Odonatologica 14 (1): 45-56 *March 1, 1985*

DESCRIPTION OF *AESHNA (HESPERAESCHNA) EDUARDOI* MACHADO, 1984, FROM THE MOUNTAINS OF MINAS GERAIS, BRAZIL (ANISOPTERA: AESHNIDAE)

A.B.M. MACHADO
Department of Morphology, Institute of Biological Sciences,
University of Minas Gerais, BR-30000 Belo Horizonte, Brazil

Received and Accepted October 22, 1984

Subsequent to a preliminary description in *Resumos XI Congr. brasil Zool.*, Belém (1984), p. 161, the sp. is here described and figured in detail (♂ holotype, ♀ allotype: Reserve of Catarina, Minas Gerais-Brumadinho, S of Belo Horizonte, 21-VI-1983, deposited in author's collection; numerous ♂, ♀ paratypes from the same locality and from Poços de Caldas). The sp. is close to *A. punctata* Martin, 1908, from which it differs in having pale ventral tergal spots in the abdomen, a dark band in the anterior part of the frons and metepimeral stripes broader than the mesepimeral ones, in addition to small differences in the anal appendages. It appears to be confined to certain iron rich habitats some of which are now under intense environmental pressure, and the red data book category of vulnerable is proposed to it.

INTRODUCTION

Collecting trips to certain mountain regions of Minas Gerais yielded several specimens of an *Hesperaeschna* which was at first identified by myself and by SANTOS (1966) as *A. punctata* Martin, 1908, based mainly on the very characteristic anal appendages. However, it was later realized that Martin's description of *A. punctata* could be applied to at least two different, although closely related, species. Thanks to the help of Prof. Jean Legrand of the Paris Museum I had the opportunity to examine and redescribe Martin's types of *punctata,* thus defining the characters of this species (MACHADO, 1985). The species initially identified as *punctata* proved to be new and has been named *A. eduardoi* in a preliminary publication in which the characters distinguishing it from the "true" *punctata* were given (MACHADO, 1984). A complete morphological description of the new species is now made, together with some

taxonomical, ecological and conservational notes. Since almost nothing is known about the color of living South American aeshnids, we deemed it interesting to describe in detail and to illustrate the colors of *A. eduardoi.* The color notation adopted is that of KORNERUP & WANSCHER (1967).

This beautiful species is dedicated to my companion of odonatological excursions, my son, Eduardo.

DESCRIPTION

AESHNA (HESPERAESCHNA) EDUARDOI MACHADO, 1984

Figures 1-6

Material — BRAZIL, Minas Gerais-Brumadinho (S. of Belo Horizonte): Reserve of Catarina: **holotype** ♂, **allotype** ♀, 1 ♂ paratype, 21-IV-1983, A., E. & P. Machado leg.; — 3 ♂, 21-IV-1981, A. & E. Machado, and J.P.C. Castro leg.; — 7 ♂, 20-II-1982, A., E. & P.A. Machado leg.; — 1 ♂, 8-I--1984, A. & E. Machado leg.; — Ibirité (S. of Belo Horizonte): Reserve of Tabuões, 1 ♂, III-1984, Neuber leg.; — Morro do Ferro, Poços de Caldas, 1 ♀, 26-VIII-1967, O.A. Roppa leg.; — 1 ♂, 1 ♀, 6-II-1964, N. Santos leg.; — 3 ♂, 1 ♀, 3-III/29-II-1964, J. Becker & O.A. Roppa leg. — Total: 18 males and 4 females. All material deposited in the author's collection, except the paratypes from Poços de Caldas, which are deposited in the National Museum, Rio de Janeiro.

