



Two new dragonfly species (Odonata: Anisoptera: Aeshnidae) from north-eastern India

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Abstract

Cephalaeschna acanthifrons sp. nov. collected from Eaglenest Wildlife Sanctuary, West Kameng District, Arunachal Pradesh, India, and *Planaeschna poumai* sp. nov. collected from two localities in Senapati District, Manipur, India, are described and compared with congeneric species. These records also represent the first reports of these obscure genera from India in the past 30 years.

Key words: New species, Manipur, Arunachal Pradesh, species description, taxonomy, Eastern Himalaya

Introduction

The genus *Cephalaeschna* was established by Selys (1883) with the description of *C. orbifrons* from “Bengale” based on a single female, while the genus *Planaeschna* was erected by McLachlan (1896) to accommodate species *P. milnei* originally described under the genus *Aeshna* Fabricius, 1775. Despite having a long historic record these genera remain poorly known, especially in Indo-China, where the diversity of these genera is highest. Fraser (1936) commented on this problem more than eight decades ago: “The genus *Cephalaeschna* is a difficult one to deal with owing to the paucity of the available material... the close similarity of species, and lastly the extremely poor and insufficient character of original descriptions”. Syoziro Asahina, who wrote numerous papers (e.g., Asahina 1981a&b, 1983, 1985) on this group echoed this opinion writing: “The quality of the specimens has been, in most cases, very unfavorable, the insects being teneral and crushed, and usually the color patterns have been badly obscured by decomposition” (Asahina 1981a). A late flying season (September–November), during which fewer surveys are undertaken, excellent flying skills, and shy habits have all contributed to the prolonged obscurity of these two closely related genera. Most species remain known only from the types, and many with only one sex described.

The genera *Planaeschna* and *Cephalaeschna* currently consist of 29 and 22 species respectively (Schorr & Paulson 2017). Five and one species of *Cephalaeschna* and *Planaeschna* respectively are reported from India (Subramanian 2014). In this study, we describe a new species of *Planaeschna* collected while surveying odonates in Senapati District, Manipur in October 2016; and a new *Cephalaeschna* from Eaglenest Wildlife Sanctuary, Arunachal Pradesh collected during insect surveys undertaken in 2015.

Materials and methods

Specimens were collected with insect nets and pinned in the field. Mid and hind legs were preserved in 100% molecular-grade ethanol to preserve DNA for future molecular analysis. Specimens were photographed using a Canon 1200D DSLR camera with a Canon 50mm macro lens (Canon Inc., Japan), external flashes and photographic umbrellas. A Leica MC 120 HD camera attached to a Leica S8 APO microscope (Leica

Microsystems, Germany) was used to take close-up images of the anal appendages. Multiple images were stacked for each specimen using the software CombineZ (Hadley 2010) to generate images with greater depth of field. Scale bars were added using Leica Application Suite (Leica Microsystems, Germany) and ImageJ (Schneider *et al.* 2012). The terminology used for abdominal maculation follows Walker (1912) with following abbreviations: S=abdominal segment, AD=anterio-dorsal, MD=medio-dorsal, PD=postero-dorsal, AL=anterio-lateral, ML=medio-lateral, PL=postero-lateral; fw= forewings, hw= hindwings. Wing terminology follows Riek & Kukalova-Peck (1984).

All specimens are now deposited in the research collections of the National Centre for Biological Sciences, Bangalore (NCBS).

***Cephalaeschna acanthifrons* sp. nov.**

(Figs. 1–2)

Holotype. ♂ (NCBS-AQ279), collected between Ramalingam camp and Lama camp, Eaglenest Wildlife Sanctuary, West Kameng District, Arunachal Pradesh, India (precise GPS coordinates unknown); 30.IX.2015; Tarun Karmarkar & Subhajit Mazumder leg.

Paratype. ♂ (NCBS-AQ373), same locality and collectors as the holotype; date of collection: 4.X.2015.

Etymology. The name '*acanthifrons*' means "pointed face", derived from the Greek *acanthi*[=thorn], and Latin *frons*[=forehead](Fig. 2a,b).

Description of the holotype. *Head.* Eyes colored dark green. Labrum greenish yellow, postclypeus greenish yellow with two irregular rounded brown markings on the basal half. Anteclypeus, labium, mandibles dark brown. Frons greenish yellow basally. This color gradually changes to dark brown towards the border so that the greenish yellow is framed by the dark brown markings. Frons >1/2 width of the face, pointed at apex with a small dark black median 'horn', pointed anteriorly in dorsal view. Dark brown near the vertex and the sides. Vertex black, postgenae with yellow markings on both sides near the eye margin, base of the antennae dark brown.

