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ADDITIONS TO THE INDIAN DRAGONFLY FAUNA, AND NEW RECORDS OF TWO ENIGMATIC DAMSELFLIES (INSECTA: ODONATA) FROM NORTHEASTERN INDIA

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Abstract: *Pseudothemis zonata* (Burmeister, 1839) and *Burmagomphus divaricatus* Lieftinck, 1964 are reported for the first time from northeastern India—hitherto not reported from the west of Thailand. The female of *Anisopleura vallei* St. Quentin, 1937, is described for the first time, with new records of this species from four localities in Kohima District, Nagaland, India. Previously, the only known record of this species was the type series collected by St. Quentin in 1935. We also provide new records of *Schmidtphaea chittaranjani* (Lahiri, 2003) which was previously known only from the holotype.

Keywords: Biodiversity hotspots, biodiversity inventory, citizen science, eastern Himalaya, Manipur, Naga Hills, *Schmidtphaea*, species rediscovery.

Northeastern India is the western part of the globally recognised Indo-Burma biodiversity hotspot (Myers et al. 2000), yet the majority of insect fauna in its remote areas remain poorly surveyed. The Indo-Burmese region is one of the most species rich regions for odonates (Clausnitzer et al. 2009). Yet, about half (47.3%) the odonates are currently classified as 'Data Deficient' by IUCN (Clausnitzer et al. 2009), which suggests a lack of sampling efforts and systematic surveys in these areas. Although recent years have seen an increase in

popularity of odonate natural history amongst young researchers in India (e.g., Dawn & Chandra 2014; Joshi & Kunte 2014; Majumder et al. 2014), large parts of northeastern India remain unexplored due to difficulty of access, poor infrastructure, and limited resources for large-scale research.

In this paper, we: (a) report new records of two dragonflies, *Pseudothemis zonata* (Libellulidae) and *Burmagomphus divaricatus* (Gomphidae) from northeastern India, adding them to the Indian odonate fauna and extending their known distributional ranges, (b) provide new records and describe specimens of *Schmidtphaea chittaranjani* (Euphaeidae), hitherto known only from the holotype, and (c) describe the female *Anisopleura vallei* (Euphaeidae) for the first time, and document new locality records.

MATERIALS AND METHODS

The Veino family collected specimens from Dimapur and Kohima districts of Nagaland, and the adjacent Senapati District of Manipur state from May to August 2016 with an insect net. Collections had been planned

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Competing interests: The authors declare no competing interests.

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after photographs were shared with the “Odonata of India” website (Joshi et. al 2017) and the importance of these records was realized. Specimens were pinned in the field, and are now deposited in the Research Collections at the National Centre for Biological Sciences, Bangalore. We photographed specimens using a Canon DSLR camera and Canon flashes and photographic umbrellas, and photographed male anal appendages using a Leica MC 120 HD camera attached to a Leica S8 APO microscope (Leica Microsystems, Germany). We stacked multiple images of each male genitalia using the software CombineZ (Hadley 2010) to generate images with greater depth-of-field to illustrate key identification characters. Scale bars on the images and automated measurements were done 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 used: S=abdominal segment, AD=anterio-dorsal, MD = medio-dorsal, PD = postero-dorsal, AL = antero-lateral, ML = medio-lateral, PL = postero-lateral,

and Riek & Kukalova-Peck (1984) was followed for the latest interpretation of the wing venation.

Odonata: Anisoptera: Gomphidae

***Burmagomphus divaricatus* Lieftinck, 1964**

(Image 1a–b, Table 1)

Material examined

NCBS-AS781, NCBS-AS805, 2 males, 13.vii.2016, India, Manipur, Senapati District, Vakho, 25.292962 N & 94.037285 E, coll. Joyce Veino, Lightson Veino & Rakoveine Veino; NCBS-AS823, 1 female, same locality as males, 15.vii.2016, coll. Joyce Veino & Lightson Veino.

Description

Male: Coupled yellow spots on labrum, postclypeus and frons with a small transverse streak on postclypeus; larger on the frons. Labium and mandibles yellow. Occiput black; a small yellow spot in the centre posterior to the ocellar space. Sides of the middle lobe and the anterior ridge of the anterior lobe of the prothorax yellow.



Image 1. *Burmagomphus divaricatus* Lieftinck, 1964 [scale= 1mm].

(a) male, (b) female, (c) male anal appendages- dorsal (NCBS-AS805), (d) male anal appendages- lateral (NCBS-AS805).

Table 1. Intraspecific variation in *Burmagomphus divaricatus*

Location	Northeastern India	Laos	Thailand	Malaysia	Koh Kong Province, Cambodia	Ratanakiri Province, Cambodia	Mandulkiri Province, Cambodia
Reference	This study	Asahina 1977	Asahina 1986	Asahina 1977; Liefertinck 1964	Kosterin 2014	Kosterin 2014	Kosterin 2016
Terminal spine on S9	Absent	Absent	One or two spines	One or two spines	Absent in one male, present in remaining 5	Absent, the segment pointed without a spine in one male (out of two).	Absent
Central spine on the cerci	Not well defined	Present, reduced	Present, reduced	Present, elaborate	Present, but reduced	Not well defined	Present, reduced
Length of parapectis	Reaching till the tip of the cerci	Reaching till the tip of the cerci	Reaching till the tip of the cerci	Not reaching till the tip of the cerci	Reaching till the tip of the cerci	Reaching till the tip of the cerci	Reaching till the tip of the cerci
Outer margin of cerci	Straight	Straight	Straight	Sinuuous	Straight	Straight	Straight
Color of the occipital area	Black, female with a yellow spot	Yellow	Black	Black	Black	Black	Black
Denticles on the posterior margin of the posterior hamuli	None	None	None	None	None	One of the two males with 2(right) /1(left) denticles	At least one on both sides in all 9 males, variable from 1-4
Black markings on the lateral thorax	Black anastomosis near the intersegmental suture, on the upper part of metanepisternum reduced and not fused with the black stripes along the metapleural suture; black stripes not broad	Black anastomosis-reduced and not fused with the black stripe along the metapleural suture; black markings not broad	Black anastomosis complete and indistinctly fused with the black stripes along the metapleural suture; black markings broad	Black anastomosis complete and indistinctly fused with the black stripes along the metapleural suture; markings broad	Black anastomosis complete and indistinctly fused with the black stripe along the metapleural suture; markings broad	Black anastomosis complete and indistinctly fused with the black stripe along the metapleural suture; markings broad	Black anastomosis not fused with the black stripe along the metapleural suture in 8 out of 9 males, indistinctly fused in one.