Male. — Head (Fig. 1) — Labium bluish white (23A2). Labrum light turquoise blue (24A4), distal margin narrowly edged with brown, a black line on the clypeo-labral suture. Anteclypeus yellowish blue. Clypeus light turquoise blue (24A4) becoming lighter laterally, a dark line on the fronto-clypeal suture, enlarged into a triangular area toward the eye. Vertical surface of frons light turquoise blue (24A4) becoming yellowish laterally toward the eye. A transverse black band 0.3-0.7 mm wide, occupying the upper third or fourth of the anterior (vertical) surface of frons, continuous with the head of the dark T spot (Fig. 1). Dorsal surface of frons light turquoise blue (24A5) becoming greenish toward the eye. Black T spot (Fig. 1) with a stem which is 1.3-1.4 mm wide at mid length, slightly constricted anteriorly, bordered laterally by a narrow yellow stripe 0.3-0.4 mm wide. A black transverse basal stripe embracing the vertex, the ocelli and the bases of the antennae, connected with the fronto-clypeal black line along the eye margin of the frons (Fig. 1). Vertex yellow. Occiput yellowish green. Eye brown with bluish tinges except for a postero-inferior yellowish green (30A6) area narrowing into a band along the posterior eye rim.

Thorax (Fig. 6) — Brown. Antehumeral stripes light green (27A5) turning into yellow below, 3.3-3.8 mm long, maximum width 1.0-1.3 mm at mid-length, anterior end almost pointed and reaching the anterior margin of the mesepisternum, hind end 1.1-1.4 mm distant from the carina of the antealar sinus. Mesepimeral stripe (Fig. 6) greyish yellow (1B6), 6.5-7.2 mm long and 1.1-1.2 mm wide at above mid length. Metepimeral stripe (Fig. 6) greyish yellow (1B6), 5.7--6.2 mm long and 1.6-2.0 mm wide at above mid length, becoming narrower toward the lower end. Legs dark, except for the proximal two thirds of femora

which are reddish brown. Wings hyaline, venation black except for the costa, nodus and some of the more anterior crossveins which are yellow (Fig. 6). Pterostigma yellowish brown, membranule dark brown, whitish anteriorly.

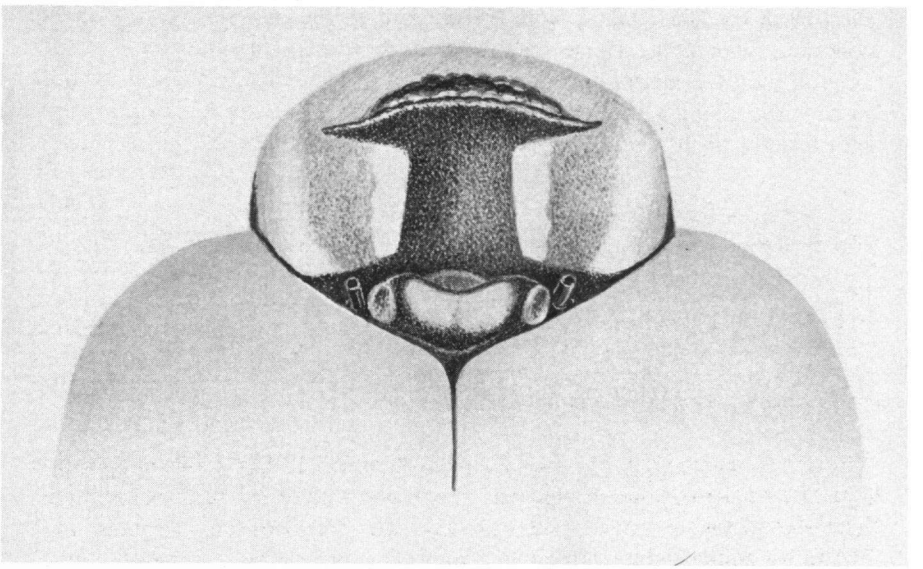


Fig. 1. *Aeshna (H.) eduardoi* Machado, 1984, holotype male. Frons in dorsal and slightly anterior view.