Thorax (Fig. 1b). Prothorax yellow on sides along with propimeron; median lobe and posterior lobe dorsally dark brown; mesostigma with greenish yellow markings on the sides. Synthorax with vivid green and yellow markings; dorsal carina black with two green yellow spots at the antealar ridge; the paired dorsal stripes on the mesepisternum of uniform width, anterior 1/4th narrowing outwards; mesepimeron with a broad green stripe almost covering it entirely, marked with a conspicuous circular yellow marking near the metastigma about halfway of the length of the stripe; metepisternum with a short triangular stripe; base of the metepisternum marked with a faint green-yellow triangular marking pointing outwards containing the metastigma; small yellow-green spots on both sides above the metepisternum; metepimeron with a green stripe narrowing anteriorly, with a dark brown basal margin; the green stripe marked with a conspicuous, slightly oblique, longitudinally oval yellow spot like the mesepimeronic stripe. Legs mainly colored with black and brown; coxae brown, marked with a small thin yellow marking on mid and hind legs posteriorly; femur and tibia mainly reddish brown, tarsi and the claws black; the junction of the femur and tibia black, the black marking continuing on the anterior femur about 2/3rd of its length.

Wings. Tinted brown, especially at the apices and the posterior margins; antenodals 19 in the fw, 15(left)–16(right) in the hw; triangle with 4 cells in the hw and 3 (left) and 4 cells (right) in the fw, anal triangle divided into 5 cells, anal loop divided into 6 cells; pterostigma maroon, weakly braced. IRP2 forking nearer to the pterostigma than the nodus.

Abdomen (Fig. 1a,b). Marked with greenish yellow, the dorsal markings not continuous; S1 with a small 'diamond-shaped' marking dorsally; laterally greenish yellow with the lateral markings connected on the dorsum anteriorly; S2 dorsally marked with a longitudinally triangular AD spot; paired MD spots very minute embedded in the supplementary transverse carina; the PD half of the S2 with a dorsal stripe broadening slightly towards the center connected to the AD spot; S2 with the ventral half irregularly brown, with a conspicuous AL greenish yellow spot, this longitudinally pointed marking continuing on the auricle till the apex; the anterior half of the auricle laterally bright green-yellow whereas the cavity and the posterior half brown, the serrations black; S3–S6 marked with paired triangular MD spots; S3–S6 thinly yellow at the PD edge this yellow marking continuing on the dorsal carina towards the MD spots but not reaching them, both the MD spots and the PD line reduced on S7; the MD and PD markings more bright yellow-green than the AD and ML markings; S3–S7 with a thin yellow AD

