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Pacific Islands comprise of Micronesian, Melanesian and Polynesian Islands.


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# A photographic survey of Odonata in Sabah, Malaysia, 2023

Benjamin Schwartz*[,1,2], Philip Benstead[3], Rory A. Dow[4,5], Denis Matthey[6] & Michael Post[7]

[1]Department of Biology, Texas State University, San Marcos, Texas, USA.

[2]Edwards Aquifer Research and Data Center, Texas State University, San Marcos, Texas, USA.

Email: bs37@txstate.edu

[3]Tranv. 9, 26962 Grevie, Sweden

Email: philbydog1@icloud.com

[4]Institute of Biodiversity and Environmental Conservation, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia

[5]Naturalis Biodiversity Centre, P.O. Box 9517, 2300 RA Leiden, The Netherlands

Email: rory.dow230@yahoo.co.uk

[6]Uvalska 89, 250 82 Tuklaty, Czech Republic

Email: matthey@seznam.cz

[7]Baden-Badener Str. 5, 69126 Heidelberg, Germany

Email: mjphd@posteo.de

*Corresponding author

## Abstract

This report provides a summary of photographic documentation of Odonata at 101 sites in Sabah, in Malaysian Borneo, during two trips: January 9 to 30, 2023, and October 2 to 14, 2023. We report 130 species documented in photographs of 1,383 individuals. This represents 68% of the 190 taxa reported to occur in Sabah prior to this trip. Notable photographic records are described and include 8 species recorded in Sabah for the first time (one of which is a new genus for Borneo). Some species that may be new and undescribed, or known and undescribed, were photographed. A complete list of all records and corresponding iNaturalist observations, species x site data, habitat descriptions, weather conditions, search time, and counts for species observed at each site are included in tables.

**Key words:** Odonata, Sabah, Malaysia, Borneo.

## Introduction

Sabah is the northeastern state of Malaysian Borneo and includes diverse habitats at elevations from sea level to >4,000 masl on Mount Kinabalu. The island was originally blanketed by forests, but much of this habitat has been altered or destroyed, which has impacted the

abundances, distribution, and biodiversity of Odonata in the region. While odonatologists have published extensively on fauna in the Malaysian state of Sarawak, and the nation of Brunei, the state of Sabah has received somewhat less attention from the scientific community. Despite this, Sabah still has high reported diversity and as of 2022 (Dow et al. 2022) 190 of the 371 species known from Borneo were reported to occur in Sabah.

Four of us (Benjamin Schwartz (BS), Philip Benstead (PB), Denis Matthey (DM), and Michael Post (MP)) undertook a synoptic photographic survey of Odonata in Sabah: from January 9 to 30, 2023, and PB again from October 2 to 11, 2023. Our primary objectives were to visit diverse habitats across the state of Sabah, document the species encountered, and to perhaps contribute to a broader understanding of abundances, seasonality, and distributions of odonates in Sabah. Together, this information may help inform future scientific sampling and research in Sabah.

Prior to the survey, a personal photographic 'field guide' for Odonata in Sabah was assembled by BS, using the most recent species checklists for Borneo (Dow et al., 2022; Dow et al., 2024). The guide incorporated live photographs from online and published sources, including primary literature whenever possible. However, many species have live photographs of relatively poor quality, uncertain identity, or (frequently) no publicly available live photographs at all. Therefore, another objective was to obtain live photos that might aid in identification of rare or uncommon species in the field.

Some sites had previously been visited by other odonatologists who have reported specimen or other reliable records from Sabah, though many species documented by those researchers were not found on this trip (e.g., see IDF publications - https://dragonflyfund.org/en/ - and additional photographic records on iNaturalist). However, we observed and documented additional species at most of these sites.

## Methods

Observations were made by BS, PB, DM, and MP from January 9 to 30, 2023, and PB again from October 2 to 14, 2023. Identifications or ID confirmation for many species were performed after the trip by Rory Dow (RD), who also contributed substantially to information about the problems and taxonomic status of difficult-to-identify groups. Prior to the trip, RD also provided primary literature and information about species and sites.

Our trip took a roughly counter-clockwise route around Sabah, beginning and ending in Kota Kinabalu, with several diversions (Figure 1). We visited as many habitat types and sites as possible during the time available, and searched intensively for odonates at each site, but no sites or habitats were exhaustively surveyed due to time constraints and/or weather conditions, and some habitat types were not visited at all (e.g., high altitude sites on Gunung Alab, where weather conditions were terrible).

## Locations

### Dalit Bay

Site 1 (N 6.15513, E 116.15677, 5m asl). January 9, 2023.

A small marsh on reclaimed mangrove swamp east of Dalit Bay Golf and Country Club.

