dorsal carina on S10 forming a mid-dorsal blunt elevation, not a distinct keel. Cerci uniformly black, slender, distinctly longer than S9+10 (Figs 1e, f); sub-parallel in dorsal view and moderately concave in lateral view; internal blade widening progressively from base to attain maximum width in the middle; external margin almost straight in lateral view, not distinctly angled between stem and base of lamina (Fig. 1e); sub-basal internal area not developed into a tubercle; ventral base of lamina not forming a ventral tubercle-like prominence; internal margin and internal blade of lamina with long black setae; ventral face of apical $\frac{1}{3}$ of lamina distinctly concave; apical half of lamina straight in dorsal view, slightly curved inward; apex blunt, curved inward in dorsal view (Fig. 1f). Epiproct distinctly bilobed apically, curved upward, reaching mid-length of cerci distally (Figs 1e, f).

Measurements: Total length (including appendages) 76.3; head maximum width 10.4; Hw length 49.0; Hw width 13.7 (from nodus to end of MP); Pt length, left Fw 4.5; abdomen total length (excluding appendages) 51.6; ventral tubercle S1 height 0.3; ventral projection of genital lobe 0.8; cerci length 6.2; epiproct length 3.6.

Variation in paratypes

One of the paratypes was excluded from description of colour pattern due to bad preservation condition.

Head: Occipital triangle with a greenish medial stripe, laterally black.

Thorax: Antehumeral stripe 3.6-4.5 long, width at mid-length 0.7-0.8; mesepimeral stripe 6.2-6.7 long and 1.3-1.4 wide at mid-length; metepimeral stripe 6.2-6.7 long and 1.6 wide. Pt brown to black, darker dorsally; – Venation (left/right). – Ax Fw 19-21; in Hw 12-15. Px in Fw before Pt 14-16; Hw 15-18. Discoidal triangles with 3-5 cells in four wings, one paratype with the basal cell of two wings, a Fw and a Hw, uncommonly divided. Supratrangles with 4-5 cells in Fw; 4 in Hw. Anal loop with 10-11 cells. Cubito-anal space 5 crossveins in Fw; 4-5 in Hw. Number of rows of cells between fork of IR₂ at level of distal end of pterostigma 3-4 in four wings. Number of cells between point of origin of IR₂ fork and Rspl 5-6 in Fw; 5-6 in Hw. Maximum number of cells between MA and Mspl 3-4 in Fw; 3-4 in Hw.

Abdomen: S1 with an additional dorsal medio-basal yellowish spot (Fig. 1a); AD present on S2, limited to anterior region, not reaching medial level of MD; AL present on S2-5 and S8, very small; MD present on S2-7, general form triangular to semi-circular, elongate on S2 and S3; PD present on S2-9, the pair almost confluent on S2-8, separated by dorsal carina; PL present on S2-3, semicircular, not connected with PD. Auricles with three or four distal teeth.

Measurements: Total length (including appendages) 71.3-73.8; head maximum width 10.5-10.8; Hw length 47.4-48.8; Hw maximum width 13.4-14.3; Pt length, left Fw 3.7-3.8; abdomen total length (excluding appendages) 43.8-48.8; ventral tubercle S1 height 0.2-0.3; ventral projection of genital lobe 0.7-0.8; cerci length 6.0-6.8; epiproct length 3.0-3.5.

Description of ultimate stadium larva (by supposition)

Head: Mandibular formula L 1234 0 ab (k) / R 1234 y a(m1)b (k). Labium when folded, reaching anterior border of metathoracic coxae posteriorly; movable hooks about 1.75 times as long as outer margin of first palpal article of labial palps (Fig. 2a); distal and outer margins of palpal lamina forming an angle of ca 90°; distal margins of palpal laminae, when the palps closed, forming an angle of ca 15°, and pair of end hooks apparently not overlapping (Fig. 2a).

