

Sundaeschna gen. nov. with Descriptions of Two New Species from Vietnam and Myanmar (Odonata, Anisoptera, Aeshnidae)

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Abstract *Sundaeschna* gen. nov. is proposed to accommodate two new species in the family Aeshnidae. One species, *S. cattienensis* sp. nov., is described from Dong Nai Province, Vietnam. Another species, *S. tanintharyiensis* sp. nov., is described from Tanintharyi Township, Myeik District, Tanintharyi Region, Myanmar. This new genus resembles the genus *Sarasaeschna* in the tribe Gomphaeschnini, but is easily distinguished by the structure of the fourth penile segment and by the pigmental spots on the posterior margins of all wings. Both these new species are recorded from lowlands, in contrast with *Sarasaeschna*, whose members generally occur in mountainous regions. These two new species are easily distinguished from each other by the shape of the male epiproct.

Key words: Odonata, Aeshnidae, Gomphaeschnini, new genus, new species, Myanmar, Vietnam.

Introduction

The family Aeshnidae currently comprises 54 extant genera (Schorr and Paulson, 2017). This family was traditionally classified into two subfamilies, Brachytroninae and Aeschninae (*sensu* Steinmann (1997)). The former includes two tribes, Gomphaeschnini and Brachytronini. The latter includes Aeshnini, Anactini, Gynacanthini, and Polycanthaginini. The tribe Gomphaeschnini was reconstructed as the basal group of Aeshnidae, based on a morphological cladistic analysis (von Ellenrieder, 2002). This tribe includes four extant genera (*sensu* von Ellenrieder, 2002): *Gomphaeschna* from North America, *Sarasaeschna* from India to East Asia, *Oligoaeschna* from the Indomalayan realm, and *Linaeschna* from Borneo (Tsuda, 2000; Kiyoshi *et al.*, 2016). There are only a small number of scattered

records for the latter three genera, except for some *Sarasaeschna* species in East Asia.

In this report, a new genus of the tribe Gomphaeschnini is proposed to accommodate two new species collected from Vietnam and Myanmar. The new genus resembles *Sarasaeschna* in body color patterns but can be distinguished by some morphological characters, particularly the straight and posteriorly protruding flagella on the fourth penile segment of the male. The type localities for both these species are in lowland areas of Vietnam (165 m a.s.l.) and Myanmar (17 m a.s.l.), in contrast to most records for *Sarasaeschna* species in Southeast Asia which have usually been reported as being present in mountainous regions above 1000 m a.s.l. (Kiyoshi *et al.*, 2016).

Materials and Methods

Morphological terminology mainly follows Walker (1958). The terms used for abdominal color pattern are as per Walker (1912).

Abbreviations: S1–S10 = abdominal segments 1–10. AD = antero-dorsal. MD = medio-dorsal. PD = postero-dorsal. AL = antero-lateral. ML = medio-lateral, PL = postero-lateral. AML is a combination of AL and ML.

Description

Sundaeschna Kiyoshi and Katatani **gen. nov.**

Type species: *Sundaeschna cattienensis* Katatani and Kiyoshi sp. nov. (by present designation)

Other species: *Sundaeschna tanintharyiensis* Kiyoshi and Katatani sp. nov.

Etymology. This new genus is named after Sundaland, a biogeographical region of South-eastern Asia that includes the type locality of the two new species.

Diagnosis

Sundaeschna can be distinguished from the other extant genera of the tribe Gomphaeschnini by the combination of following characters: (1) a well-defined T-mark on the frons, (2) a small spot of brownish pigmentation at the ends of R4+5 and MA along the hind margin of each wing, (3) margin of central depression in 1st penile segment strongly uplifted, (4) flagella of fourth penile segment straight and posteriorly protruding, (5) dorsum of tenth abdominal segment without tiny denticles, and (6) inwardly twisted and knife-shaped male cerci.

Description

Male. Large sized dragonflies; body black with bright green-yellowish markings when alive.