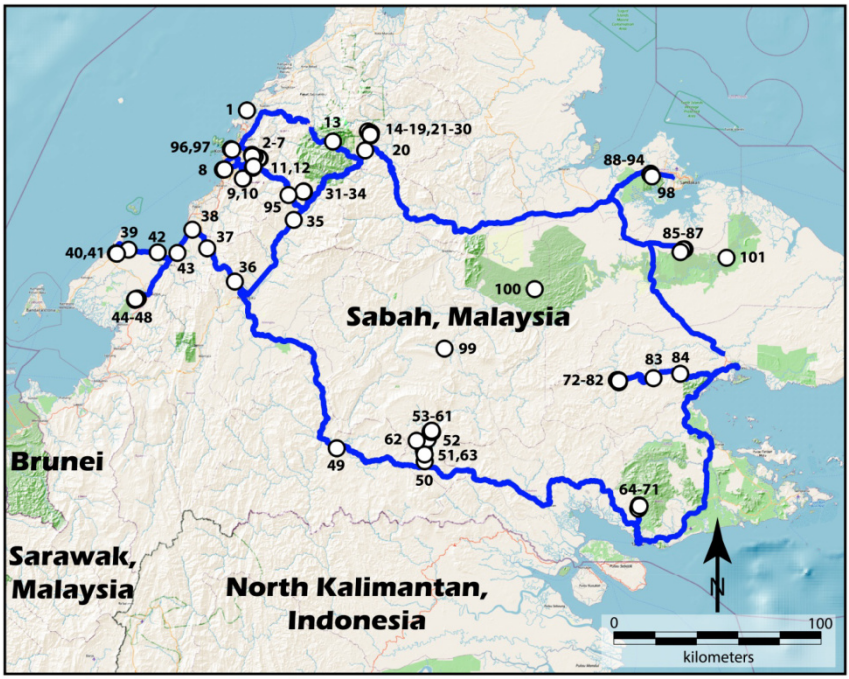



**Figure 1. Map of northeastern Borneo showing numbered locations of the 101 sites visited in Sabah, and the route traveled in blue (counterclockwise). Exact coordinates and descriptions of each site are provided in the report. Tracks and exact site locations were created in the field by BS using the Base Map app on an iPhone 13 (https://www.basemap.com/). Figure created using QGIS 3.34.14, with edits in Adobe Illustrator.**

### Eko-Pelancongan and nearby sites

Site 2 (N 5.94383, E 116.21270, 220m asl). January 10, 2023.

A brief reconnaissance by BS and PB of the riverside nature park Eko-Pelancongan, situated on the banks of a high-gradient medium-sized clear-water river. Habitats include open boulder/cobble river, adjacent mowed meadows, a small tributary forest stream, and adjacent seeps and swampy areas. Warm and sunny with patchy clouds; odonates were very active. Duration of visit: ~2 hours. Access is via a route from the NW beginning near Kampung Pomotodon Inanam. Route-finding was tricky in a few places and not all roads shown on map apps are useable.

Site 3 (N 5.95396, E 116.18017, 420m asl). January 10, 2023.

A small dry ditch along a dirt road in secondary forest on a mountainside. Warm and partly cloudy. A single female *Vestalis* sp. observed. Duration of visit: 10 minutes.

Site 4 (N 5.95163, E 116.19075, 400m asl). January 10, 2023.

A small mountain creek flowing through twin culverts at a road crossing. Steep and bouldery with pools and small cascades, with adjacent secondary forest and roadside clearings. Warm and sunny with patchy clouds; several common odonate species were very active. Duration of visit: 15 minutes.

Site 5 (N 5.94470, E 116.20868, 255m asl). January 10, 2023.

A concrete low-water crossing of a medium-sized mountain stream with open canopy over pools. Large boulders and pools in secondary forest with dense patches of spiny ferns. Adjacent tiny tributary through forest with a shaded 'wallow' pool and small seep habitats. Weather was warm and sunny with patchy clouds, and odonates were very active. Duration of visit: 45 minutes.

Site 6 (N 5.95189, E 116.19121, 405m asl). January 10, 2023.

Two small mountain creeks joining and flowing through a concrete culvert at a road crossing. Steep and bouldery with small pools and cascades in secondary forest and a roadside clearing. Warm and sunny with patchy clouds; a few common odonates very active in the open. Duration of visit: 15 minutes.

Site 7 (N 5.95968, E 116.17913, 288m asl). January 10, 2023.

A small drippy waterfall behind some roadside brush, in secondary forest. Overhanging damp rocks and vegetation, and roadside vegetation. Weather was warm and mostly cloudy, and odonates were active. Duration of visit: 15 minutes.

Site 8 (N 5.89500, E 116.05690, 12m asl). January 10, 2023.

Large marsh filled with emergent vegetation, rushes, and sedges, bordered by urban brushy forest, and open grasses and water-filled ditches along the large and muddy Sungai Moyog in Putatan. Weather was very warm and mostly cloudy. Duration of visit: ~1.5 hours. Many common and widespread lowland species were very active in late afternoon and early evening.

**Crocker Inobong substation and Babagon**

Site 9 (N 5.85497, E 116.13816, 500m asl). January 11, 2023.

A very small trickle stream in thick undergrowth and giant bamboo in dense forest on the trail between Crocker Inobong Substation and the Inobong waterfall (Figure 2). Weather was warm and partly cloudy. Odonates were moderately active in the morning. Duration of visit: ~45 minutes.

Site 10 (N 5.85456, E 116.14007, 450m asl). January 11, 2023.

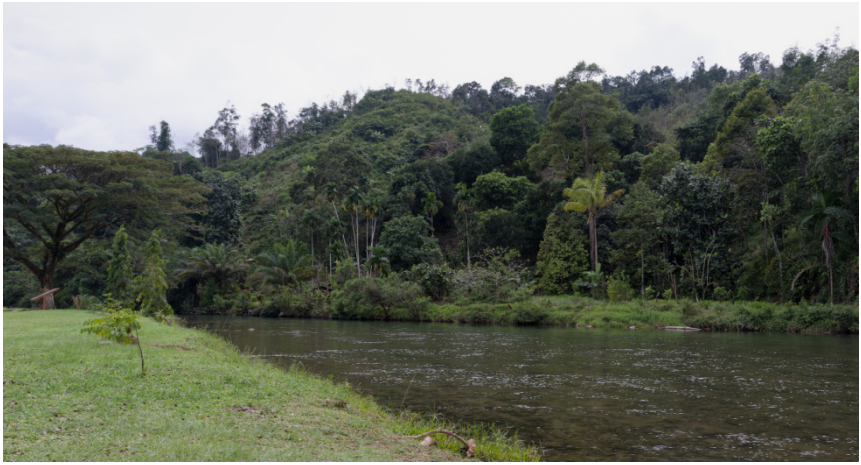
Large and steep mountain stream at and below the Crocker Inobong Waterfall. Habitats include the boulder/cobble stream, adjacent steep streambank seeps and drippy areas, and small understory openings over the stream in dense forest. Warm and mostly cloudy with very little sun. Odonates were moderately active. Duration of visit: 2 hours.

Site 11 (N 5.90314, E 116.18332, 50m asl). January 11, 2023.