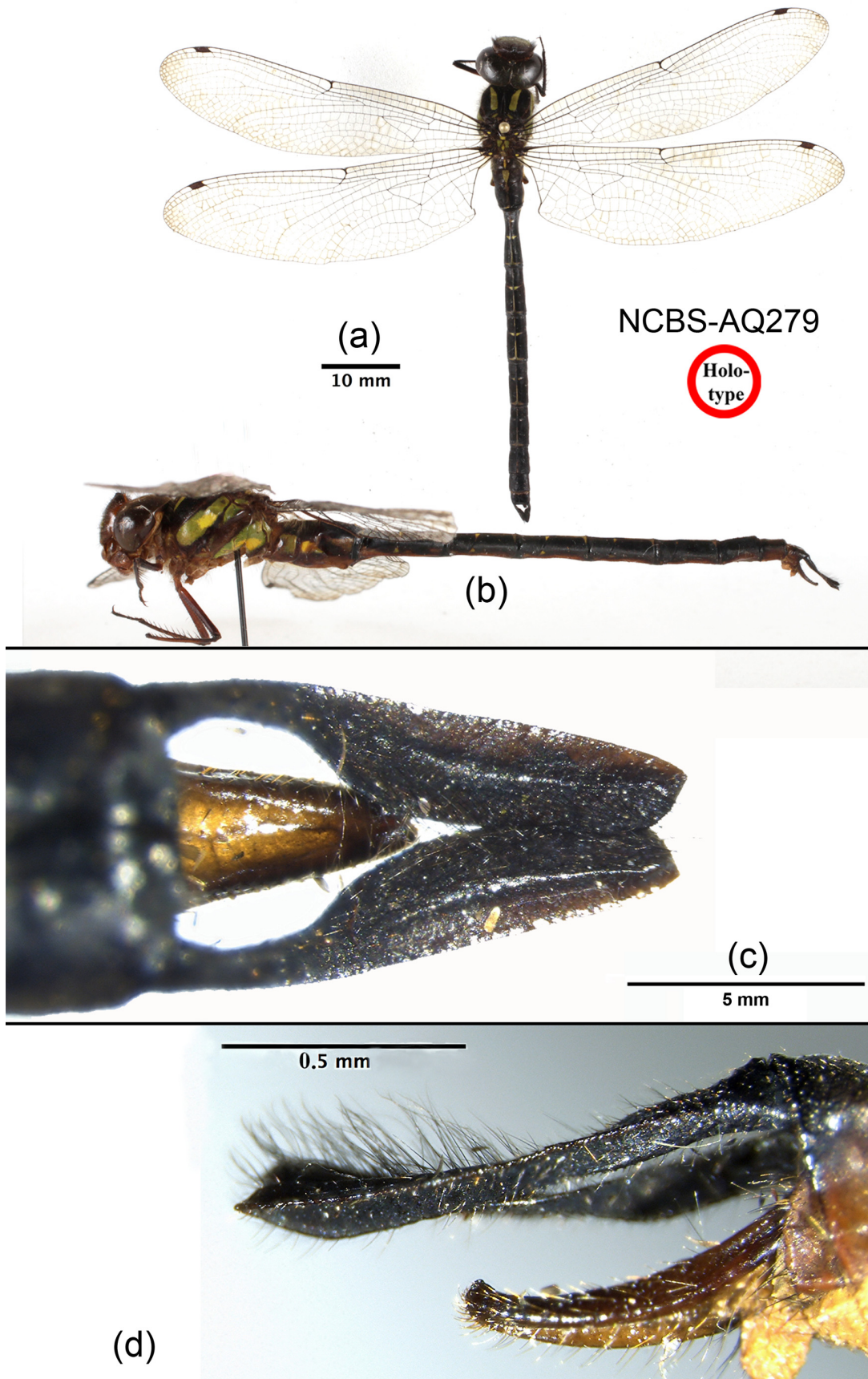


FIGURE 1. *Cephalaeschna acanthifrons* sp. nov., holotype male (NCBS-AQ279); (a) dorsal habitus, (b) lateral habitus, (c) anal appendages: dorsal view, (d) face, and (e) anal appendages: lateral view.