HEAD: Large and globular. Prementum with median cleft. Gena with green spot. Antefrons gently protruded anteriorly; postfrons depressed

medially and black, laterally invaded by a pair of transverse green spots originating from green area of the antefrons, and forming a T-mark. Vertex, antennae, and occiput black. Vertex about one-third of the width of frons, globularly protruding anteriorly above median ocellus. Compound eyes pale green in living condition, eye-seam rather short, slightly shorter than width of vertex; diameter of head across eyes less than twice frons width.

PTEROTHORAX: Black with greenish spots. Legs short but robust, hind femur slightly shorter than synthorax.

WINGS: Broad and long, base of hind-wing in male shallowly excavated, margin of anal field gently angled. Small distinct spot with brownish pigmentation present at posterior end of R4+5 and MA in all wings. Anal triangle variable, 1 to 3 celled; anal loop small, 3- to 4-celled. Discoidal cells 2- to 3-celled in every wing; base of discoidal cell shortly distal of level of arc. Supratriangle entire or 2 celled; basal space entire. Single cubital nervure present in all wings. Discoidal field with two or three rows of cells; IR3 not forked; R3 making an abrupt curve towards the pterostigma. Rspl and Mspl well defined, with a single row of cells between IR3 and two rows of cells between MA, respectively. Pterostigma of medium size, braced; membranule well developed, reaching nearly half of anal triangle.

ABDOMEN: Longer than hind-wing, globular at base, constricted at middle of 3rd segment, inflated again to middle of 4th segment, then narrowing gradually to the end. Dorsum of 10th segment without tiny denticles. Auricles angulate with tiny teeth on posterior margin. Laterally, cerci narrow on basal third, dilated and spatulated on apical two-thirds; dorsally, twisted inward from base to apex. Ventrally, epiproct narrow and bifid at apex; laterally, gently curved upward.

PENIS: First segment (sperm vesicle) broadly hollow ventrally and cup-shaped, marginal flange greatly uplifted. In ventral view, width of protruding marginal flange of 1st segment not expanded in upper part. Second segment without

dorsal projection. Third segment shorter than 2nd segment, and as long and wide as 4th segment, with one pair of dorso-lateral clefts. Fourth segment with one pair of apical lobes separated from each other dorsally. Flagella straight and protruding posteriorly from apex of 4th segment.

Female. Unknown.

Distribution. Type species, *Sundaeschna cattienensis* Katatani and Kiyoshi sp. nov., from Vietnam; *S. tanintharyiensis* Kiyoshi and Katatani sp. nov., from Myanmar.

***Sundaeschna cattienensis* Katatani and Kiyoshi
sp. nov.**

(Figs. 1–7)

Etymology. The new species is named after its type locality, Cat Tien National Park in Dong Nai Province in Vietnam.

Diagnosis. *Sundaeschna cattienensis* Katatani and Kiyoshi sp. nov. differs from the congeneric species *S. tanintharyiensis* Kiyoshi and Katatani sp. nov. as follows: (1) cerci of *S. cattienensis* twists inward more strongly than those of *S. tanintharyiensis*; (2) the width of the fork at the posterior part of epiproct of *S. cattienensis* is wider than that of *S. tanintharyiensis*.

Male (Holotype)