A riverside park on the banks of Sungai Moyog at Babagon (Figure 3). A large, open,

**Figure 2. Site 9, tiny stream in dense bamboo forest at Crocker Inobong Substation. Photographer: M. Post.**

**Figure 3. Site 11, a riverside park on Sungai Moyog at Babagon. Photographer: M. Post.**



clear-water river with secondary forest on one side and short grass and homes on the other side. River is a series of large pools, riffles, and rapids with sand to large cobble substrate. Weather was warm and mostly cloudy, and odonates were very active. Duration of visit: ~1 hour.

Site 12 (N 5.90836, E 116.18560, 70m asl). January 11, 2023.

Medium-size bouldery stream below Babagon Dam with mix of boulder riffles, gravel, and bedrock (Figure 4). Open and brushy adjacent hillslopes. Weather was warm and sunny and several common species were very active. Duration of visit: ~1 hour.

**Mount Kinabalu National Park**

Site 13 (N 6.01835, E 116.53711, 1,650m asl). January 12, 2023.

On and along the Silau-Silau Trail, Mount Kinabalu N.P (Figure 5). A small steep creek in dense montane forest. Habitats include boulder/cobble with small waterfalls and pools, adjacent seeps and trickle tributaries, and a small open area near the top end of the trail. Weather was cool and cloudy with periodic light rain, and odonates were not active: only one *Coeliccia* sp. was seen. Duration of visit: 2.5 hours.

**Mount Kinabalu National Park – Poring Hot Spring to Langanan Waterfall**

Site 14 (N 6.04802, E 116.70210, 510m asl). January 13, 2023.

Areas around and in concrete pools at Poring Hot Springs. Habitats include open mowed meadows, brushy edges, and some small streams and ditches. Some odonates were seen in (dead) or near the scalding pools. Weather was hot and sunny and odonates were very active. Duration of visit: ~1 hour.

Site 15 (N 6.05224, E 116.70008, 600m asl). January 13, 2023.

Along trail from Poring Hot Springs to Langanan Waterfall, through mature forest on dry hillslopes well away from water, but above a large stream in the valley below. Weather was hot and sunny with patchy clouds. Duration of visit: ~15 minutes.

Site 16 (N 6.05368, E 116.69799, 705m asl). January 13, 2023.

Along trail from Poring Hot Springs to Langanan Waterfall. A small trickle creek on a steep hillside at the edge of a landslide opening in the forest. Weather was hot and sunny with patchy clouds. Duration of visit: ~15 minutes.

Site 17 (N 6.05672, E 116.69622, 815m asl). January 13, 2023.

A small trailside seep on a steep forested mountainside near a landslide opening. Weather was hot and sunny with patchy clouds. Duration of visit: ~15 minutes.

Site 18 (N 6.05846, E 116.69592, 840m asl). January 13, 2023.

A small headwater seep in a steep rocky mountainside drainage in deeply shaded primary forest. Some dripping rock slabs and boulders. Weather was hot and sunny with patchy clouds. Duration of visit: ~20 minutes.

Site 19 (N 6.06235, E 116.69156, 920m asl). January 13, 2023.

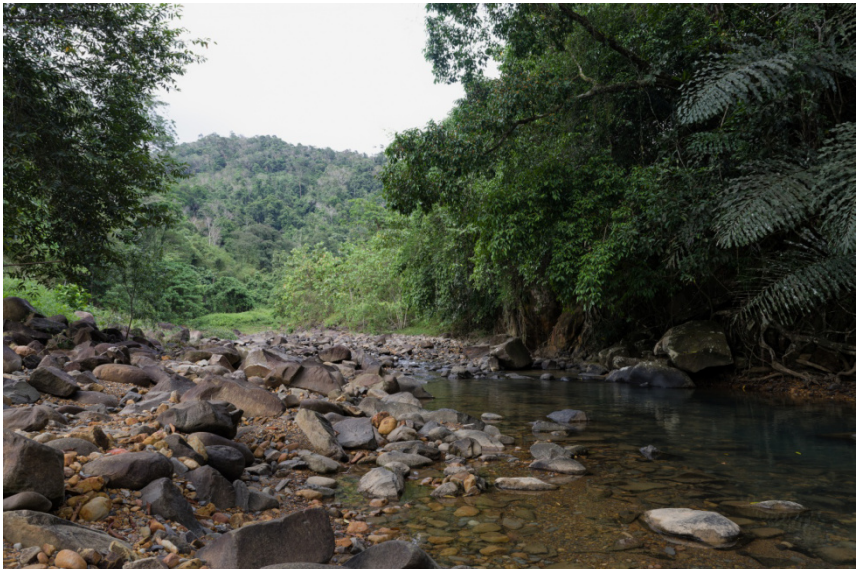


**Figure 4. Site 12, stream below Babagon Dam. Photographer: M. Post.**

**Figure 5. Site 13, forest stream along the Silau-Silau Trail, Mount Kinabalu N.P. Photographer: M. Post.**

A medium-sized steep mountain river with clear water below Langanan Waterfall (Figure 6). Habitats include large boulder/cobble in the river, bedrock ledges and small falls, and deep pools connected by runs and riffles. Adjacent dense primary forest with riverbanks lined with huge ferns, understory riparian shrubs and plants, and palms. Weather was cloudy with sparse weak sun, and odonates were relatively inactive. Duration of visit: ~1 hour. Accessed along trail to Langanan Waterfall.

**Figure 6. Site 19, a steep mountain river below Langanan Waterfall, Mount Kinabalu N.P. Photographer: M. Post.**

### Ranau

Site 20 (N 5.97927, E 116.68007, 560m asl). January 13, 2023.

Mowed areas around creekside rental cabins near Ranau (OYO 90284), with adjacent overgrown brushy field and medium river. Weather was warm and nearly dark at dusk. Crepuscular odonates (multiple species) were very active and feeding around small trees and 3-10 m above the ground. Duration of flight time: ~30 minutes.

### Mount Kinabalu National Park at and near Poring Hot Springs

Site 21 (N 6.05069, E 116.70272, 510m asl). January 14, 2023.