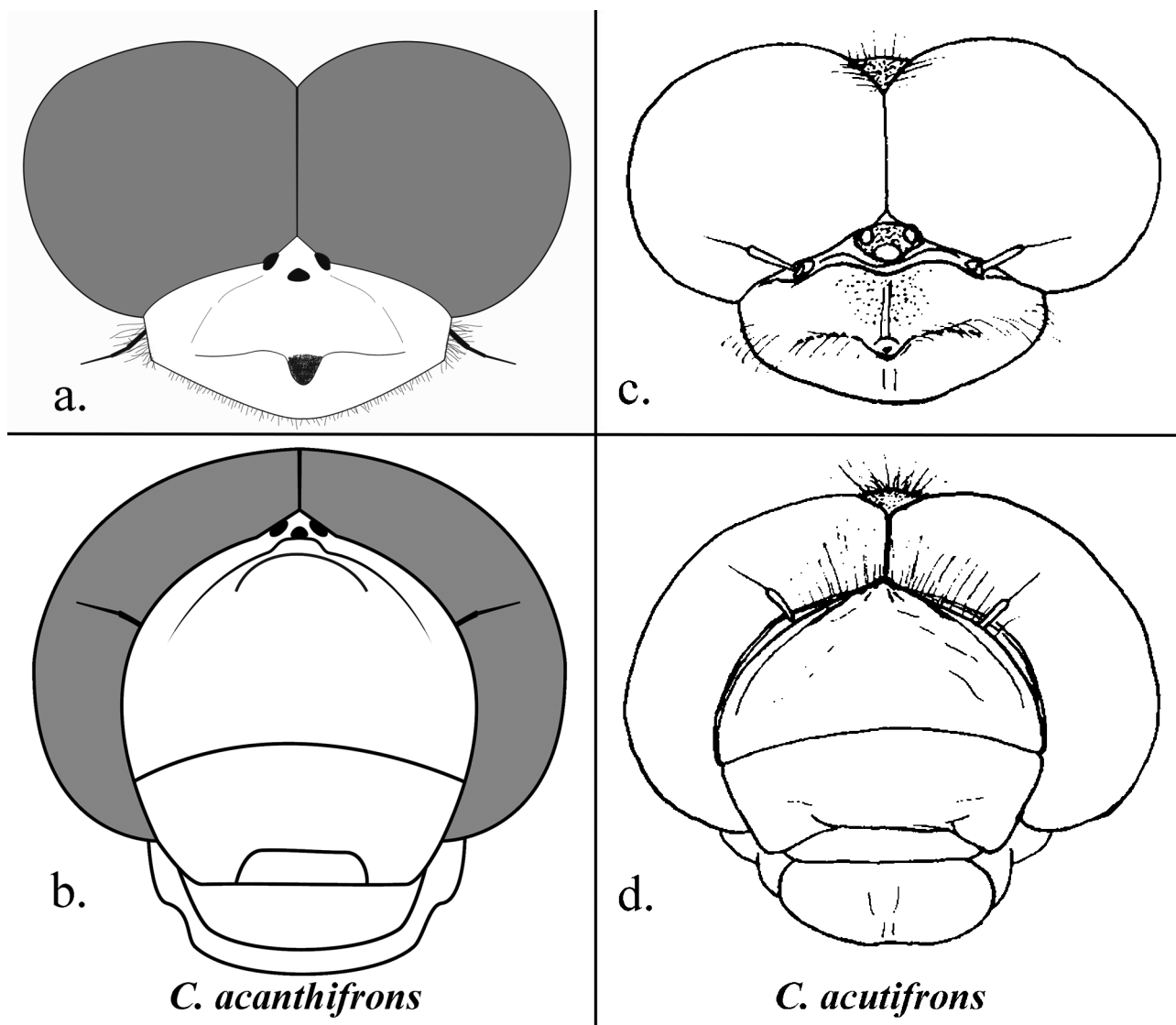


FIGURE 2. Comparison of heads of *C. acanthifrons* sp. nov.: a: dorsal, b: frontal, and *C. acutifrons* (Martin, 1909) [from Asahina 1981]: c: dorsal, d: frontal.

stripe, on S3 this line continuing about $\frac{2}{3}$ rd the length till the transverse carina (jugal line); not extending beyond $\frac{1}{2}$ of the jugal area in other segments, very faint in S6–S7; S8 with a triangular area of tubercles at the posterior end peculiar to this group of dragonflies; this triangular patch contains a small yellow line running about half the length of the segment; S10 with very small AD spots on both sides; longitudinally flattened; S9 and S10 with the ventral half dark yellow; a small triangular spot pointing upwards on the posterior side of the transverse carina on S3–S9, this marking connects very faintly to the MD spots via the transverse carina on S4–S5; S4–S8 with extremely small AL spots at the ventral edge of the segments; reduced on S7–S8.

Anal appendages (Fig. 1c,d). Ventrum of S10 and paraprocts covered with dried soil; cerci colored black, paraprocts dark brown. *Dorsally* posterior $\frac{2}{3}$ of cerci expanded, outer margin straight, inner margin curved, apical margin rounded pointing slightly outwards, outer margin of cerci faintly yellow. Paraprocts dark brown laterally, ventrally, and on dorsal margin. The central groove of the paraprocts dark-yellow. Paraprocts reaching about half the length of cerci in lateral view, slightly curved upwards, darkened at the apex. *Laterally* apex of cerci pointed; a medial ridge running on cerci, the ventral margin is straight while the upper margin is curved for apical $\frac{1}{3}$ of cerci, medially.

Measurements (mm): abdomen (including anal appendages)=38.9, hw=38, fw=37.4.

Variation in the paratype. Paratype is a younger male than the holotype (wings completely hyaline vs. wings tinted brown in the holotype). Triangle divided into 5 cells in all wings; anal loop 7-celled in right hw, 6-celled in

other three wings. Only the PL half of S1 marked with a green-yellow stripe connecting dorsally. The PD edge of the S2 marked thinly with yellow. The AL spots on S4–S8 larger and more conspicuous than the holotype, yellow line at the PD edge less broad. The yellow markings on the outer margin of cerci are very faint in the paratype compared to the type.

Measurements (mm): abdomen (including anal appendages)=38.5, hw=38.1, fw=37.6.

Female: Unknown.

Diagnosis. This species can be distinguished from its congeners by the following set of characters: (a) outwardly pointed apex of cerci in dorsal view; (b) distinctive abdominal markings; and (c) the apex of the frons elevated into a blunt ‘horn’. The dorsal stripe present on the posterior half of S3–S7 is thin, a condition similar to the Indian *C. viridifrons* (Fraser, 1922). The pointed and protruding frons is an interesting character also shared by the Chinese *C. cornifrons* Zhang & Cai 2013; add the Indian *C. acutifrons* (Martin, 1909) also has pointed frons but not sharply pointed as in *cornifrons* or *acanthifrons* **sp. nov.** as seen in dorsal view (Figure 2). *C. acanthifrons* can be diagnosed from *C. acutifrons* by the number of cells in the anal triangle (3 vs. 5) and from *C. cornifrons* by the reduced abdominal markings and the shape of cerci in dorsal view (Zhang & Cai 2013).

Cephaloeschna masoni (Martin, 1909) and *acanthifrons* **sp. nov.** are similar to each other, having the apex of the frons dark, anal triangle with 5 cells each, IRiii forking nearer to the pterostigma and green thoracic stripes. However, *acanthifrons* **sp. nov.** can be diagnosed from *C. masoni* based on: (a) the middorsal yellow line, running intermittently with transverse striae at the posterior of each segment; and (b) the elevated pointed medial lobe of frons (rounded in *C. masoni*), pointing anteriorly in dorsal view.