Synthorax marked with a collar and long stripes (the fused antehumeral and dorsal stripes, as follows from comparison with other species of the genus) reaching the lower half of the mesepisternum; well-defined spots present at the antealar ridge. The mesepimeronic and mesepisternic stripes are fused at the subalar ridge, dorsal half of mesepimeron yellow except a thin black marking running from the anterior edge of the subalar ridge to the intersegmental suture. Legs black. Posterior hamuli of the genitalia with only one anteriorly curved spine; anterior and posterior margins with long dense black hair characteristic of this species (Kosterin 2014). Antenodals: 13/14 in the fore wings, 9/10 in the hind wings; anal triangle 3-celled; cubital space traversed by one crossvein. Pterostigma dark brown, braced black. S1 laterally yellow, dorsally with a broad yellow marking broader anteriorly. S2 with a broad dorsal stripe; laterally yellow, except a small rounded black area posterior to the auricle; auricle yellow; the dorsal and lateral markings connected by a thin yellow line from dorsum to the auricles along the transverse carina. S3–S5 with a dorsal yellow line. S3–S7 with AL spots; larger and triangular on S3; these spots fused with the AD spot on S6–S7. S8 thinly yellow at the dorso-anterior margin. S9 with a broad PD stripe pointed slightly anterior; without a terminal spine. Anal appendages black. Cerci with the outer margin straight; the central spine not well-differentiated. Epipectis ‘divaricate’ or branching away; slightly broader than previously illustrated specimens; reaching posteriorly till the level of cerci. Measurements (in mm): abdomen (including anal appendages) = 27, fore wings = 26, hind wings = 24–25.

Female: The head and thorax similar to male. Occiput with a round yellow spot. Black markings on the side of the thorax reduced compared to males’. Antenodals: 12–13 in the fore wings, 9 in the hind wings. Pterostigma dark brown, braced. S1 broadly yellow on the dorsum and laterally. S2–S6 with a dorsal yellow stripe; broader at the base; shaped like an arrow-head on S2 anteriorly. S2–S7 with AL yellow markings reaching the transverse carina, S2–S6 with a thin transverse stripe posteriorly, successively reducing in length; an AD yellow marking on the S7 is fused with the AL spots marking the base of the segment. S9 with a small yellow marking at the postero-dorsal edge. S10 with two small yellow PD spots. Vulvar lamina short, not projected; bituberculate. Measurements (in mm): abdomen (including anal appendages) = 29, fore wings = 26–27, hind wings = 25.

Notes on the intraspecific variation

Anal appendages of the specimens reported here

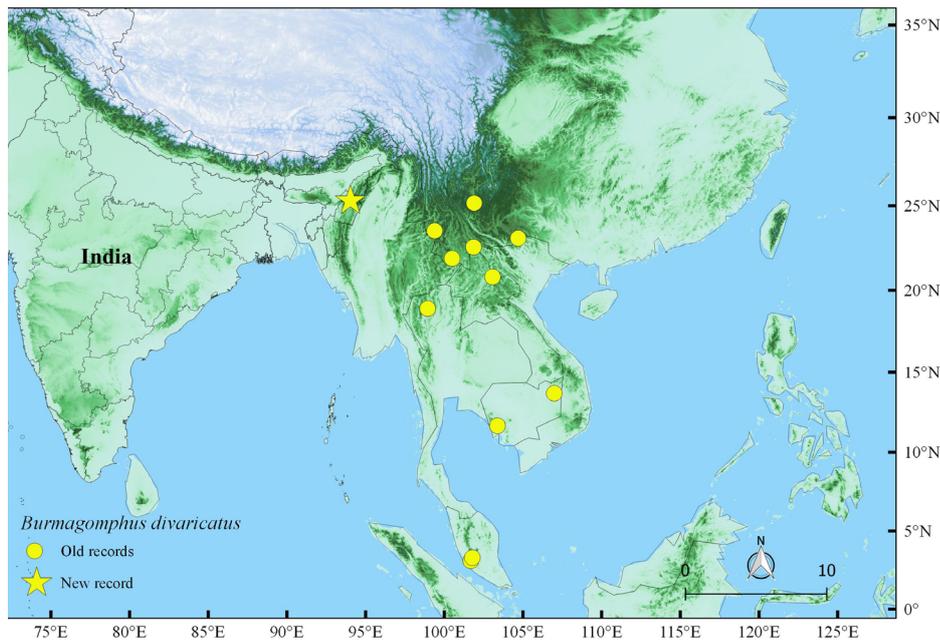


Image 6. Distribution of *Burmagomphus divaricatus*

match well with published figures with minor variation (e.g., Lieftinck 1964). This variation is in line with that reported earlier for this species, especially regarding the antehumeral stripes and thoracic pattern, shape of the anal appendages, the teeth on the posterior hamuli, and the spine on S9 (Kosterin 2014; Kosterin pers. comm. 2016). There are also some consistent differences across previously described specimens, e.g., the shape of the outer margin of the cerci (evenly shaped vs. sinuous), which vary consistently across Indo-China (Thailand, Cambodia, Laos) and peninsular Malaysia (Asahina 1977, 1986; Kosterin 2014; Kosterin 2016; Kosterin pers. comm. 2016). We compare the intraspecific variation in *Burmagomphus divaricatus* from published sources (cited above) and our specimens; the key characters which differ consistently are summarized in Table 1.