A small mowed grassy area under large trees at the restrooms below Kipungit Waterfall. Weather was warm and sunny with patchy clouds and odonates were very active. Duration of visit: ~30 minutes.

Site 22 (N 6.05153, E 116.70231, 530m asl). January 14, 2023.

Along the banks of the steep rocky river below Kipungit Waterfall. Weather was warm and sunny with patchy clouds. Odonates were very active. Duration of visit: ~45 minutes.

Site 23 (N 6.05145, E 116.70131, 560m asl). January 14, 2023.

A steep rocky river below Kipungit Waterfall, with small side overflow channels and isolated pools. Weather was warm and sunny with patchy clouds. Odonates were very active. Duration of visit: ~20 minutes.

Site 24 (N 6.04858, E 116.70180, 530m asl). January 14, 2023.

Areas of disturbed forest along trails near Poring Hot Springs entrance, with small ephemeral drainageways. Weather was hot and mostly cloudy. Duration of visit: ~15 minutes.

Site 25 (N 6.04506, E 116.70380, 510m asl). January 14, 2023.

A small creek and culvert at edge of Poring Hot Springs parking lot. Mowed grasses and edges of brushy secondary forest. Weather was very hot and mostly sunny with very active odonates. Duration of visit: ~15 minutes.

Site 26 (N 6.04465, E 116.70320, 530m asl). January 14, 2023.

A small stream in a dense giant bamboo forest just upslope from the Poring Hot Springs parking lot. Weather was hot and mostly sunny. Duration of visit: ~45 minutes.

Site 27 (N 6.04507, E 116.70290, 520m asl). January 14, 2023.

A tiny shaded seep and mucky areas in a drainage under trees on a grassy mowed hillside above the football field at Poring Hot Springs. Hot and mostly cloudy. Duration of visit: ~10 minutes.

Site 28 (N 6.04555, E 116.70290, 515m asl). January 14, 2023.

Ditches around the Poring Hot Springs football field and a nearby small pond at the forest-edge; pond with dense emergent vegetation. Hot and cloudy with many very active odonates. Duration of visit: ~45 minutes.

Site 29 (N 6.05172, E 116.70369, 485m asl). January 14, 2023.

Medium river below Kipungit Waterfall at small road crossing near Poring Hot Springs. Gravel and cobbles with pool and riffle habitats. Partly cloudy and late in the day. Duration of visit: ~20 minutes.

Site 30 (N 6.05604, E 116.70535, 480m asl). January 14, 2023.

A large, clear river at a low-water road crossing near Poring Hot Springs, with gravel bars, cobbles, and boulders. Partly cloudy and very late in the day. Duration of visit: ~20 minutes.

**Mahua Waterfall, Mahua Substation, Crocker Range Park**

Site 31 (N 5.79781, E 116.40632, 1,110m asl). January 15, 2023.

Small, steep, and boulder-filled tributary drainages (some were dry or only had isolated spots of water) in dense forest along the large and clear Sungai Mahua: along the trail to Mahua Waterfall (Air Terjun Mahua). Weather was warm and mostly cloudy with sparse sun. Duration of visit: ~1 hour.

Site 32 (N 5.79694, E 116.40849, 1,050m asl). January 15, 2023.

Sungai Mahua at Mahua Substation Parking Area: a high-gradient clear river with boulders and small rapids, with adjacent forest and mowed open areas. Some small seeps along edges of open areas. Weather hot in the open, and partly sunny: odonate activity moderate. Duration of visit: ~2 hours.

Site 33 (N 5.79841, E 116.40878, 1,110m asl). January 15, 2023.

A small rocky and gravelly tributary to Sungai Mahua just north of the park entrance. Dense understory in secondary forest, with some clearings and small landslips along the creek. Hot and mostly cloudy with patchy sun but cool along the creek; odonate activity moderate. Duration of visit: ~1 hour.

Site 34 (N 5.79744, E 116.40798, 1,090m asl). January 15, 2023.

A small mucky boggy area below the manmade fishponds near the Mahua Substation. A small stream flows through a patch of dense brushy forest, with thick emergent wetland vegetation and deep mucky sediments beneath the water in shallow pooled areas. Mostly cloudy with patchy sun; odonate activity moderate. Duration of visit: ~30 minutes.

Site 35 (N 5.67267, E 116.36366, 580m asl). January 15, 2023.

Recently harvested rice paddy behind the Tambunan Rafflesia Hotel. Hot and mostly sunny afternoon with several common species. Duration of visit: ~45 minutes.

**Tambunan to Kuala Penyu**

Site 36 (N 5.40082, E 116.10318, 975m asl). January 16, 2023.

Small steep stream with waterfalls near the Crocker Park entrance station on Jalan Keningau Kimanis. Mostly sunny and cool with some odonate activity. Duration of visit: ~30 minutes.

Site 37 (N 5.54722, E 115.98068, 55m asl). January 16, 2023.

Sungai Kimanis - a large river with boulders, cobbles, pools, and riffles (Figure 7). Partly wooded along edges with lots of open and cultivated areas. Hot and sunny. Duration of visit: ~45 minutes.

Site 38 (N 5.62945, E 115.91515, 10m asl). January 16, 2023.

A roadside canal crossing just east of Kimanis on Jalan Keningau Kimanis. In open terrain with weeds, grasses, and emergent aquatic plants. Hot and partly sunny. Duration of visit: ~30 minutes.

Site 39 (N 5.54147, E 115.63250, 10m asl). January 16, 2023.

A roadside ditch with tannic water along Jalan Bandau Kuala Penyu, in secondary forest (maybe a relict peat swamp forest?) (Figure 8). Pitcher Plants in adjacent boggy and swampy areas, and abundant emergent spike rushes and weedy/brush in and around the ditch. Hot and mostly cloudy. Many odonates. Duration of visit: ~45 minutes.