Updated key to the Indian *Cephaloeschna* species (expanded from Fraser 1936 and Asahina 1983)

- | | | |
|-----|---|-------------------------------------|
| 1. | Anal triangle with 3 cells | 2 |
| 1' | Anal triangle with 5 or more cells. | 3 |
| 2. | Face rounded, frons not elevated above, as broad as deep | <i>orbifrons</i> |
| 2' | Face oval, frons elevated into a medial cone, deeper than broad | <i>acutifrons</i> |
| 3. | IRP2 forking mid-way between the node and pterostigma; anal triangle with 4 to 6 cells | <i>viridifrons</i> |
| 3' | IRP2 forking nearer to pterostigma than nodus; anal triangle with 5 or more cells | 4 |
| 4. | Apex of the frons rounded; anal triangle with 5 to 8 cells; middorsal abdominal yellow line undeveloped | <i>masoni</i> |
| 4'. | Frons elevated into a pointed medial cone; anal triangle with 5 cells; middorsal abdominal line developed, running intermittently | <i>acanthifrons</i> sp. nov. |

Planaeschna poumai **sp. nov.**

(Figs. 3–4)

Holotype. ♂ (NCBS-AV557), collected on the Senapati-Purul road near TNK village, Senapati District, Manipur, India (25.3756N, 94.2318E), 11.X.2016, Shantanu Joshi leg.

Paratype. ♂ (NCBS-AV585) and **allotype** ♀ (NCBS-AV568): upstream from Mayangkhang village, Senapati District, Manipur, India (25.2304N, 94.0066E), 14.X.2016, Shantanu Joshi leg.

Etymology. This species is named after the Poumai tribe, one of the larger extant Naga tribes in NE India, which predominantly inhabits the Senapati District of Manipur where the specimens were collected. There are no protected areas in this whole district, which makes community forests critical for biodiversity conservation.

Description of the holotype. *Head* (Fig. 3e). Labrum, labium, anteclypeus, postclypeus and frons yellow; mandibles brown; postclypeus with two faint brown markings; the crest of the frons and vertex black. Eyes dark green, in live specimens with blue in the center; postgenae marked yellow.

Thorax (Fig. 3d,f). Prothorax black, anterior edge of the mesostigmal plate yellow; propimeron greenish yellow. Synthorax with mesokatepisternum and metakatepisternum marked with yellow; dorsal stripes on mesepisternum green, pointing outwards, faintly yellow at the antealar ridge; mesepimeron marked with a greenish yellow stripe, thinner towards the subalar ridge; a triangular spot below subalar ridge on the mesepimeron and a small spot above the subalar ridge; metepimeron almost entirely yellow; both the mesepimeronic and metepimeronic stripes appear darker green towards the dorsal 1/3rd of its length in live specimens. Legs black; coxae and base of the femur marked with reddish brown; femur of the forelegs marked with yellow on the inside about half its length.