The shape of paraprocts is also variable in this species. Specimens from Malaysia exhibit either slender paraproct arms curved at the end (Lieftinck 1964) or the paraprocts broader, shorter and with a slight cavity towards the apex (Asahina 1977). Paraprocts of the Cambodian specimens are slender and straight, similar to *B. arboreus*. The specimens we report here from Manipur, India have paraprocts most similar to the specimens illustrated by Asahina (1977) from Kuala Lumpur, Malaysia. Detailed molecular and morphological analyses are needed to comment further on the geographically correlated variation in *B. divaricatus* and to establish the diagnostic differences between this species and *B. arboreus*, Lieftinck 1964 from Myanmar.

Remarks

This highly diverse gomphid genus contains at least 29 species (Zhang et al. 2015), five of which are currently known from India (Subramanian 2014). The genus can be divided into four groups based on thoracic markings (Kosterin et al. 2012), *B. divaricatus* belonging to 'Group 1', characterized by "fusion of the antehumeral and dorsal [thoracic] stripes" (Kosterin et al. 2012). This species can be differentiated from the other species of "Group 1" by the shape of its anal appendages (Image 1c,d).

Distribution

After its description from "Malay Peninsula" (now Peninsular Malaysia; Lieftinck 1964), this species has been recorded from China (Yunnan), Cambodia, Lao PDR, Singapore and Thailand (Manh 2011). The current record from Manipur extends the known range of this widely distributed species westwards (Image 6), while southern China is its known northern limit (Yang & Davies 1996)

Habits and Habitat

We observed at least seven males and two females near the road leading to Senapati Town in Manipur. Most specimens perched on rocks or sand near water, or on tall grass further away (e.g., Image 1a,b). This patch of river was far from pristine, with a lot of plastic and other waste materials from the town and nearby villages littering the riverbed.

Odonata: Anisoptera: Libellulidae

***Pseudothemis zonata* (Burmeister, 1839)
(Image 2a–b)**

Material examined

NCBS-AS830, NCBS-AS831, 1 male (immature), 1 female, 13.v.2016, India, Nagaland, Dimapur District, Diphupar “B”, 25.853480 N & 93.753563 E, coll. Joyce Veino & Lightson Veino.

Diagnosis

The diagnostic characters between *P. zonata* (Burmeister, 1839) and *P. jorina* Förster, 1904 are poorly reflected in the literature. The original descriptions were not very detailed and no clear diagnosis has been published since comparing these two species. We propose the following diagnostic differences between these two species after comparing our specimens, the original description of *P. jorina* by Förster (1904), the illustration by Asahina (1989) and observations available online (e.g., DeLonglee 2011; Farrell 2011): (a) The basal dark patch on the hind wings is smaller in *P. jorina* than in *P. zonata* in both sexes. In *P. jorina* the dark markings are restricted to the level of the subtriangle where in *P. zonata* the dark markings continue anteriorly along the anal margin, (b) The wing tips are dark in *P. zonata*; transparent in *P. jorina*, (c) Female and immature male *P. zonata* have one pair of lunular lateral yellow spots on S5-7 (rarely a trace on S4), whereas *P. jorina* has two pairs (one lateral and one dorsal) of elongate yellow streaks on S4-S7.

Distribution

P. zonata is reported from China, Korea, Hong Kong,

Japan, Taiwan, Thailand and Viet Nam (Asahina 1989; Ferro et al. 2009; Wilson 2009). *P. zonata* and the genus *Pseudothemis* are hitherto unreported from India or the neighbouring Nepal and Myanmar (This species was photographed by Ismavel 2012 and 2016, in Assam, India, but the specific identity could not be confirmed without a detailed examination). The current record extends the known range of this species westward by more than 1,000km; the previous western limit of this species was the Sichuan province in China (Image 7).

Age-correlated color changes

At least two females and three males were observed in the wild, out of which one male (Immature, Image 2) and one female were collected. Observations of the color changes (several males were observed regularly from 3 May to 11 June) suggest that younger males have bright yellow markings on the abdominal segments and on the face, and black coloration at the base of the wings is less pronounced, partly yellow (Image 2a). Adult males have dark black abdomens, base of the wings dark black, dorsum of first three segments bright white with a tinge of yellow, face white. Such similar age-correlated color changes have been reported elsewhere for this species (DeLonglee 2011).

Habits

This species was usually observed in flight during the early mornings and late afternoons. Most specimens were observed flying in a characteristic hawking flight, in open clearings adjacent to bamboo or dense shrubs as well as high up in the canopy. Individuals were also observed flying in and around a fishery pond.