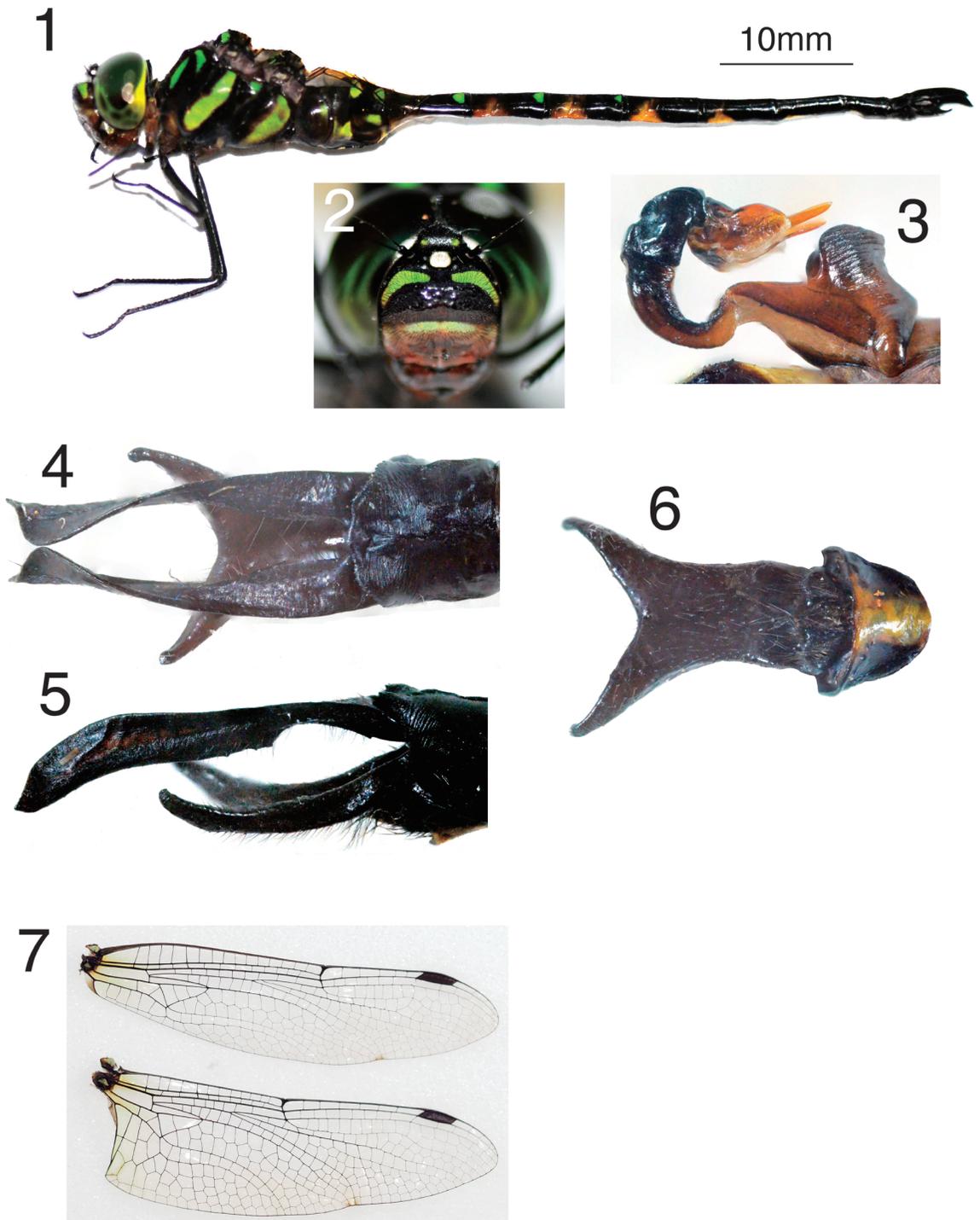
HEAD (Figs. 1–2): Labium and labrum orange red; mandibles orange red with yellow-green spots at base. Anteclypeus and postclypeus orange red, latter with yellow-green band at posterior border, not extending to lateral margin; antefrons protruding anteriorly, black with ventral third coarsely wrinkled; postfrons depressed medially and black, laterally invaded by one pair of transverse green spots originating from green area of antefrons and forming T-mark. Vertex, antennae, and occiput black. Vertex about one-third of frons width, globularly protruding anteriorly above median ocellus, with one pair of small faint green spots at base. Compound eyes pale green, eye-seam slightly shorter than vertex width; diameter of head across eyes less than

twice frons width. Black hairs present on lateral sides of mandible, frons, postclypeus, vertex and occiput.

PTEROTHORAX (Fig. 1): Black with green spots as follows: dorsal stripes cigar-shaped, not reaching antealar ridge, transversely rectangular bands below antealar ridge extending outwards towards humeral suture; broad stripe on mesepimeron with ventral end rounded; posterior half of metinfraepisternum brown; small triangular dorsal spot present on metepisternum; posterior three-quarters of metepimeron. Legs black, hind femur markedly shorter than pterothorax (10:14).