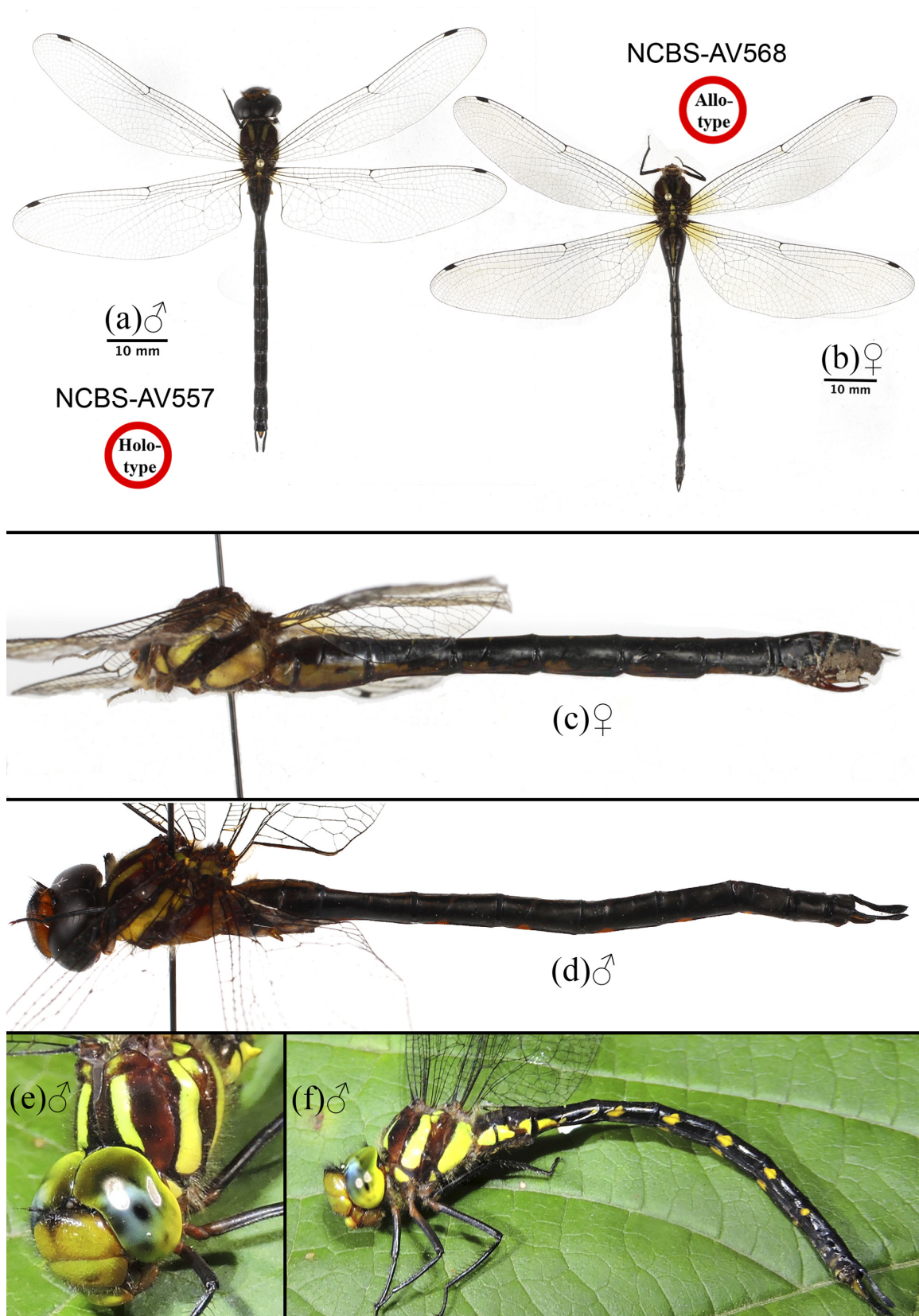


FIGURE 3. *Planaeschna poumai* sp. nov.: (a) dorsal habitus of holotype male (NCBS-AV557), (b) dorsal habitus of allotype female (NCBS-AV568), (c) lateral habitus of allotype female (NCBS-AV568), (d) lateral habitus of holotype male (NCBS-AV557), (e) face of holotype male (NCBS-AV557, image credit: J. Veino & L. Veino), and (f) lateral habitus of holotype male (NCBS-AV557, image credit: J. Veino & L. Veino).