Venation — Antenodals in forewing (FW) 15 (45%), 16 (42%), 14 (6%), 13 (3%), 17 (3%); in hindwing (HW) 10 (56%), 11 (32%), 9 (12%). Postnodal in FW 12 (53%), 11 (26%), 13 (12%), 10 (9%); in HW 13 (43%), 15 (24%), 14 (15%), 12 (9%), 11 (6%), 16 (3%). Triangles with 4 (80%) or 5 (20%) cells in FW and 4 (94%) or 5 (6%) cells in HW. Supratriangles with 2 (70%) or 3 (30%) crossveins in FW and HW. Anal triangle with 3 (97%) or 2 (3%) cells. Anal loop with 9 (65%), 10 (32%) or 7 (3%) cells. Cubito-anal crossveins in FW 6 (70%), 5 (18%) or 7 (12%); in HW 5 (85%), 6 (12%) or 4 (3%). Number of cells between the fork of IR3 at the level of the distal end of the pterostigma 4 (91%) or 3 (9%) in FW and 4 (94%) or 3 (6%) in HW. Second reinforced antenodal in FW 5th (100%), in HW 5th (94%) or 6th (6%).

Abdomen (Fig. 6) — Pale spots in all segments, disposed as follows (Nomenclature according to WALKER, 1912): AD present in all segments, except 1 and 8-10, connected with MD by a mid-dorsal line on 2. MD fused with each other and with PD on 2, fused with each other and with ML on 3, triangular, fused with each other and connected with ML on 4-6, separated from ML on 7-8, separated from each other on 8, absent from 9-10. PMD (CALVERT, 1956)

fused with each other on mid-dorsal line on 7-8, forming a single rounded dorsal spot connected with MD and PD on 7 and a transverse rectangular spot on 8, absent from the remaining segments. PD connected with each other on 1, fused with each other, with MD and ML + PL on 2, separated from each other on 3-10. AL absent on 1, extending from the anterior to the transverse carina on 2-8, continous with a transverse narrow stripe bordering the transverse carina anteriorly on 4-7, absent on 9-10. ML absent on 1, fused with PL and PD on 2, fused with MD on 3, connected with PL on 8; on 4-8 ML appears as a trapezoid spot fused with the ventral tergal spots across the lateral carina which becomes pale at the contact area. PL represented by a triangular spot on 1, fused with ML and PD on 2, a small elongated spot on 3-7 (absent from 6-7 in some specimens), very conspicuous and connected with ML and PD on 8, connected with PD on 9-10. Ventral inflexed surface of each tergite of segments 4-8 with a pale rectangular spot occupying its proximal 3/4. The spots are laterally adjacent to the carina and have a medial concavity that delimitates together with that of the opposite side, a dark rounded area in the middle of each segment. On segment 2 there are a small, yellowish green, comma-shaped transverse spot in front of the dorsal part of the transverse carina and a small elongated bluish spot on the outer surface of the genital lobe, both of uncertain homology. Abdominal colors (Fig. 6): ground color dark brown becoming darker on the last five segments except for the sternites of 9 (behind the genital valvules) and 10, which are pale yellow. Lateral carinae dark except on the areas of contact between ML and the ventral tergal spots which become blue. Superior appendages brown, inferior appendages yellowish brown, with the borders dark brown. Pale tergal spots colored as follows: AD light green (27A5, 26A5) on 7, MD turquoise blue (24A6) on 2 light green (27A5) on 3-6, light green (26A5) on 7, greenish yellow on 8. PL of 1 and anterior parts of AL and ML of 2, greenish-yellow (1B6). Ventral tergal spots bluish white (24A2). Remaining spots light