WINGS (Fig. 7): Hyaline with brownish area in basal part; veins black; small distinct brownish spot present on the ends of R4+5 and MA; pterostigma, 3.3 mm on forewing, 3.0 mm on hindwing, dark reddish-brown, braced on all wings and underlaid by 1.5 cells. Venation simple, anal triangles two-celled, supra-triangles entire; triangles three celled in forewings, two celled in hindwings; anal loops three celled. Nodal index 5:15:15:5 in forewings, 7:10:12:6 in hindwings. One cubito-anal cross-vein in all wings. IR3 not forked with only one row of cells between it and Rspl. Two rows of cells between MA and Mspl in both wings. Discoidal field starts with two rows of cells. Anal angle roundly angulate; membranule well developed and pale brownish, reaching basal half of anal triangle.

ABDOMEN (Figs. 1, 4–6): Slender, black with greenish and yellow-greenish markings. S1 and S2 globular, S3 weakly constricted at middle, S4–5 parallel-sided, S6–8 gradually narrowed, distal half of S9 slightly widened, S10 slightly widened posteriorly. Dorsally, S1 with one pair of very tiny yellow spots at middle, S2 with large triangular AD, paired pyriform MD and paired triangular PD spots; paired triangular PD spots of S3–5 sub-triangular and closely adjoining, largest at S3 and gradually becoming smaller on posterior segments. Laterally, S1 with large green spot. S2 with AL spot covering auricle and two PL spots. S3 with one AL spot. S4–9



Figs. 1–7. *Sundaeschna cattienensis* Katatani and Kiyoshi sp. nov. 1, body, lateral; 2, head; 3, penis, upside down in lateral view lateral view; 4, cerci, dorsal view; 5, cerci, lateral view; 6, epiproct, ventral view; 7, right wings.

with one yellow AML spot, distinct on S4–7 and obscure on S8–9. S10 black with yellow-green fringe at antro-ventral margin. Auricle with hind angles triangular, posterior margin furnished with small number (17–18) of black acute spines loosely set. Dorsum of S10 with vestigial longitudinal carina, without tiny denticles. Cerci 5.2 mm in length, approximately 2.6 times as long as S10; laterally, narrow on basal third, with apical two-thirds dilated and spatulate, and apical third moderately curving downward; a small protrusion pointing downward near the base. In dorsal view, outer edge of cerci twisting strongly inward, tip of inner side sharply pointed. Epiproct about two-thirds as long as cerci, laterally, smoothly curved upward; apex with stout teeth protruding upward; in ventral view, basal two thirds bifid with two forks diverging at about 120 degrees, apical notch about twice as broad as epiproct at base.

PENIS (Fig. 3): First segment broadly hollow ventrally and cup-shaped, with marginal flange uplifted. Second segment curved ventrad, with vestigial dorsal projection. Third segment shorter than 2nd segment and as long and wide as 4th segment, with a pair of dorso-lateral clefts. Apical lobes of 4th segment separated from each other dorsally. Flagella straight and protruding posteriorly, slightly curving outward in ventral view; in lateral view, the entire length (including the embedded part) of flagella 1.5 times as long as glans, but exposed length only about one third glans length. Ventrobasal plate of 4th segment flat in lateral view. Ventral surface of flagella not covered, lacking membranaceous properties of glans, in ventral view.

Variation in paratype

WINGS: Anal triangles three celled, supra-triangles entire (one cross vein in right hindwing); triangles three celled in forewings, two or three celled in hindwings; anal loops three celled; nodal index 7:17:15:7 in forewings, 7:10:10:7 in hindwings. Discoidal field start with three rows of cells.

Measurements (mm). Holotype: ♂ abdomen +

cerci 51.4 mm, hindwing 35.5 mm, with maximum width 11.8 mm. Paratype: ♂ abdomen + cerci 51.1 mm, hindwing 36.2 mm

Female: unknown.

Material Examined. Holotype: male, 16-V-2010, Cat Tien National Park, Dong Nai Province, southern Vietnam (11.274 N, 107.220 E, ca. 165 m a.s.l.), leg. Kanji Kishi. Holotype was deposited in the National Museum of Nature and Science, Tokyo. Paratype: 1 male, data the same as for the holotype; leg. Native collector. Paratype will be deposited in the Vietnamese National Museum of Nature.