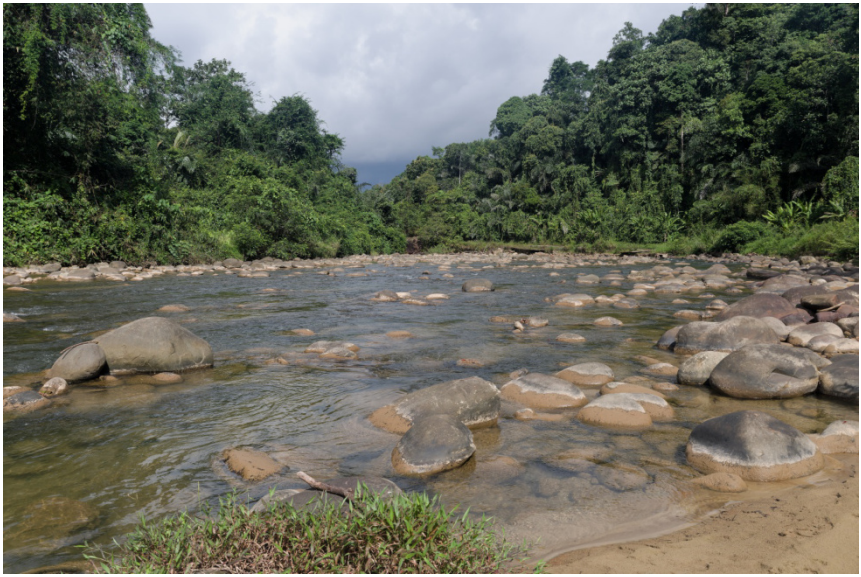


**Figure 7. Site 37, Sungai Kimanis along Jalan Keningau Kimanis. Photographer: M. Post.**

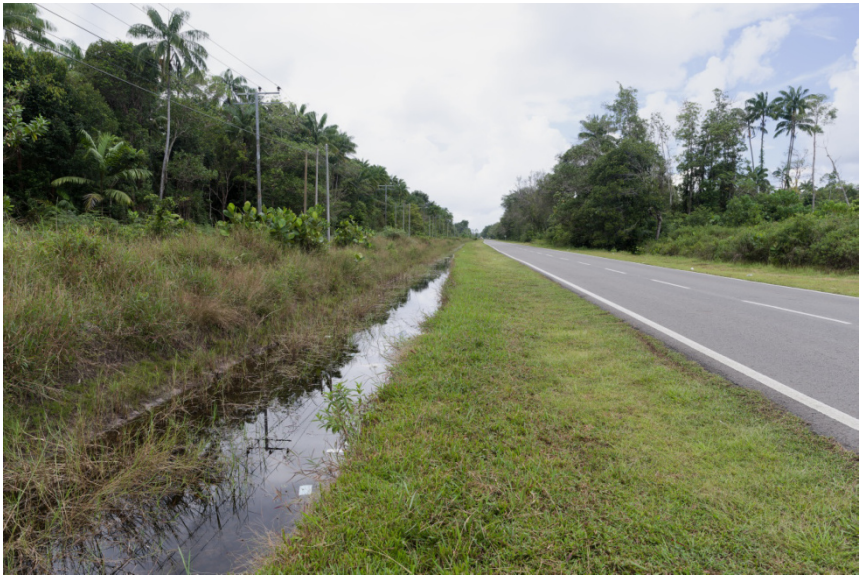


**Figure 8. Site 39, tannic roadside ditch along Jalan Bandau Kuala Penyu. Photographer: M. Post.**

Site 40 (N 5.52514, E 115.57693, 5m asl). January 16, 2023.

Rice paddy with some rushes, sedges, and weeds. Hot and cloudy. Duration of visit: ~15 minutes.

Site 41 (N 5.52390, E 115.58096, 5m asl). January 16, 2023.

Canal with mangroves along it and in nearby swamps on the southwestern side of Lake Sitompok (Figure 9). Open land around with some low brush and salt-tolerant plants. Hot and mostly cloudy with spots of sun. Duration of visit: ~30 minutes.

Site 42 (N 5.52960, E 115.76151, 1m asl). January 16, 2023.

Small, shallow, spike rush-lined, near-coast freshwater pools in tall grass meadows just north of Kampong Madang Pimping (Figure 10). Warm and mostly cloudy. Duration of visit: ~45 minutes.

Site 43 (N 5.52694, E 115.84895, 10m asl). January 16, 2023.

Mowed lawns around a couple ponds at the Eagle Wood Garden OYO, with some nearby forest and brush. Warm: cloudy late afternoon and clearing in the evening. Many active crepuscular dragonflies. Duration of visit: ~1 hour.

**Klias Peat Swamp Forest**

Site 44 (N 5.32460, E 115.67134, 10m asl). January 17, 2023.

Dry peat swamp forest along the boardwalk in the Klias Peat Swamp Forest. No water was seen along most of the boardwalk. Hot and sunny with plenty of active odonates. Duration of visit: ~2 hours.

Site 45 (N 5.32018, E 115.66098, 10m asl). January 17, 2023.

A small pool of tannic water beneath an upturned tree root ball in a small clearing in a mostly dry peat swamp forest, at the back loop on the boardwalk (Figure 11). Hot and sunny. Duration of visit: ~1 hour.

Site 46 (N 5.32360, E 115.66362, 10m asl). January 17, 2023.

A tiny pool of tannic water beneath a root ball in deep shade along the boardwalk. Hot and sunny. Duration of visit: ~20 minutes.

Site 47 (N 5.32320, E 115.66628, 10m asl). January 17, 2023.

Small shallow pool in thick peat swamp forest. Hot and sunny. Duration of visit: ~10 minutes.

Site 48 (N 5.32534, E 115.67305, 10m asl). January 17, 2023.

Tannic water drainage ditches around the Klias entrance station, surrounded on two sides by peat swamp forest. Dense brush and understory, with some open areas. Hot and partly cloudy in the late afternoon and early evening. Many active and perched odonates. Duration of visit: ~2 hours.