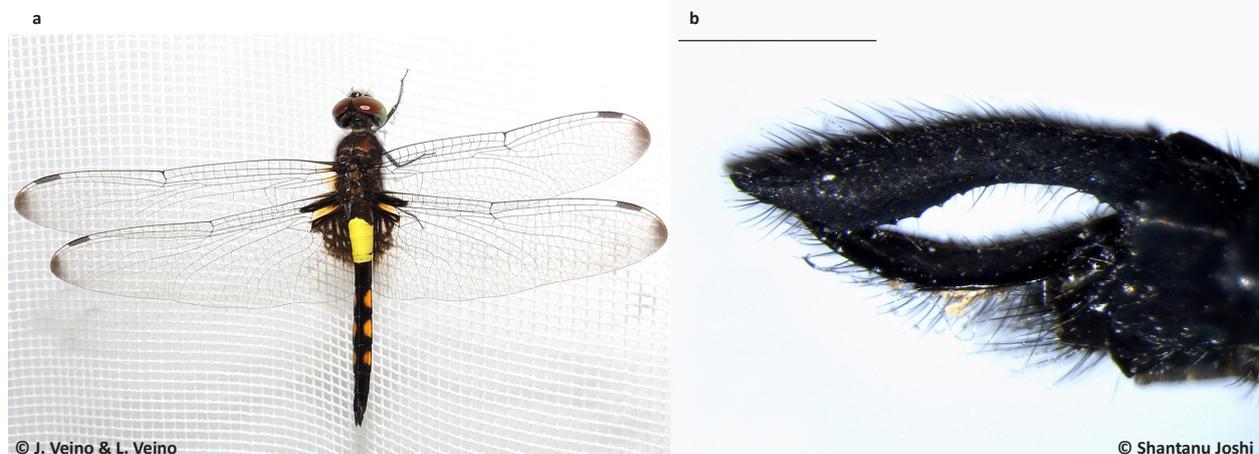


Image 2. *Pseudothemis zonata* (Burmeister, 1839) (NCBS-AS831). (a) Immature male, (b) male anal appendages [scale= 1mm]

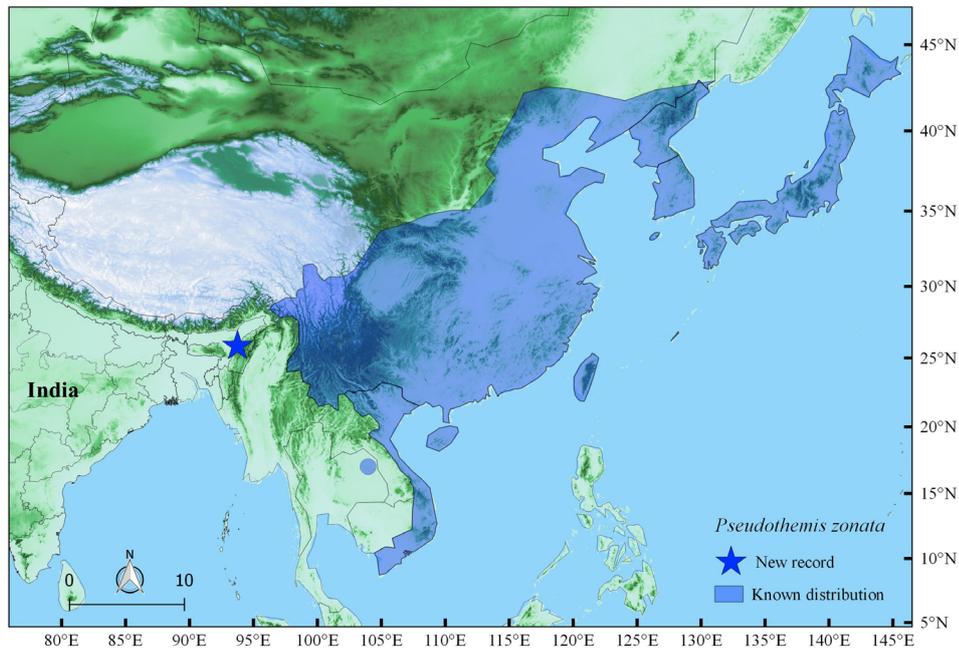


Image 7. Distribution of *Pseudothemis zonata*

Odonata: Zygoptera: Euphaeidae

***Anisopleura vallei* St. Quentin, 1937**

(Images 3a–d, 4a–b)

Materials examined

NCBS-AS824, 1 male, 16.vii.2016, India, Nagaland, Kohima District, Jotsoma, 25.67453 N & 94.061726 E, coll. Rakoveine Veino & Lightson Veino; NCBS-AV630, 1 female, 03.viii.2016, same locality as male, Joyce Veino & Lightson Veino.

Description

Male: Labrum black, rest of the face blue in immature specimens; in adults middle lobe of the labium pale blue, rest of the face yellow. Frons and top of the head black with a pair of 'teardrop-shaped' spots (pale blue in both mature and immature specimens). Prothorax black, two yellow paired oval spots on both sides of the middle lobe. Antehumeral stripe tapering stripe on each side, broad, lobe-shaped anteriorly; shaped hook-like posteriorly. The irregular marking on the mesepimeron covering both sides of the first suture is reduced, compared to *A. furcata* Selys, 1891. The marking is bifurcated on both sides of the suture with the dorso-anterior portion lobe-shaped. Metepimeron yellow. Synthorax black beneath with two pale yellow round markings. Legs black, femur greenish yellow anteriorly. Femur marked with yellow as follows: very small (ca. one-fourth of the femur) on the fore legs, covering half on the mid legs and about two-thirds

on the hind legs. A narrow dark patch at the apex of the forewings (absent in some specimens), tinted with brownish-yellow more so at the base. Anterior margin of the fore wing is slightly curved near the base while in the hind wing it is strongly angulated between the base and the nodus (like *A. furcata*). Cubital space with one or two cross-veins, discoidal cell entire. Antenodals: 17–18 in the fore wings, 15–16 in the hind wings. Abdomen black, with blue [immatures] and yellow [adults] markings. S1 yellow laterally, S2 marked yellow dorso-laterally on both sides, the marking connected by a thin stripe posteriorly on the dorsal side. S3–S6 marked on both sides with a spot (yellow in adults, pale blue in immatures) on the anterior margin and a longitudinal stripe dorso-laterally, on both sides of each segment. The spots on S3 connect to form a short basal stripe dorsally. The stripe on S6 is very faint, and on S7 only present as a small basal spot. S8 black, S9 and S10 pruinosed in both immatures and adults. Anal appendages (Image 3d) black, cerci crossing each other. Cerci shaped like a sail, broader at base; the outer margin is thicker with a thin inner portion. Cerci curved inwards, overlapping; pruinosed in some specimens. Paraprocts reduced. Measurements (in mm): abdomen (including anal appendages) = 32–33, fore wings = 29, hind wings = 26.5.