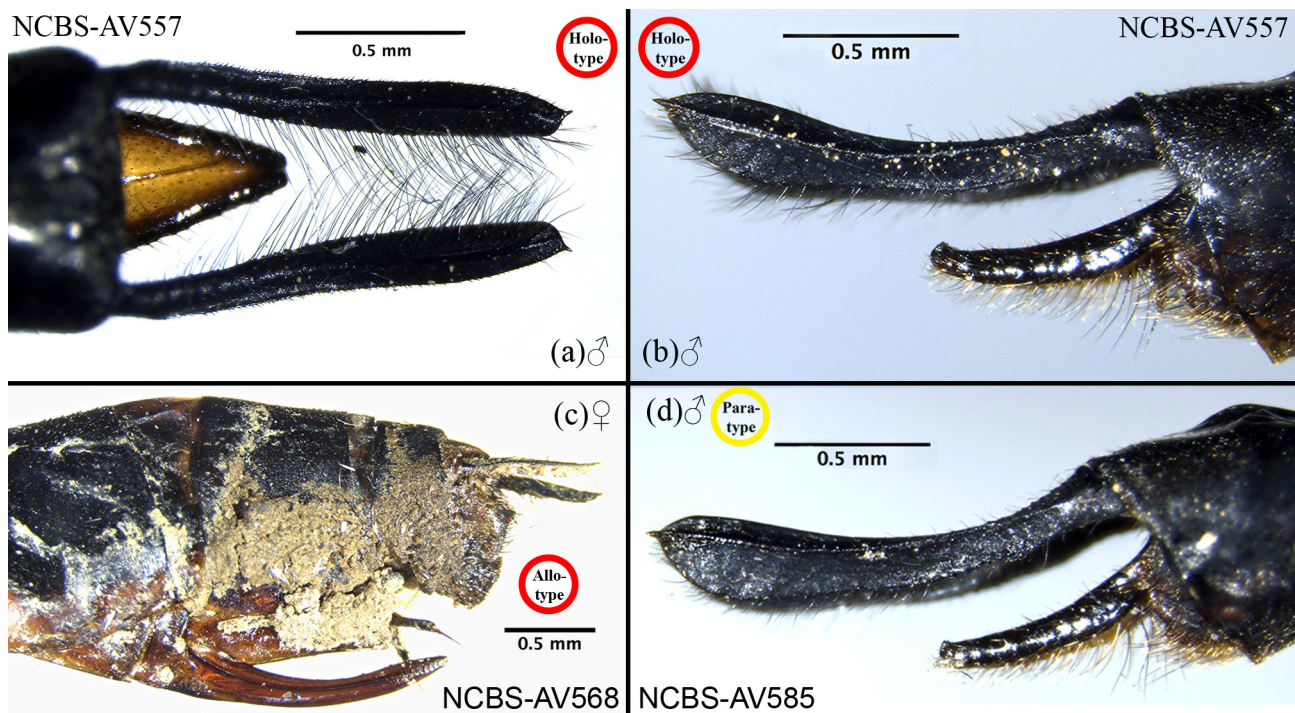


FIGURE 4. Anal appendages of *Planaeschna poumai* sp. nov.; (a) dorsal view of holotype male (NCBS-AV557), (b) left lateral view of holotype male, (c) left lateral view (ovipositor) of allotype female (NCBS-AV568), and (d) left lateral view of paratype male (NCBS-AV585).

Wings. Hyaline; triangle 3-celled (2 in left hw); anal loop 6/7-celled; anal triangle 3-celled; antenodals: 19/20 in the fw (a short incomplete nervure present on the left fw between the 2nd and 3rd nervures), 14 in the hw; venation denser towards the apices.

Abdomen (Fig. 3a,d,f). Marked with citron-yellow and green; S1 laterally marked with triangular spot pointing anteriorly, dorsal carina with a yellow stripe; S2 dorsally with a yellow stripe disconnected at the transverse carina; PD edge with a horizontal yellow stripe, laterally with bright yellow AL and PL markings separated by the auricle, the AL marking continuing on the lateral side of the auricle; the auricle posteriorly dark brown; S3–S7 with paired MD spots situated anteriorly about 2/3rd the length of each segment; S3–S7 also with AD and PD yellow stripes on the dorsal carina, reaching the MD spots on S3 and S4; the AD marking reduced on S5–S7, more pronounced and broader on S3; S3–S8 with paired antero-ventral round yellow spots, these spots continuing dorsally connect to the small ML spots on S3–S7 and the base of the supplementary transverse carina; the ventral spots perfectly rounded on S8; S8 and S10 with paired round black ‘depressions’ dorsally, S9 and S10 black.

Anal appendages (Fig. 4a,b,d). Cerci black; paraprocts black, the central groove and ventral area dark yellow. Cerci twice the length of S10, paraprocts about half the length of cerci. Laterally both cerci and the paraprocts are curved upwards, the cerci are broader and curved slightly more upwards caudal 3/5th of its length, pointed at the apex. The apical 2/5th is spatulate divided in the middle by a lateral ridge. *Laterally*, the base is thinner and the dorsal half is concave. Paraprocts gently curved upwards, the tip conical, pointing upwards. *Dorsally*, the anterior cerci are thinner, the outer margin is straight for 1/10th the length of cerci, curved inwards thereafter; the apical spine of the cerci is pointed outwards, sharply pointed. Paraprocts triangular, blunt at the apex.

Measurements (mm): abdomen (including anal appendages)=38.6, fw=33.9, hw=34.8.

Variation in the paratype (Anal appendages: Fig. 4d). Paratype male is very similar to the holotype. The PD markings on S2 edge without a thin yellow stripe like on the holotype. Triangle 3 or 4 (right hw) celled, anal triangle 3-celled, anal loop 5-celled. Antenodals: 16/17 in the fw, 14/16 in the hw.

Measurements (mm): abdomen (including anal appendages)=38.5, fw=33.2, hw=33.7.

Description of the allotype (Fig. 3b–c, 4c). The specimen was accidentally decapitated while netting, and the head was lost in the stream beneath, hence the head is not described.

Thorax (Fig. 3c). Prothorax dark brown; the apex of the posterior lobe and the middle lobe black. Synthoracic

markings very similar to the male; vibrant yellow-green. The propimeron, mesokatepisternum and metakatepisternum bright yellow; the paired dorsal stripes on the mesepisternum curving slightly outwards at the anterior end; antalar edge marked with faint yellow spots; the mesepimeronic stripe broad and slightly angulated, thinner at the dorsal end with a triangular spot right next to it near the subalar edge; another spot directly above the triangular spot above the subalar ridge; metepimeron marked almost entirely with bright yellowish green, ventral margin thinly brown; the mesepimeronic and metepimeronic markings appear more bright yellow towards the ventral half similar to the male. Legs black; coxae marked yellow posteriorly; basal half of the femur marked yellow posteriorly on the forelegs.