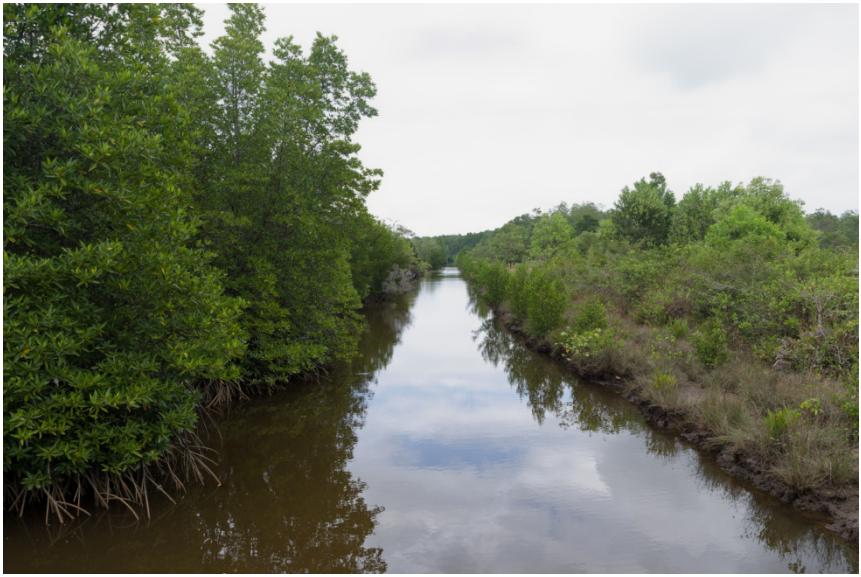


**Figure 9. Site 41, mangrove-lined canal near Lake Sitompok. Photographer: M. Post.**

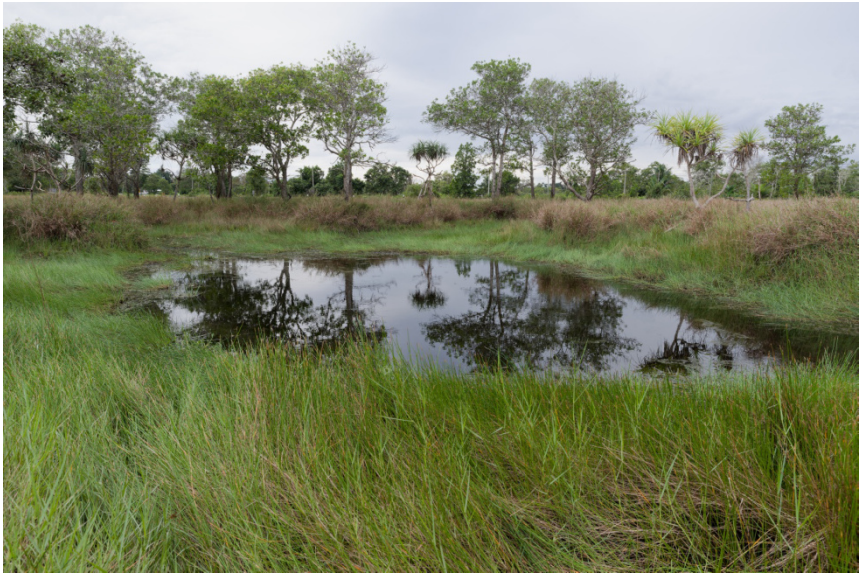


**Figure 10. Site 42, spike rush-lined freshwater pond near the coast along Jalan Bandau Kuala Penyu. Photographer: M. Post.**

**Figure 11. Site 45, tannic pool in a root-ball hole in Klias peat swamp forest. Photographer: M. Post.**

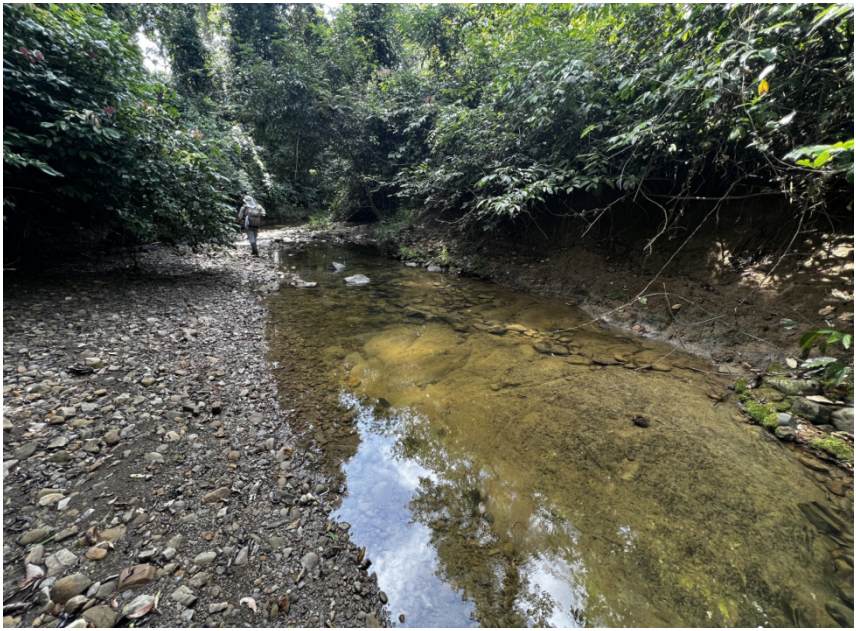


**Figure 12. Site 52, small forest river along entrance road to Maliau Basin. Photographer: B. Schwartz.**

**Beaufort area to Maliau Basin**

Site 49 (N 4.66501, E 116.55416, 280m asl). January 18, 2023.

A medium-sized river at a bridge on Jalan Tawau-Keningau, with clear water during the visit. Pools and riffles/rapids with silt and sand, cobbles and small boulders, and some bedrock. Sunny and hot with good ode activity. Duration of visit: ~40 minutes.

Site 50 (N 4.60768, E 116.94337, 420m asl). January 18, 2023.

Small roadside ditch and seep along the entrance road into Maliau Basin. Hot and sunny. Lots of damselfly activity. Duration of visit: ~15 minutes.