Female: Stouter than the male, markings similar. Face pale blue except the clypeus and labrum, frons black in the middle with a pale blue stripe on both sides running till the vertex. Vertex black, two lachrymiform pale



Image 3. *Anisopleura vallei* St Quentin, 1937. (a) Adult male, (b) immature male exhibiting both yellow and blue colors, (c) immature female (d) male anal appendages- dorsal (NCBS-AS824) [scale= 1mm]

blue markings near the lateral ocelli. Median lobes of prothorax blue. Antehumeral, and synthoracic markings are similar to that of the male. The antehumeral stripe clubbed on one side posteriorly, broader anteriorly. Coxa pale blue posteriorly, femur also marked with the same color as the coxa with proportions of colored portion in each leg similar to the male. Metascutum at the base of the wings marked with blue. Wings tinted with yellow at the base, more prominently at the costal border. Pterostigma black. Costal border slightly angulated. Cubital space with one cross-vein in both wings with the discoidal cell entire. Antenodal nervures: 17 in fore wings, 15/16 in hind wings. S1 pale blue dorsally, with pale blue dots on both sides, S2 with a broadly pale blue dorso-laterally, markings dorsally not fused like the male. S3 and S4 dorso-laterally with a vertical 'dash-like' marking anteriorly, a long horizontal stripe centrally, and a minute spot posteriorly. S5-S8 marked like the previous two segments without the minute posterior marking, markings reduced in

successive segments with S9 and S10 completely black. Anal appendages black, sharply pointed. Vulvar scale extends to the level of S10. Measurements (in mm): abdomen (including anal appendages) = 29, fore wings = 30, hind wings = 28.

Age-dependent color variation

Age-dependent color changes are common in odonates (Corbet 1999; Fincke et al. 2005) and previously have been reported in the genus *Anisopleura* (Hämäläinen & Karube 2013). Teneral specimens of *A. vallei* are brown colored with obscure blue markings, while immature males and females have blue thoracic and abdominal markings (Image 3c) which change gradually to yellow in adults (Image 3a). A male was observed at Jotsoma which had both blue and greenish-yellow colors (Image 3b).

Diagnosis

Anisopleura can be divided into two groups,

“species with 1 or 2 cross veins in cubital space” or “species with several (3-5) cross veins in cubital space” (Zhang et al. 2014). Three *Anisopleura* with one or two cross veins in the cubital space occur in India and Myanmar, viz., *A. lestoides* (Sélys, 1853), *A. furcata* and *A. vallei* (Subramanian 2014). *A. vallei* closely resembles *A. furcata* Selys, 1891 with respect to its thoracic and abdominal pattern, but can be differentiated from it by the shape of the marking on the mesepimeron and the shape of the anal appendages (for the appendages of *A. furcata* Asahina 1985). *A. vallei* is known only from the type series from Cherrapunjee, Khasi Hills (Meghalaya), consisting of nine males (St. Quentin 1937). One paratype currently at the Zoological Museum of University of Helsinki, exhibits a similar thoracic pattern and the shape of anal appendages as observed in our material (M. Hämäläinen, pers. comm. 2016).

Distribution

A total of at least 11 individuals were observed (1 male and 1 female collected) at four localities (total distance ca. 23.5km) along the National Highway-2 (renamed from NH-39 in 2011, hereafter NH-2), which connects the two biggest cities of Nagaland, Dimapur and Kohima (Image 8). A single male was first

photographed in Jotsoma in September 2015; later the species was again observed in June-September 2016 at a total of four localities collected specimens are from Jotsoma (where the species was observed at two localities) while individuals were also observed at the nearby Piphema (Dimapur District) and Peducha (Kohima District).

Remarks

The type locality of *A. vallei* (Cherrapunjee in Khasi Hills, Meghalaya) was once the wettest place on earth with rich biodiversity and high endemism. But these hills have suffered rampant habitat destruction and mining in recent years. Many species have lost their habitats to the threshold of being threatened with extinction like the Khasi Hill Rock Toad- *Bufoides meghalayanus* (Yazdani & Chanda, 1971) (Deuti et al. 2012; IUCN SSC Amphibian Specialist Group 2013). This continued habitat loss at its type locality makes the discovery of an additional locality in Nagaland even more important.

Habitat

This species was observed at four different localities (altitude ranging from 794–1,109 m) with fast-flowing hill streams, small spring-fed waterways, and irrigation channels surrounded by tall vegetation (Image



Image 4. (a) Hill stream at Peducha, Kohima District, Nagaland [Habitat of *A. vallei*], (b) a patch of cleared forest at Piphema, Dimapur District, Nagaland

4). Individuals were observed perched on vegetation along the water.

Odonata: Zygoptera: Euphaeidae

***Schmidtphaea chittaranjani* (Lahiri, 2003)
(Image 5a–f)**

Original combination: *Bayadera chittaranjani* Lahiri, 2003 (Hämäläinen 2013)

Material examined

NCBS-AV629, 1 male, 25.viii.2016, India, Nagaland, Kohima District, Jotsoma, 25.674531 N & 94.061726 E, coll. Dahru Veino & Lightson Veino.