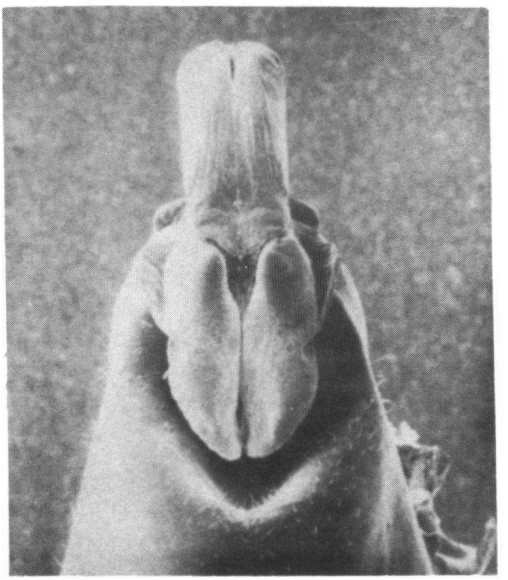
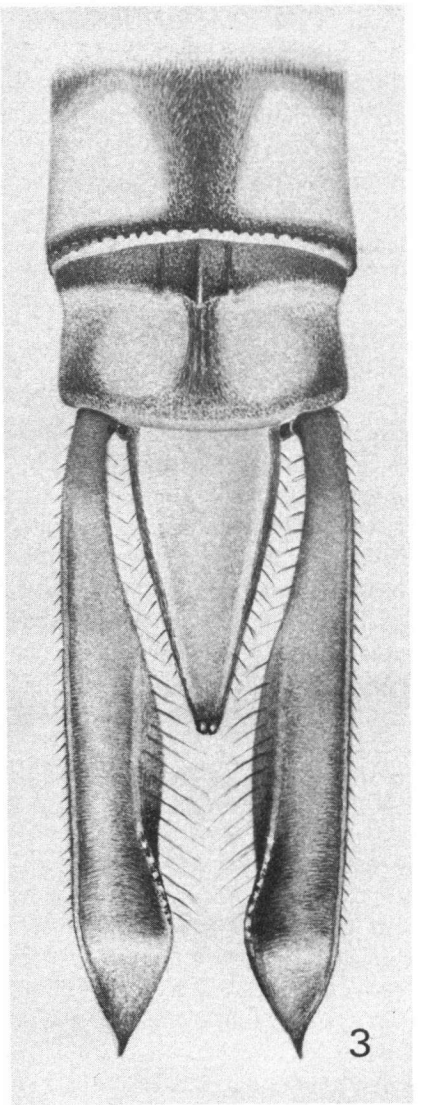
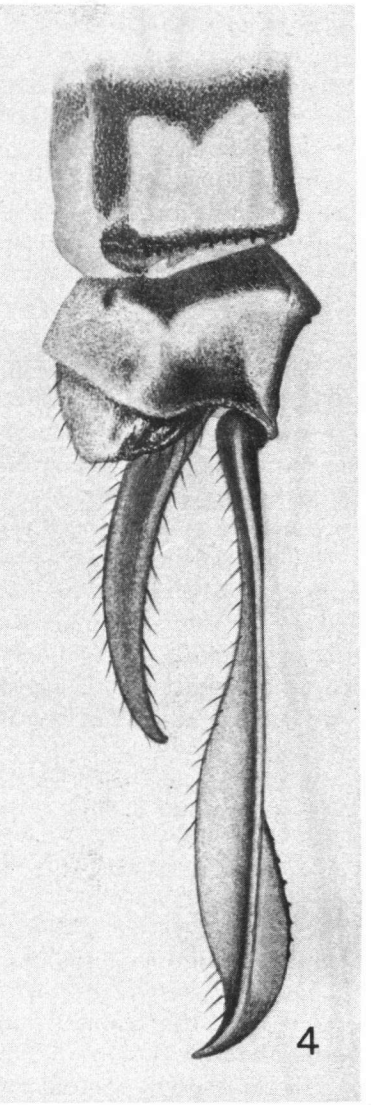


Fig. 2. *Aeshna (H.) eduardoi* Machado, 1984, paratype. Scanning electron micrograph of the penis.





Figs 3-4. *Aeshna (H.) eduardoi* Machado, 1984, paratype. Abdominal segments 9-10 with appendages in dorsal (Fig. 3) and left lateral (Fig. 4) view.

turquoise blue (24A5).