Site 51 (N 4.65278, E 116.94005, 265m asl). January 18, 2023.

Small-medium clear forest river along the entrance road into Maliau Basin, with pools and gravel bars and riffles (Figure 12). Deep shade with patchy open areas. Hot and sunny, but cool and shady along river, with many active odonates. Duration of visit: ~60 minutes.

Site 52 (N 4.70478, E 116.95660, 270m asl). January 18, 2023.

A medium-size clear-water forest stream along the entrance road into Maliau Basin, with cobble and gravel runs and a few pools. Hot and partly cloudy with plenty of damselfly activity. Duration of visit: ~30 minutes.

Site 53 (N 4.73673, E 116.97616, 240m asl). January 18-19, 2023.

Diverse habitats around the Maliau Basin headquarters include small forest streams, seeps, wetlands, and a large man-made pond (Figure 13). Variable, but mostly hot and sunny. Duration of visits over two days: ~3 hours.

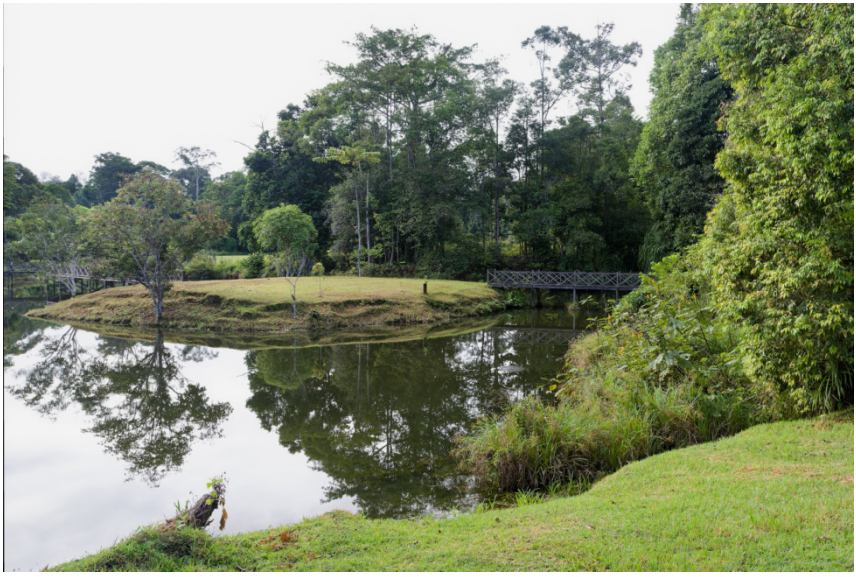


**Figure 13. Site 53, pond at Maliau Basin headquarters. Photographer: M. Post.**

**Maliau Basin**

Site 54 (N 4.73933, E 116.97430, 225m asl). January 19, 2023.

Small roadside swamp and pond between Maliau Basin headquarters and Sungai Maliau at Belian Camp. Hot and cloudy with sparse sun, but many active odonates. Duration of visit: ~30 minutes.

Site 55 (N 4.74011, E 116.97411, 225m asl). January 19, 2023.

Small brush-edged roadside 'wallow' hole between Maliau Basin headquarters and Sungai Maliau at Belian Camp with a tiny pool of water filled with leaves. Hot and cloudy with sparse sun. Duration of visit: ~15 minutes.

Site 56 (N 4.73758, E 116.97221, 240m asl). January 19, 2023.

Along the trail leading upriver from Belian Camp. Small stream beginning as tiny, steep, rocky, seepage creeks and flowing through a series of very swampy pools/wallows and mud flats, with recent elephant tracks. Dense undergrowth and downed trees in forest creating shade and open patches. Partly sunny and hot with many odonates.

Site 57 (N 4.74259, E 116.97287, 215m asl). January 19, 2023.

Along riverbanks on Sungai Maliau near bridge at Belian Camp headquarters. Mostly cloudy and hot. Duration of visit: ~20 minutes. Very few odonates.

Site 58 (N 4.73842, E 116.97549, 230m asl). January 19, 2023.

Very small forest stream (outlet waters from the lake) along the Nature Trail near Maliau Basin headquarters, with mud-bottomed pools and sand riffles; dense canopy of undergrowth. Hot and cloudy. Duration of visit: ~10 minutes.

Site 59 (N 4.74241, E 116.97427, 220m asl). January 19, 2023.

Cleared areas around Belian Camp near Sungai Maliau, with swampy drainage ditches and small pools around the edges. Hot and cloudy with light rain at times. Duration of visit: ~30 minutes. Odonates were moderately active.

Site 60 (N 4.73874, E 116.96956, 230m asl). January 19, 2023.

Small rocky and steep tributary to Sungai Maliau in dense forest along the trail southwest from Belian Camp. Cloudy and hot with light rain. Duration of visit: ~15 minutes. Only a few odonates were seen here.

Site 61 (N 4.73808, E 116.96943, 240m asl). January 19, 2023.

Tiny steep and rocky tributary to Sungai Maliau, in dense forest along the trail southwest from Belian Camp. Cloudy and hot with light rain. Duration of visit: ~15 minutes.

**Maliau Basin to Tawau**

Site 62 (N 4.69826, E 116.90732, 518m asl). January 20, 2023.