Wings. Antenodals: 13–14 in the hw, 19 in the fw. Base of the wings tinted yellow and the area near the node faintly yellow. Median space not traversed by any cross-veins. The triangle is made up of four cells in the hw and three cells in the fw. Pterostigma dark brown, spanning a little more than 2 cells.

Abdomen (Fig. 3b,c). S1 laterally marked with a broad yellow stripe, broader posteriorly; dorsally marked with a thin yellow line; S2 yellow laterally, small, brown, rounded marking on both sides resembling the markings in the area posterior to the auricle of males; a dorsal yellow stripe on S2, S3–S7 with yellow ventro-lateral anterior spots, PL longitudinal spots on S3–S5; S3–S7 with thin yellow AD and PD stripes on the carina disconnected at the center where paired triangular MD spots are present, smaller than the male; S8 marked yellow at the posterior-dorsal edge; S8, S9 and S10 black, lower half is dark yellow continuing on to the vulvar scale.

Ovipositor (Fig. 4c). Covered with dry mud suggesting that the female had oviposited or attempted to so in muddy waters. The sternite and ovipositor dark-brown; ovipositor and style extend posteriorly till the base of cerci; cerci about the length of S10, pointed at the apex.

Measurements (mm): abdomen (including anal appendages)=47, fw=40, hw=42.

Diagnosis. The shape of male anal appendages and the abdominal pattern is similar to *P. intersedens* (Martin, 1909), the only Indian species of this genus. *P. poumai* differs with respect to the following diagnostic characters: (a) in both sexes the abdominal pattern differs from *P. intersedens* in that the paired MD spots on S2 are not present, S9 and S10 unmarked with yellow dorsally, and the PD abdominal spots absent or reduced on S3–S10; (b) the lateral ridge divides the apex of cerci in equal proportions, whereas in *P. intersedens* the portion below the ridge is more expanded; (c) the posterior half of cerci is not as widely expanded as that in *P. intersedens*; (d) the apical expansion of cerci laterally angled straight, not curved upwards like *P. intersedens*; and (e) in both sexes of *P. intersedens* S2 is laterally yellow; but in *P. poumai* **sp. nov.** the lateral yellow markings on S2 of both males is broken posterior to the auricle; this lateral yellow stripe in the female is marked with a round brown spot. The reduced abdominal markings distinguish this species from all other *Planaeschna* species.

Discussion

Very little work has been devoted to the odonate fauna of northeastern India. The family Aeshnidae is poorly investigated in the recent past even when type-species of many monotypic and/or rare genera were originally described from this region (e.g., *Cephalaeschna*, *Gynacanthaeschna*). This is especially true for the subfamily Brachytroninae (to which *Planaeschna* and *Cephalaeschna* belong), of which no species or specimens have been reported from India since the 1980s (Asahina 1981a&b, 1983, Lahiri 1987). For example, *Planaeschna intersedens* – the westernmost representative of the genus and the only representative in India – was described from the Khasi Hills, Meghalaya, and subsequently reported from Myanmar and northern Thailand (Asahina 1985). In China, where odonates are much better sampled, this genus is represented by 14 species (Zhang *et al.* 2010). Such historical under-sampling, coupled with the lack of sampling in the recent past in the Indian region, suggests that other undescribed species of these two rare and obscure genera may still remain to be discovered.

Cephalaeschna acanthifrons **sp. nov.** was collected from the Eaglenest Wildlife Sanctuary, western Arunachal Pradesh—a local biodiversity hotspot within the globally recognized Himalaya biodiversity hotspot. Several new taxa have recently been described from this sanctuary, e.g., frogs (Sondhi & Ohler 2005, Mahony *et al.* 2013), a bird (Athreya 2006), and a macaque (Sinha *et al.* 2005). The discovery of a new odonate species described above, along with rediscoveries and major range extensions of over a dozen butterfly species (Sondhi & Kunte 2016), underscores the incredible invertebrate diversity of this valuable but poorly explored protected area.

Planaeschna poumai **sp. nov.** was caught at two localities in hill streams of Senapati District of northern

Manipur, where many forests exist as community forests, a situation also observed in other parts of northeastern India (Poffenberger & Smith-Hanssen 2007). There is not even one protected area in this district, and in the entire Manipur state a meager 0.02% of the total area constitutes 'legally protected forest' (National Wildlife Database Cell 2016). Hence, more research on community forests, their biodiversity and resource management is urgently needed to protect biodiversity and livelihoods of people in this area.

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Further information on this species will be made available in the future on the species page (<http://www.indianodonata.org/108-Cephalaeschna/Cephalaeschna-acanthifrons>, <http://www.indianodonata.org/114-Planaeschna/Planaeschna-poumai>) of the Odonata of India website (Joshi et al. 2017).