Structural characters (Figs 2-4) — Auricles with two distal teeth. Abdominal segment 1 with a mid-ventral tubercle bearing many spinules. Anterior lamina

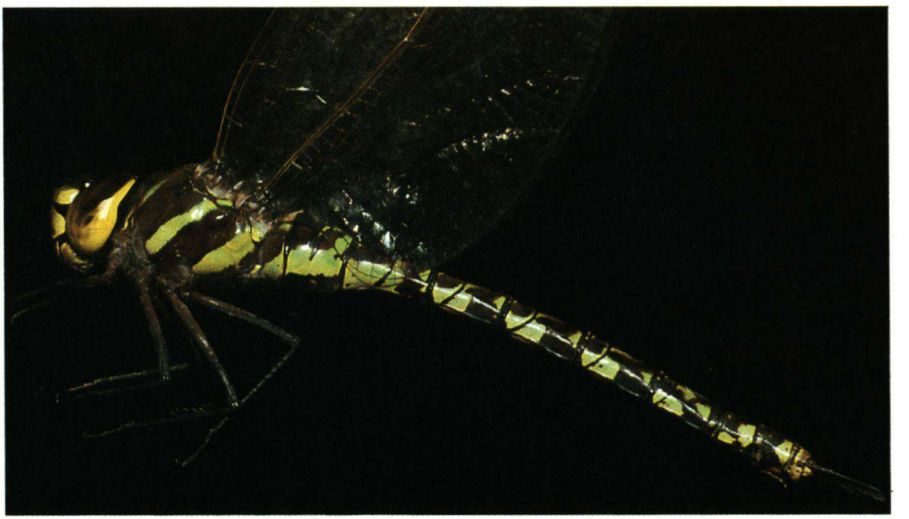
cleft to, or almost to, the level of the hind end of the sternum of abdominal segment 1, its spines (length 0.49 mm) reaching almost to the level of the hind margin of the hamular process, in profile, their apices do not project ventrally to the margin of the genital fossa. Posterior part of the lateral margin of the genital fossa produced ventrally to form the genital lobe at an angle of about 40°. The genital lobe projects ventrally 0.8-1.2 mm beyond the prolonged margin of the genital fossa and its length at base measured 1-8-2.2 mm. The margin and the lateral surface of the genital lobe are provided with spinules. Penis as shown in Figure 2. Dorsum of abdominal segment 10 with a mid-dorsal tooth (Figs 3-4) and, on each side of it, one or two blunt carinae. Superior appendages (Figs 3-4) slender, slightly longer than abdominal segments 9 + 10. Narrow at base, widening progressively to attain maximum width (0.9-1.1 mm) at the distal two thirds, narrowing again abruptly toward the apex. A superior carina extends for more than the distal half of the appendage increasing in height on the distal third to form an arch very distinct in lateral view (Fig. 4). The arch attains a height of 0.35-0.5 mm (measured as indicated by CALVERT, 1956) and shows 3-9 crenulations at its margin. The inner margin of the appendage is sinuous, while the outer margin is straight almost to the apex, where the two margins and the down-curved prolongation of the arch, converge to form a sharp-pointed apical spine. In the normal position of the appendages the archs are inclined medially and the apical spines slightly directed laterally so that, in dorsal or dorso-posterior view, the apices of the appendages are slightly divergent (Fig. 3). Inferior appendage about half as long as the superior and shaped as shown in Figures 3 and 4.

Measurements (mm) — Holotype, with size ranges of 18 paratypes (in parenthesis): total length including appendages 70 (70-72) abdomen without appendages 49.3 (47.8-51.0), superior appendages 5.9 (5.8-6.1), hindwing 45.0 (44.1-47.3), pterostigma 3.2 (3.2-3.6).

Female. — Head (Fig. 5) — Differs from that of the male as follows: labium greenish, becoming brownish medially. Labrum, clypeus and anterior surface of frons light green (28A5) becoming yellowish green (30A6) laterally. Dorsal surface of frons with the area lateral to the yellow stripe, dull green (27E4) followed by green (27A6) more laterally. Vertex and occiput greenish yellow (1A7). Eye brown (greenish tinges?), except for its postero-inferior area which is greenish yellow (1A7).