Description

Male: Thorax and the abdomen are pruinosed, and the wings tinted brown indicating a mature specimen (Image 5). Labrum, labium, mandibles,

clypeus, genae, and frons bright yellow (Image 5b). Base of the antennae and the ocellar space black, sides yellow up to the lateral ocelli. Head black ventrally and posteriorly. Vertex of the head black except for two minute yellow lines running from the lateral ocelli to the base of the antennae on each side. Eyes black in live specimens, brown in pinned specimens. The middle lobes of the prothorax markedly pruinosed; rest of the prothorax black. Legs black and hairy. The femur is marked with faint yellow markings anteriorly, reduced on the forelegs; extending half the length in mid and hind legs. Thorax pruinosed laterally and ventrally, black dorsally. Metascutum pruinosed, base of the wings brown. Wings (Image 5e,f) entirely tinted light brown. Cubital space traversed by one nervure. Antenodals: 19/20 in fore wings, 16/17 in hind wings; postnodals: 27 in fore wings, 25/26 in hind wings. One (or two in some parts) row of cells between the border of wings and IA. Pterostigma black, broader and longer in the hind wing.

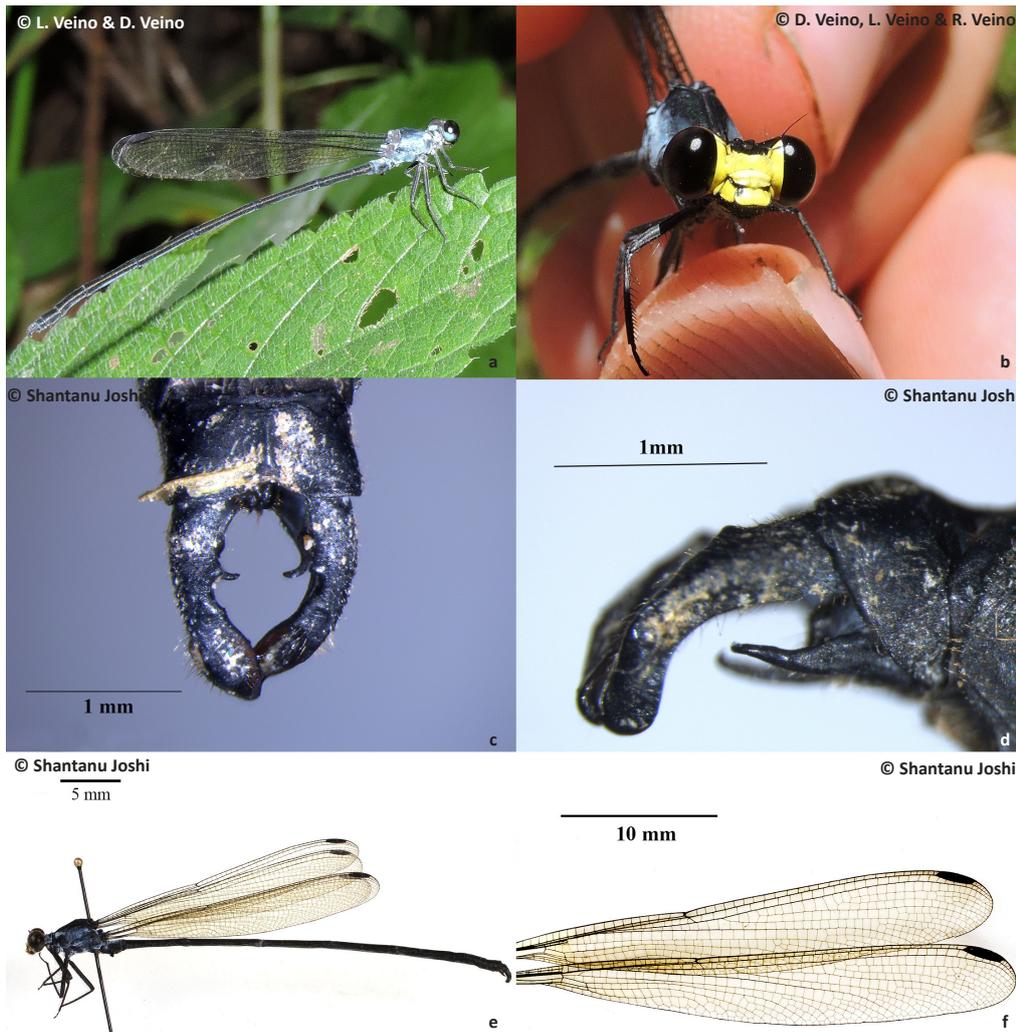


Image 5. *Schmidtphaea chittaranjani* (Lahiri, 2003)- (NCBS-AV629). (a) Lateral habitus (in situ), (b) face, (c) anal appendages- dorsal [scale = 1mm], (d) anal appendages- lateral [scale = 1mm], (e) lateral habitus [scale = 5mm], (f) wings [scale = 10mm]