Notes: Cat Tien national park is located in the south of Vietnam, approximately 150 km north of Ho Chi Minh City. It has an area of about 720 km², and protects one of the largest areas of lowland tropical and primary forests left in Vietnam. Two males were collected during the daytime, inside the forest. One of the males was flying in a circular manner within a small gap in the forest. Another male was perched on a twig with the abdomen hanging vertically, in a manner typical of aeshnids. In addition, another male was observed flying above the grasses alongside forest roads, again during the daytime.

Sundaeschna tanintharyiensis

Kiyoshi and Katatani **sp. nov.**

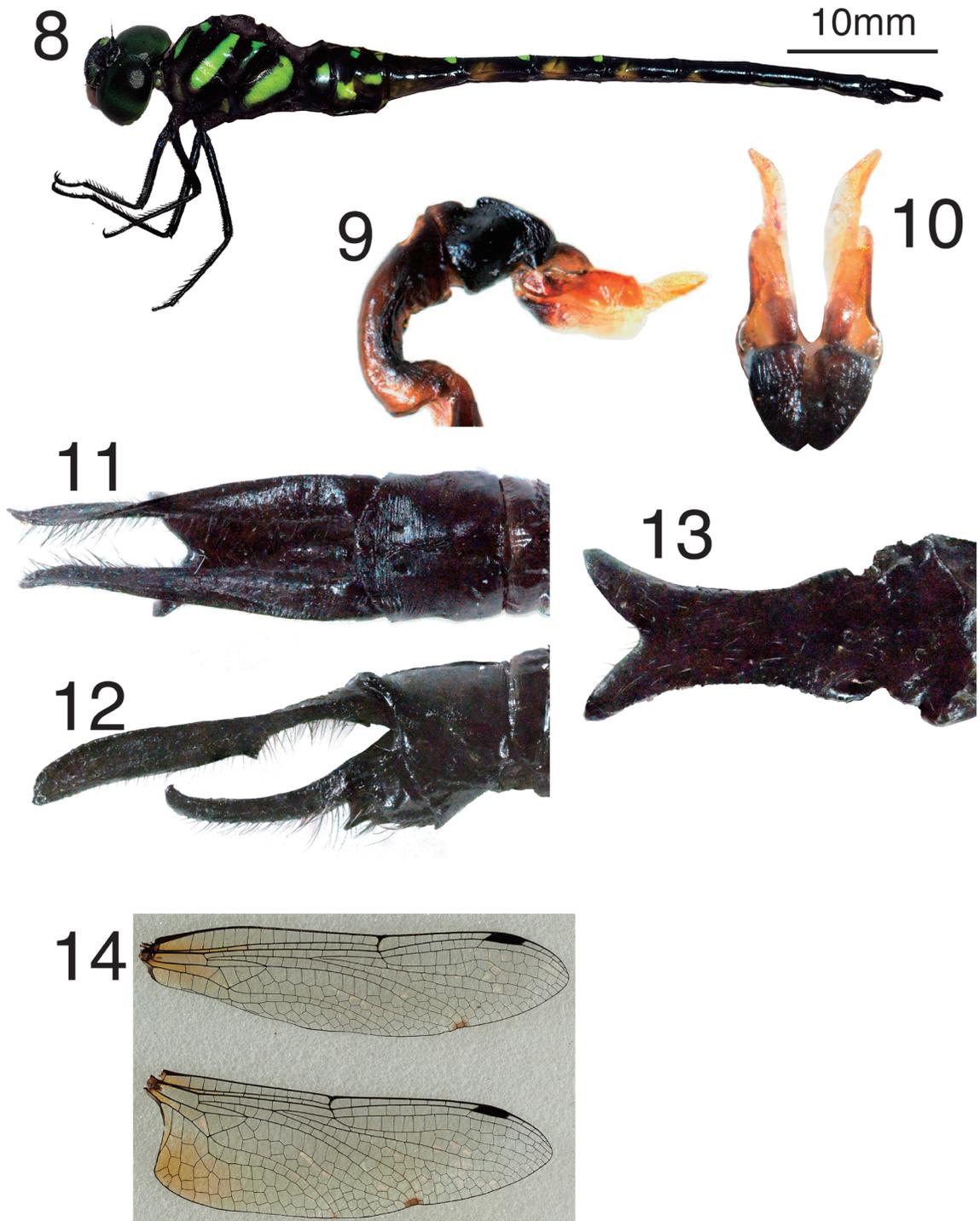
(Figs. 8–14)

Etymology. The new species is named after its type locality, the Tanintharyi Region, Myanmar.