Thorax (Fig. 5) — Antehumeral stripes green (27A6) turning into yellow below. Lateral stripes yellowish green, the metepimeral (30A7) slightly more yellowish than the metepisternal (30B7). All other features as in the male.

Venation — Antenodals in FW 15 (57%), 16 (28%), 17 (14%); in HW 9 (28%), 10 (28%), 11 (28%), 12 (14%). Postnodals in FW 11 (86%), 12 (14%); in HW 13 (72%), 14 (28%). Triangles with 4 (86%) or 5 (14%) cells in FW and 4 (100%) cells in HW. Supratriangles with 3 (86%) or 2 (14%) crossveins in FW and 2 (100%) crossveins in HW. Anal loop with 11 (42%), 10 (28%), 9 (14%) or 12 (14%) cells.



Figs 5-6. *Aeshna (H.) eduardoi* Machado, 1984: holotype male (bottom), and allotype female (top), in lateral view.

Cubito-anal crossveins in FW 6 (86%) or 7 (14%), in HW 5 (100%). Number of cells between the fork of IR3 at the level of the distal end of the pterostigma in FW and HW 4 (100%). Second reinforced antenodal in FW 5th (100%), in HW 5th (72%) or 6th (28%).

Abdomen (Fig. 5) — Arrangement of the pale spots as in the male, except for the following: MD separated or only narrowly connected with PD on 2. PMD absent from 8. PD fused with each other on 10 so that the segment is entirely pale. PL very small on 3-5 and absent from 6-10. Ventral tergal spots absent from 8. Abdominal colors in life (Fig. 5): ground color dark brown becoming darker toward the distal segments. Ventral part and distal half of the dorsal part of 10, dull yellow (3B4). Lateral carinae as in the male. Appendages dark brown. Pale tergal spots as follows: AD of 3, MD of 8, the band formed by fusion of the lateral spots on 2, AL of 3 and a small comma-shaped transverse spot in front of the dorsal part of the transverse carina of 2, yellowish green (30A7). Ventral tergal spots greyish green (30B5). All the remaining spots green (28A7).

Structural characters — Abdominal segment 1 with a mid-ventral tubercle bearing many spinules. Segment 10 with a mid-dorsal longitudinal carina poorly developed and sternum provided with about 100 spinules grouped in two paired areas. Ovipositor projecting caudally beyond the level of the hind edge of the tergum of 9, genital valves reaching to, or slightly beyond that level. Anal appendages much longer than 9 + 10, about as long as 8 + 9 with maximum width of 1.2-1.3 mm at mid length, the outer margin straight almost to the apex, the inner margin convex throughout, a longitudinal carina distinct for the entire length, apex acute, terminating in a minute spine.

Measurements (mm) —Allotype, with size ranges of 3 paratypes in parenthesis: Total length including appendages 72 (70-72); abdomen without appendages 48.1 (47.2-49.6); appendages 6.9 (6.3-6.7); hindwing 46.0 (45.8-47.9); pterostigma 3.8 (3.5-3.8).

DISCUSSION

Together with *A. punctata* Martin and *A. decessus* Calvert, *A. eduardoi* belongs to the group *punctata* (MACHADO, 1984) of the subgenus *Hesperaeschna.* The main characteristic of this group is the peculiar shape of the male superior appendages, whose apex forms a sharp spine directed ventrally and caudally in prolongation of the superior carina, thus presenting an appearance comparable to the beak, or to the claw of a bird. Within this group *eduardoi* and *punctata* can be readily separated from *decessus,* by the presence of a spine on the anterior lamina of the male, which is absent in *decessus.* The characters of punctata have been recently studied by the redescription of the lectotype (MACHADO, 1985) and it is clear that the species is very close to *eduardoi.* I have compared *eduardoi* with specimens from a large series (62 males and 6 females) of *punctata* from the region of Caparaó at the Minas Gerais-Espirito