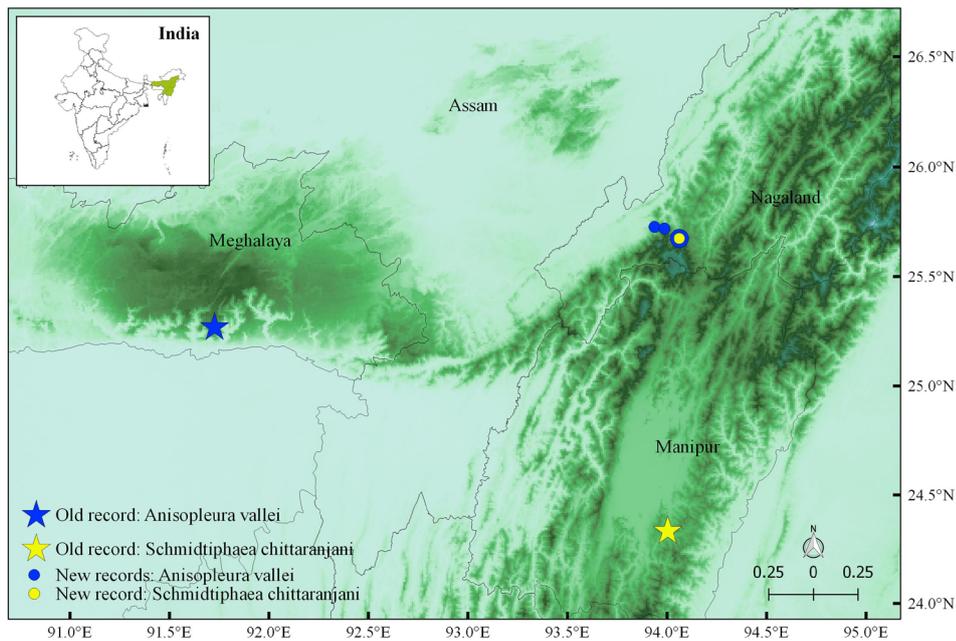


Image 8. Distribution of *Schmidtiphaea chittaranjani* and *Anisopleura vallei*.

Pterostigma placed apicad (but less so compared to *S. schmidi*, Asahina, 1978), spanning 5–6 cells. Abdomen black, except for a minute mid-dorsal yellow carina; reduced on S9 and S10. S1 and S2 pruinose dorsally. Anal appendages (Image 5c,d) black. Cerci broader at base, the inner margin incurved halfway to the apex, with a semicircular excavation laterally; a tooth pointing laterally inwards present posterior to the excavation; a quadrangular tubercle pointing ventrally is situated antero-ventral to the laterally pointing tooth. Cerci spatulate at the apices; outer margin denticulated till the apical dilation. Paraprocts black, about half the length of cerci) pointed, broader at the base; curved inwards near the cavity on the cerci dorsally; laterally curved upwards. Measurements (in mm): abdomen (including anal appendages) = 65, fore wings = 34, hind wings = 34–35.

Remarks

The genotype of the genus *Schmidtiphaea*, *Schmidtiphaea schmidi* was described from Huaihu, Manipur from a single male specimen with broken anal appendages from Eric Schmidt's collection (Asahina 1978). Asahina re-described the same species with new material from northern Thailand (Asahina 1987), but those four male specimens were later proven to be misidentified and were described as a new genus and species *Cryptophaea saukra* Hämäläinen, 2003 (for details, see Hämäläinen 2003). *Bayadera chittaranjani* Lahiri, 2003, was described from a single specimen (now broken, Babu et al. 2013) from Chandel,

Manipur. Hämäläinen (2013) transferred this species to the genus *Schmidtiphaea* based on its notably long slender abdomen and wing venation characters congruent with the genus *Schmidtiphaea*. *S. chittaranjani* can be differentiated from *S. schmidi* by: (a) face bright yellow (Image 5b) “zinc blue” in *S. schmidi*; this feature can be age-dependent, (b) the pterostigma is relatively shorter and broader, and in forewing it is placed more apicad in *S. chittaranjani* than in *S. schmidi*. Since the appendages of the holotype of *S. schmidi* are damaged, the structures in these two taxa cannot be reliably compared. Asahina (1978) wrote “Caudal appendages damaged, only the fragments of the superiors are remaining. The inferiors may be short”. At present even the fragments of the appendages of the type are lost (Hämäläinen 2013). The taxonomic relationship of *S. schmidi* and *S. chittaranjani* remains unclear owing to the poor condition of both holotypes. Our specimen matches more closely with the description of *S. chittaranjani* from the features mentioned above. The anal appendages match well with the illustrations in Lahiri (2003). We cannot provide any definite conclusions on the mutual taxonomic status of these two potentially valid species until more specimens become available.

Distribution and Habitat

This record extends the range of this species to Jotsoma, Nagaland, more than 200km from the type locality Chandel, Manipur (Image 8). This species was observed along with *A. vallei* at Jotsoma (yellow circle

outlined with blue in Image 8). This species was observed only twice despite multiple visits to the same locality. Both specimens were found on the edge of the stream resting on vegetation.

DISCUSSION

We report the genus *Pseudothemis*, and specifically *P. zonata*, and *Burmagomphus divaricatus* for the first time from India. These species have been hitherto unreported from the neighbouring Nepal, which is relatively better sampled, and Myanmar which remains largely unsampled. The occurrence of *P. zonata* in northeastern India is perhaps not surprising as it is known to have a wide distributional range in eastern and Southeast Asia, but our records extend the range of this species further west (Image 7). The occurrence of *B. divaricatus* is an interesting addition to the Indian fauna, making it one of the most widespread species of the genus (Image 6). Coincidentally, both of these species were recorded in human-disturbed habitats; *B. divaricatus* was observed adjacent to National Highway-2 (previously named NH-39) near the town of Senapati, Manipur along the banks of a plastic-ridden river. *P. zonata* was observed in the outskirts of Dimapur, the largest city in the state of Nagaland. It was observed near fishery ponds and bamboo patches near houses in Diphupar “B”, Dimapur. These two records indicate even the accessible areas of northeastern India may still contain many unrecorded odonates.

Out of the 19 endemic species of odonates known from the Patkai-Chin Hills (which cover parts of Meghalaya, Nagaland, and Manipur in India), 16 are Data deficient (Mittra et al. 2010); two such species, viz., *Anisopleura valleii* and *Schmidtphaea chittaranjani* are reported here (Subramanian 2010). *Anisopleura valleii* and *S. chittaranjani* were observed in streams along the Dimapur-Kohima road (part of NH-2; Image 8). These hill slopes are quite vulnerable to human activity and development. Habitat destruction is taking place in the form of land clearing, logging and road construction off the main highway, as well as current four laning of the main highway. This road also faces considerable landslides and ground sinking events in part catalyzed by the construction and development, often making it inaccessible (Anonymous 2011; Veino, J., pers. obs., 2015–2016; Yhosu 2015). Assessment of distribution of these poorly known species will be essential in determining the threats to these taxa and planning conservation measures.