Diagnosis. *S. tanintharyiensis* Kiyoshi and Katatani sp. nov. differs from the congeneric species *Sundaeschna cattienensis* Katatani and Kiyoshi sp. nov. as follows: (1) the width of the fork at the posterior part of epiproct of *S. tanintharyiensis* is narrower than that of *S. cattienensis*. (2) inwardly twist of cerci of *S. tanintharyiensis* weaker than those of *S. cattienensis*.

Male (Holotype)

HEAD: Labium and mandibles brown; labrum



Figs. 8–14. *Sundaeschna tanintharyiensis* Kiyoshi and Katatani sp. nov. 8, body, lateral; 9, apical parts of penis, upside down in lateral view; 10, apical parts of penis, ventral view; 11, cerci, dorsal view; 12, cerci, lateral view; 13, epiproct, ventral view; 14, right wings.

brown with a pair of faint yellowish spots; anteclypeus and postclypeus brown, the latter with a narrow yellow greenish band at the posterior border not extending to lateral margin; antefrons black with ventral third coarsely wrinkled, lateral side greenish-yellow; postfrons depressed medially and black, laterally invaded by a pair of transverse yellow spots originating from yellow area of antefrons, and forming a T-mark. Vertex about one third of the width of frons, globularly protruded anteriorly above median ocellus, with a pair of small faint green spots at the base. Compound eyes pale green, eye-seam short, a little shorter than the width of vertex; diameter of head across eyes less than twice the width of frons. Black hairs present on lateral sides of mandible, frons, postclypeus, vertex and occiput.

PTEROTHORAX (Fig. 8): Black with greenish spots. Dorsally, a pair of narrow dorsal stripes diverging downward from each other, upper ends separated from a short rectangular stripe extending outwards towards the humeral suture. Stripes of mesepimeron gradually narrowed upward. Metepisternum with a narrow yellowish stripe extending from dorsal margin to middle. Posterior three-quarters of metepimeron green. Mesinfraepisternum with a faint greenish spot, posterior half of metinfraepisternum green. Legs black.

WINGS (Fig. 14): Hyaline and basally amber-tinted; veins black; a small distinct brownish spot at the posterior ends of R4 + 5 and MA as in *S. cattiensis*. Pterostigma dark reddish-brown, braced in all wings and underlaid by 1.8–2.5 cells. Venation simple, anal triangles and supra-triangles entire; triangles three celled in forewings, two celled in hindwings; anal loops three celled. Nodal index 5:15:15:6 in forewings, 7:10:10:7 in hindwings. One cubito-anal cross-vein in all wings; IR3 not forked; only one row of cells between IR3 and Rspl. Anal angle roundly angulated; membranule well developed and pale brownish, reaching basal half of anal triangle.

ABDOMEN (Figs. 8, 11–13): Black with yellowish markings. S1–2 globose, S3 weakly con-

stricted at middle, S4–5 parallel-sided; S6–8 gradually narrowed backward, distal half of S9 slightly widened, and S10 almost parallel-sided. Dorsally, S1 with a pair of very tiny yellow spots at middle, S2 with a large triangular AD, paired pyriform MD, and paired triangular PD spots; paired PD spots of S3–5 sub-triangular and closely adjoining, largest at S3 and gradually becoming smaller in posterior segments. Laterally, S1 with a large green spot; S2 with an AL spot covering auricle and two PL spots; S3 with an AL spot; S4–9 with a yellow AML spot, distinct on S4–7 and obscure on S8–9; S10 black with yellow green fringe at antero-ventral margin. The hind angles of the auricles triangular, and the posterior margins are furnished with loosely set and acute black spines. Dorsum of S10 with vestigial longitudinal carina and without tiny denticles. Cerci about twice as long as S10, in lateral view narrow basally, with apical half dilated and spatulated and a small ventral protuberance at basal two-fifths (Fig. 4); in dorsal view, weakly twisted inward. Epiproct about two-thirds as long as cerci, apex upcurved gently and deeply notched apically, two forks diverged from each other at about 90 degrees, depth of the apical notch nearly the half of its width and one-fifth as long as epiproct.