Santo border. Structurally the two species are very similar. However, small but consistent differences were observed in the male superior appendages which are slightly longer and narrower in *eduardoi* and have the outer border straight in *eduardoi* and slightly convex in *punctata.* Besides, the apical spine is sharp-pointed in *eduardoi* and blunt-pointed in *punctata* and the apex of the two appendages, in dorsal, or dorso-posterior view are slightly divergent (Fig. 3) in *eduardoi* and slightly convergent in *punctata* (MACHADO, 1985, fig. 7). In addition to these structural differences males and females of *eduardoi* can be readily separated from those of *punctata* by the following differences in the color pattern:

(1) Black area on the anterior surface of frons occupying the upper third or fourth of this surface in *eduardoi* and reduced to a transverse line in *punctata.*
(2) Metepimeral stripe distinctly wider than the mesepimeral one in *eduardoi,* about equal in *punctata.*
(3) Abdominal segments 4-8 with pale markings on the ventral surfaces of terga in *eduardoi* which are absent in *punctata* (except at segment 8, in 60% of the specimens).

The pale markings in the ventral surface of the abdomen of *eduardoi* although very distinct in living or acetonized specimens, are more prone to fading than the dorsal ones. Since they are continuous with the medio-lateral spots (ML), the lateral carina becomes pale in the areas of contact. Fortunately these pale areas of the carina remain visible even in badly faded specimens.

It is unfortunate that almost nothing is known about the living colors in the South American species of *Aeshna* in marked contrast with the holarctic representatives of the genus. This is specially regrettable for the females, which, in holarctic species, present the interesting phenomenon of polychromatism (WALKER, 1912; DUNKLE, 1983) that has never been demonstrated for the South American species. The only female of *eduardoi* that I could study and photograph alive had predominantly greenish colors (Fig. 5), in marked contrast with the predominantly blue male (Fig. 6). This specimen is thus typically heterochromatic and it would be highly interesting to know whether an homochromatic color phase exists in females of *eduardoi.*

ECOLOGY

A. eduardoi was collected at Morro do Ferro near Poços de Caldas and at the Reserves of Catarina and Tabuões situated on the mountains to the south of Belo Horizonte. This range is made up mainly of dolomites at the base and iron formation at the top. It is chiefly a campo region ("campos rupestres") but there are also many areas of forests in the valleys, in the flancks of the mountains and along the streams. Blocks of "canga" (laterite) partly fill most of the streams and pools of the region whose beds have the characteristic red color of iron

sediments. The streams at the Reserves of Tabuões (altitude about 1000 m) and Catarina (altitude about 1200 m) have been dammed inside or near the forest, resulting in the formation of pools of different sizes used as water supply sources for the towns nearby. *A. eduardoi* was frequently observed patrolling the margins of some of these pools in a low and rapid flight. They were specially abundant in a small (about 20 x 5 m) and very shallow (maximum depth 0.8 m) pool at Catarina and rather rare in the larger and deeper pool of Tabuões. Although the general Odonata fauna of these pools is rather poor, due probably to the scarcity of macrophytes, they are very rich in aeshnids. Thus the following species (in order of frequency) have been recorded from the main pool at Tabuões: *Castoraeschna januaria* (Hag.), *C. longfieldae* (Kimmins), *C. castor* (Br.), *Aeshna eduardoi* Machado, Limnetron sp. (larva) and *Castoraeschna margarethae* Jurzitza. From the main pool of Catarina: *Aeshna eduardoi, Castoraeschna januaria* and *C. longfieldae* were reported.