The website ‘Odonata of India’ (Joshi et al. 2017) was created as a citizen-science project with the aim of

generating an online database documenting distribution patterns of odonates via user-submitted, photograph-based observations. It was through the contributions to this website that authors of this paper made contact, discovering that the Veino family (with two children ages 15 and 9) have been observing odonates in their backyard and other places in remote parts of Nagaland and Manipur. Such records by dragonfly enthusiasts are adding to the meticulous natural history observations, spot records, range extensions and new species descriptions. This is an encouraging model of how citizen scientists and professional researchers can build fruitful collaborations to study biodiversity in developing megadiverse countries (e.g., Gonella et al. 2015; Vázquez-García et al. 2015; Skejo et al. 2016), and bridge the ‘Wallacean gap’ (Beck et al. 2013).

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Communications

The status of Arabian Gazelles *Gazella arabica* (Mammalia: Cetartiodactyla: Bovidae) in Al Wusta Wildlife Reserve and Ras Ash Shajar Nature Reserve, Oman

-- Mansoor H. Al Jahdhami, Sultan Al Bulushi, Haitham Al Rawahi, Waheed Al Fazari, Ahmed Al Amri, AbdulRahman Al Owaisi, Salim Al Rubaiey, Zahran Al Abdulasalam, Metab Al Ghafri, Shaeilendra Yadav, Sami Al Rahbi & Steven Ross, Pp. 10369–10373

On the occurrence of the Black Spine-cheek Gudgeon *Eleotris melanosoma* Bleeker in Sri Lankan waters, with comments on the Green-backed Guavina *Bunaka gyrinoides* (Bleeker) (Teleostei: Eleotridae)

-- Sudesh Batuwita, Sampath Udugampala & Udeni Edirisinghe, 10374–10379

Captive breeding for conservation of Dussumier's Catfish (Actinopterygii: Siluriformes: Clariidae: *Clarias dussumieri*) a Near Threatened endemic catfish of peninsular India

-- K.G. Padmakumar, L. Bindu, P.S. Sreerekha, Nitta Joseph, Anuradha Krishnan, P.S. Manu & V.S. Basheer, Pp. 10380–10385

Influence of seasonal and edaphic factors on the diversity of scolopendromorph centipedes (Chilopoda: Scolopendromorpha) and general observations on their ecology from Kerala, India

-- Dhanya Balan & P.M. Sureshan, 10386–10395

Butterflies of eastern Assam, India

-- Arun P. Singh, 10396–10420

Short Communications

Three noteworthy additions to the flora of the western Himalaya, India

-- Ishwari Datt Rai, Amit Kumar, Gajendra Singh, Bhupendra Singh Adhikari & Gopal Singh Rawat, 10421–10425

New distribution records of three *Sarcophyton* species (Alcyonacea: Alcyoniidae) in Indian waters from Andaman Islands

-- Seepana Rajendra, C. Raghunathan & Tamal Mondal, 10426–10432

Additions to the Indian dragonfly fauna, and new records of two enigmatic damselflies (Insecta: Odonata) from northeastern India

-- Shantanu Joshi, Joyce Veino, Dahru Veino, Lightson Veino, Rakoveine Veino & Krushnamegh Kunte, Pp. 10433–10444

Dragonflies and Damselflies (Odonata: Insecta) of Keoladeo National Park, Rajasthan, India

-- Dheerendra Singh, Brijendra Singh & Jan T. Hermans, Pp. 10445–10452

Records of the Indian Sand Snake *Psammophis condanarus* (Merrem, 1820) (Reptilia: Lamprophiidae) in southern India

-- S.R. Ganesh, Vivek Sharma & M. Bubesh Guptha, Pp. 10453–10458

An ecological note on the new record of *Cuora amboinensis* (Riche in Daudin, 1801) (Reptilia: Testudines: Geoemydidae) in northeastern India

-- Kulendra Chandra Das & Abhik Gupta, Pp. 10459–10462

A new distribution record of the European Free-tailed Bat *Tadarida teniotis* (Chiroptera: Molossidae) from the western Himalaya, India

-- Rohit Chakravarty, Pp. 10463–10467

Measuring Indian Blackbuck *Antelope cervicapra* (Mammalia: Cetartiodactyla: Bovidae) abundance at Basur Amruth Mahal Kaval Conservation Reserve, Chikkamagaluru, southern India

-- H.S. Sathya Chandra Sagar & P.U. Antoney, Pp. 10468–10472

Notes

A new species of *Sarcinella* (Ascomycetes) from Eturnagaram Wildlife Sanctuary, Warangal District, Telangana, India

-- Khaja Moinuddin Mohammad, Bagyanarayana Gaddam & Rana Kausar, Pp. 10473–10475

Re-collection of the Black Catchfly *Silene nigrescens* (Caryophyllales: Caryophyllaceae) after 130 years from Indian western Himalaya

-- Satish Chandra, D.S. Rawat & P.K. Pusalkar, Pp. 10476–10479

Eight new records of the family Erebiidae (Lepidoptera: Noctuoidea) from India

-- Jagbir Singh Kirti, Navneet Singh & Harkanwal Singh, Pp. 10480–10486

New records of hover wasps (Hymenoptera: Vespidae: Stenogastrinae) from Bhutan

-- Tshering Nidup, Wim Klein & Phurpa Dorji, Pp. 10487–10489

Addition of four species to the butterfly checklist of Kaleshwar National Park, Haryana, India

-- Sachin P. Ranade, Pp. 10490–10492