PENIS (Figs. 9–10): First segment broadly hollow ventrally and cup-shaped, with marginal flange uplifted. Dorsal projection of 2nd segment very vestigial. Third segment shorter than 2nd segment and as long and wide as 4th segment, with a pair of dorso-lateral clefts. Apical lobes of 4th segment separated along from each other dorsally. Flagella robust and straight, protruding posteriorly and slightly curving outward in ventral view. Ventrobasal bony plate of 4th segment protruded in lateral view.

Female: unknown.

Measurements (mm). Holotype: ♂ abdomen + cerci 43 mm, hindwing 31 mm.

Material Examined. Holotype: male (NSMT-I-Od-17675), 7-VI-2016; Tanintharyi Township, Myeik District, Tanintharyi Region, Myanmar, 12.085 N 99.009 E, 18 m a.s.l., leg. T. Kiyoshi.

Holotype is deposited in the National Museum of Nature and Science.

Discussion

The tribe Gomphaeschnini comprises five genera: *Sarasaeschna*, *Gomphaeschna*, *Linaeschna*, *Oligoaeschna* and *Sundaeschna*. A cladistic analysis by von Ellenrieder (2002) reconstructed reciprocal monophyly of (*Sarasaeschna* + *Gomphaeschna*) and (*Linaeschna* + *Oligoaeschna*). The morphological traits of *Sundaeschna* were discussed, with comparisons among Gomphaeschnini genera.

Regarding the color pattern of the body, *Sundaeschna* most resembles *Sarasaeschna* and *Gomphaeschna*, with a well-formed T-mark on the frons and heliochromic patterns on the abdomen. *Sarasaeschna* was split from the genus *Oligoaeschna*, chiefly due to the differences in male penile characters noted by Karube and Yeh (2001). They described *Sarasaeschna* based on minute comparisons of the penile organs of Gomphaeschnini, with illustrations showing the apical three segments in lateral view, and the fourth segment in ventral view. With regards to the penile organ of *Sarasaeschna*, the width of the protruding marginal flange of the first segment is expanded in the upper part in ventral view, and flagella of the fourth segment is well developed and sickle-shaped, as long as the glans, and sometimes twisted. This latter character is shared with *Gomphaeschna*. The penis of *Oligoaeschna* is short and robust. The flagella of the fourth segment is slender and bent near apex (except in *O. venatrix* and *O. uroptera*, where it is not bent). The flagella of *Linaeschna* is straight and very short in comparison with other genera. The penis structure of *Sundaeschna* is simple and robust. In ventral view, the width of the protruding marginal flange of the first segment is not spread in the upper part. The flagella are thick and straight, protruding posteriorly, and slightly curving outward in ventral view. With regard to the penile structure, *Sundaeschna* most resembles to *Oligoaeschna*.

The wings of *Sarasaeschna*, *Gomphaeschna* and *Oligoaeschna* are hyaline in males, and are more or less tinted with amber in females. The costal region of the forewings of *Linaeschna* is darkly pigmented. The wings of all species in the genus *Sundaeschna* are hyaline with a small, but distinct, brownish spot that covers the ends of R4 + 5 and the MA along the hind margin. This trait highlights the differences between this genus and other genera, and hence may be useful in identification.

The male cerci of *Oligoaeschna* is expanded and leaf-like shaped (except in *O. venatrix*, where it is extremely long and slenderly stalked). For *Sarasaeschna*, *Linaeschna*, and *Gomphaeschna*, it is not greatly expanded or leaf-like, but is usually slender and knife-shaped. *Sundaeschna* also has a slender and knife-shaped male cerci, but it twists strongly inward in the dorsal view.

There was not enough genetic material sampled to enable a molecular phylogenetic analysis. This is because most members of Gomphaeschnini are rare species, and hence records are scarce and scattered. The phylogenetic position of the genus *Sundaeschna* within Gomphaeschnini is still unknown, but it might be in an intermediate position between the clades (*Sarasaeschna* + *Gomphaeschna*) and (*Linaeschna* + *Oligoaeschna*).

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