The botanical landscape of Morro do Ferro (1541 m), situated near Poços de Caldas, has been described by SANTOS (1966) and looks similar to that of the mountains to the south of Belo Horizonte. Intense collecting of dragonflies has been performed around Poços de Caldas as part of a faunistic survey of the region (SANTOS, 1966). *A. eduardoi* was found only in pools and swamps formed by the south stream of Morro do Ferro and the species (under *punctata*) has been regarded by SANTOS (1966) as lentic. The habitats of *eduardoi* at Morro do Ferro have in common with those to the south of Belo Horizonte the richness in iron. Chemical analysis of the water of the south stream of Morro do Ferro (PIVÊTTE, 1983) revealed a high concentration of Fe^{2+} that precipitates to form red deposits of iron hydroxide in several areas of the stream and its pools. The fact that *A. eduardoi* prefers iron rich habitats, where most probably their larvae breed, appears to be an interesting ecological peculiarity of this species.

STATUS AND CONSERVATION

Conservation of the rich aeshnid fauna of the mountainous region near Belo Horizonte depends directly on the protection of the streams and pools where the larvae breed. Unfortunately deforestation and specially uncontrolled mining has considerably spoiled these streams by enhancing erosion and allowing large amounts of mining waste to be deposited in the stream beds. Many streams are also heavily polluted by the human activities in the area. However, relatively undisturbed aeshnid habitats still exist near Belo Horizonte thanks mainly to the efforts made by COPASA (Companhia de Saneamento de Minas Gerais) to protect the streams within their reserves. In some cases, however, these efforts are hampered by uncontrolled mining in the neighbourhood of the Reserves.

A stable population of *A. eduardoi* has been under observation at the Reserve of Catarina since 1981 and other populations are likely to exist in the region. In spite of that, the conservation of *A. eduardoi* is a matter of concern. Unlike the other aeshnids that coexist with it and have a large distribution (except *C. margarethae*), *A. eduardoi* appears to be confined to iron rich habitats in certain mountainous regions of Minas Gerais, most of which are now subject to intense

environmental pressure. Since this pressure is likely to increase in the near future I propose for *A. eduardoi* the Red Data Book category **"vulnerable"**.

ACKNOWLEDGEMENTS

This research was supported by FINEP and CNPq. I would like to thank Dr FABIO LUCIO RODRIGUES AVELAR, director of Companhia de Saneamento de Minas Gerais — COPASA, for allowing me free access to COPASA's Reserves near Belo Horizonte in order to study their rich dragonfly fauna. I thank also Prof. Dr NEWTON DIAS DOS SANTOS from Museu Nacional, Rio de Janeiro, for allowing me to study the specimens from Morro do Ferro, and Mr FERNANDO VAL MORO for the drawings that illustrate this article.

REFERENCES

CALVERT, P.P., 1956. The neotropical species of the "subgenus Aeshna" sensu selysii 1883 (Odonata). *Mem. Am. ent. Soc.* 15: V + 251 pp., 47 pls excl.

DUNKLE, S.W., 1983. Polychromatism in female Aeshnidae. *Selysia* 12 (1): 3-4.

KORNERUP, A. & J.H. WANSCHER, 1967. *Methuen handbook of color.* Methuen, London.

MACHADO, A.B.M., 1984. Estudo sobre as Aeshnas do grupo punctata com observações sobre os tipos de A. punctata Martin, 1908 (Odonata-Aeshnidae). *Resumos XI Congr. brasil. Zool.*, Belém, p. 161.

MACHADO, A.B.M., 1985. Notes on the types of Aeshna punctata Martin, 1908 (Odonata Aeshnidae). *Revta brasil. Zool.* 2. (In press).

MARTIN, R., 1908. Aeschnines. *Colls zool. de Selys Longchamps* 18: 1-84, pls 1-2 excl.

PIVETTE, F.R., 1983. *Estudo da composição química de águas do Morro do Ferro.* Tese de Mestrado, Pontifícia Universidade Católica, Rio de Janeiro.

SANTOS, N.D., 1966. Odonatas da região de Poços de Caldas, Minas Gerais. *Atas Soc. Biol. Rio de J.* 10(3): 65-69.

WALKER, E.M., 1912. The North American dragonflies of the genus Aeshna. *Univ. Toronto Stud.* (Biol.) 11: 1-213, pls 1-28 excl.