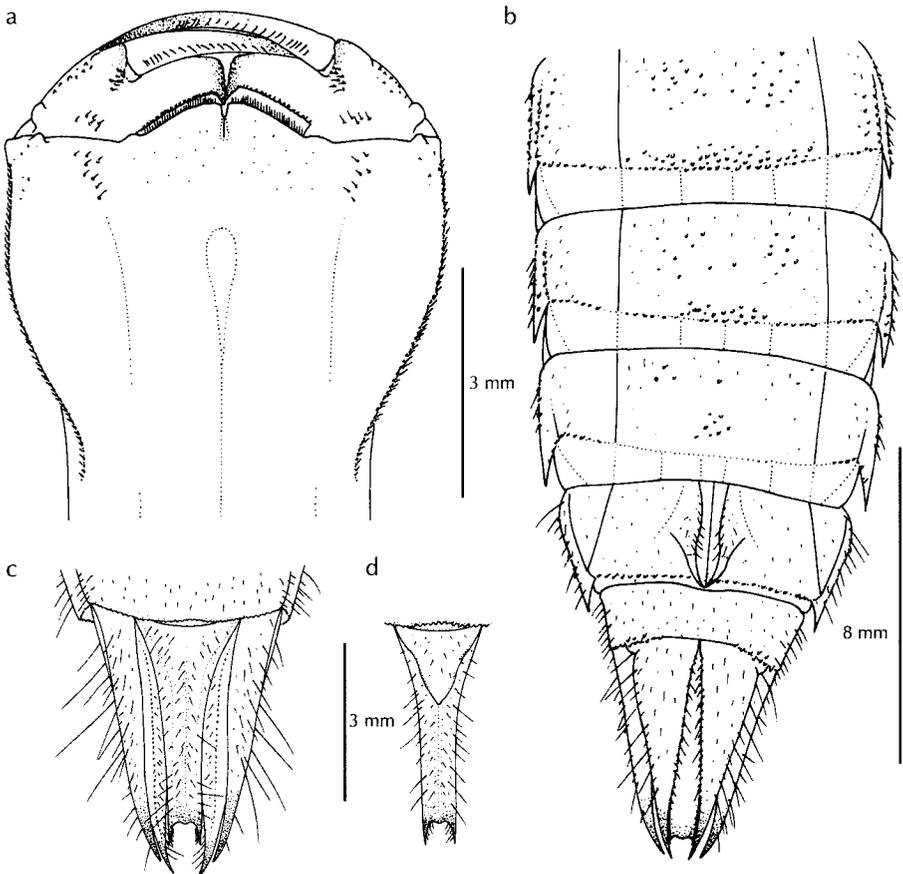


Figure 2: Ultimate stadium larva of *Castoraeschna corbeti* sp. nov. — (a) ♂ labium, dorsal view; (b) ♂ S6-10, ventral view; (c) ♂ S10 and anal pyramid, dorsal view; (d) ♂ epiproct, dorsal view.

Abdomen: Lateral spines of S7 almost reaching distally level of posterior margin of adjacent membrane (Fig. 2b); lateral spines of S9 almost reaching middle portion of S10. Complete rows of spinules on posterior edge of ventral esclerites in S1–7 and S9, and limited to carinae of lateral sclerites only in S8 and S10 (Fig. 2b); S1–8 with scattered spinules on sternites. Female gonapophyses barely surpassing posterior limit of S9 (Fig. 2b); ventral pair slightly longer than lateral one. Epiproct with weak continuous medio-dorsal carina (Figs 2c, d), especially distinct in dorso-lateral view; base of male epiproct with a triangular projection, extending about $\frac{1}{3}$ of appendage length (Fig. 2d).

Measurements (male and female larvae, respectively): total length (including appendages) 42.0/47.0; head median length 7.0/7.7; head maximum width 10.0/10.7; right antenna length 2.9/2.9; antennomeres length (from basal to apical) 0.35, 0.40, 0.70, 0.36, 0.38, 0.35, 0.35/0.35, 0.40, 0.72, 0.38, 0.43, 0.38, 0.33; prementum median length 8.8/9.2; prementum maximum width 5.7/6.1; posterior right wing case length 10.5/10.5; posterior right femur length 8.4/8.6; abdomen length (excluding appendages) 21.3/28.5; abdomen maximum width (at S7) 9.1/8.9; right female gonapophyses length (measured from posterior limit of S8) 2.6; epiproct length (in right lateral view) 4.2/4.3; projection of male epiproct length 1.5; right cercus length (in right lateral view) 4.8/4.8; right paraproct maximum length (in right lateral view) 5.1/5.1.

Diagnosis

A dark reddish, green-spotted robust aeshnid, typical of *Castoraeschna*. It can be distinguished from all other species of the genus by the following combination of characters: postfrons without a T-spot, with carina at junction of antefrons and postfrons black (Plate VIa); antefrons with a semicircular blackish spot connected with the black carina; costal wing margin black; brace vein distinct, oblique, perfectly aligned with proximal end of Pt; PD on S8–9 very narrow, not covering more than $\frac{1}{4}$ of lateral area of respective tergite (Fig. 1a); vesica spermalis with an elongated dorso-medial process on V4, curved ventrally, with a short and blunt dorsally curved expansion distal to apex of article (Fig. 1d); cerci external margin almost straight in lateral view, without a distinct angulation between stem and base of lamina (Fig. 1e); sub-basal internal area of stem cerci without a tubercle; cerci apex blunt both in lateral and dorsal views (Figs 1e, f). Larva presents the following exclusive characters: complete rows of spinules on posterior edge of ventral esclerites in S1–7 and S9, and limited to lateral sclerites of carinae only in S8 and S10 (Fig. 2b); S1–8 with scattered spinules on sternites.

Ecological data

The Floresta Nacional de Carajás (Carajás National Forest), a federal conservation unit under regime of concession for sustainable use, was established by decree 2,486 of the Brazilian government in February 1998. The area encompasses 411,948.87 ha within municipalities of Água Azul do Norte, Canaã dos Carajás, and Parauapebas, including the area of Serra dos Carajás in SE Pará State. Climate is rainy tropical, with a severe dry period during winter. Annual precipitation ranges between 2,000–2,400 mm and annual average temperature is around 24°C, with hottest period between July and September. Average relative humidity is around 80%. The Serra dos

Carajás represents the biggest iron mine in the world, bearing besides manganese, gold, and copper (ICMBIO 2009).

The specimens of *Castoraeschna* studied were found at a small shaded second-order stream section, ca 3 m width, shallow with a maximum depth of 20 cm outside pools (Plate VIb). Adults were observed and collected in flight along margins. Stream bed was composed mainly of pebbles and boulders, with allochthonous organic matter deposited at various points, from which larvae were obtained. The stream was located within primary forest (Amazonian liana forest) in a valley surrounded by natural areas of “Canga”, an outcropping of iron ore concretions forming irregular stony fields colonized predominantly by herbaceous or shrubby vegetation (Secco & Mesquita 1983). In one of the nearby fields, an enormous mine owned by the Carajás Iron Ore Project from the Brazilian miner Vale, the world’s biggest iron ore producer and exporter, is in activity. Unfortunately, this forest is under the strong and increasing impact of mining, and will probably disappear in few years. The main upper section (first order) of the surveyed stream was completely destroyed in the last two years by the runoff of mine by-products and deforestation around its margins.

The odonate fauna of the Floresta Nacional de Carajás is very rich, with more than 100 species found during surveys conducted between 2005–2008 (APP unpubl.). At the same collecting point of *C. corbeti* sp. nov. adults of 27 other species were collected, with predominance of *Chalcopteryx rutilans* (Rambur, 1842) (Polythoridae) and an unidentified species of *Heteragrion* (Megapodagrionidae).

DISCUSSION

Castoraeschna corbeti sp. nov. is very similar to *C. longfieldae* and *C. coronata*, keying out between them in Dunkle & Cook’s (1984) and Heckman’s (2006: 460) keys. These three species share many features, such as postfrons without a T-spot but with carina at junction of antefrons and postfrons dark (Plate VIa); brace vein distinct, obliquely positioned in relation to other Px, and generally perfectly aligned with proximal end of pterostigma; dorso-medial elongated process of V4 with a short and blunt dorsally curved expansion (Fig. 1d); sub-basal internal area of stem of cerci without a tubercle (Fig. 1e); and ventral base of lamina of cerci not forming a ventral tubercle-like prominence in lateral view (Fig. 1e).

Individuals of *C. longfieldae* can be easily separated from those of *C. corbeti* by their costal wing margin ochraceous, lighter than other veins, PD on S8-9 large, covering generally $\frac{1}{3}$ or more of lateral area of respective tergite, and cerci external margin distinctly angled between stem and base of lamina.

Although poorly characterized in its original description, it is evident that *C. coronata*, described from a single male from Rio Songo, Bolivia, is close to *C. corbeti* but is clearly a distinct species. Colour pattern and cerci structure of the former are distinctive: PLs are absent on S3, MDs are present on S8, PDs are absent on S9-10, cerci apices are pointed both in lateral and dorsal views, and somewhat curved outward in dorsal view, as seen in the unique original figure by Ris (1918: fig. 110). The description presented for *C. coronata* in Calvert’s (1956) revision, although very detailed and accompanied by many figures, was not considered here for comparison with *C. corbeti* because Calvert did not examine the type of *C. coronata* and only

considered a series of five males from Satipo, Peru for the treatment of that species in his revision. Cerci and colour pattern of these individuals (Calvert 1956) seem to be very different from those depicted and described for *C. coronata* (Ris 1918), and we consider they probably belong to another species.

The larva of *C. corbeti* keys to *C. longfieldae* in Carvalho et al. (2006), but it can be distinguished by the complete rows of spinules adjacent to sternal and ventral intersegmental membranes on S1-7 and by the scattered spinules on sternites S1-8 (Fig. 2b), conditions which are unique for *C. corbeti* among the six described larvae of the genus.

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