Small forest rivers at Agathis Research Station in Maliau Basin, near a confluence of two small rivers with pools, bedrock falls, gravel and cobble riffles, and logs, with adjacent

**Figure 14. Site 62, forest river at Agathis Research Station in Maliau Basin. Photographer: M. Post**

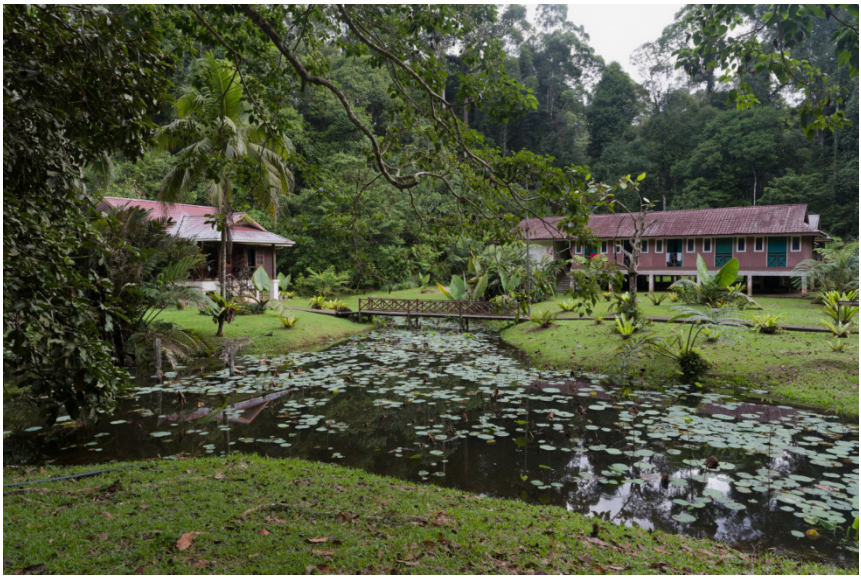


**Figure 15. Site 64, back pond at the Tawau Hills Conservation Park headquarters. Photographer: M. Post.**

seeps and small tributaries (Figure 14). Cool and mostly cloudy in the morning. Moderate odonate activity. Duration of visit: ~3 hours.

Site 63 (N 4.63785, E 116.94290, 280m asl). January 20, 2023.

Roadside pond along the entrance road to Maliau Basin, with tall weeds and abundant emergent aquatic vegetation around the edges. Hot and mostly sunny with many active odonates. Duration of visit: ~20 minutes.

**Tawau Hills**

Site 64 (N 4.39944, E 117.88920, 280m asl). January 21, 2023.

Back pond at the Tawau Hills Conservation Park headquarters area (Figure 15). Cloudy and warm with a few spots of sun, many very active odonates. Duration of visit: ~45 minutes.

Site 65 (N 4.39814, E 117.88861, 275m asl). January 21, 2023.

Medium-sized clear-water river at the Tawau Hills Conservation Park entrance area, with pools and cobble riffles, logs, and brush. Cloudy and warm. Duration of visit: ~15 minutes. Only a couple damselflies, but the area had many swimmers and picnicking families.

Site 66 (N 4.40014, E 117.88883, 290m asl). January 21, 2023.

A small mucky seep and old wallow pool with dirt sides, between the entrance to the trails at Tawau Hills Conservation Park and the river. Cloudy and dark. Duration of visit: ~15 minutes.

**Figure 16. Site 67, forest creek at Tawau Hills. Photographer: M. Post.**

Site 67 (N 4.40047, E 117.89045, 292m asl). January 21-22, 2023.

A brushy and well-shaded low-gradient small forest creek with shallow water over a gravel and sand bottom containing abundant buried decomposing woody debris (Figure 16). Warm and cloudy. Duration of visit: ~40 minutes combined over two days.

Site 68 (N 4.41131, E 117.89382, 310m asl). January 21-22, 2023.

A small boggy and mucky forest stream near the riverside trail, with thick patches of fine roots and orange microbial mats. Cloudy and warm. Duration of visit: ~1.5 hours combined over 2 days.

Site 69 (N 4.41296, E 117.89201, 330m asl). January 21-22, 2023.

A river crossing on the trail to the Bukit Gelas Waterfall. A medium size clear-water river in forested mountains with open and closed canopy, boulders and cobbles, logs, and bedrock in a few places, with a few tiny tributary seepage areas. Dense riparian and understory vegetation. Rainy and warm on first day (few odonates), with some sun on second day. Duration of visit: ~1.5 hours combined over two days.

Site 70 (N 4.41268, E 117.89217, 330m asl). January 21-22, 2023.

Along the trail to the Bukit Gelas Waterfall: a headwater mucky and gravelly seep complex in dark forest with relatively open understory over shallow water. Hot and partly sunny. Duration of visit: ~1 hour.

Site 71 (N 4.40983, E 117.89446, 310m asl). January 21-22, 2023.

A medium-large high-gradient river with boulders and cobbles along the trail to the Bukit Gelas Waterfall (Figure 17). Warm and partly sunny. Duration of visit: ~30 minutes.

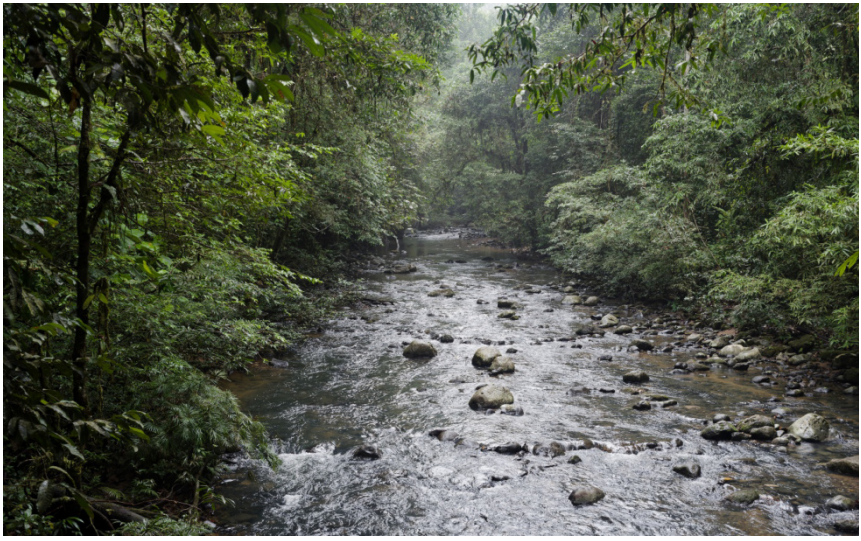


**Figure 17. Site 71, river along trail to Bukit Gelas Waterfall at Tawau Hills. Photographer: M. Post.**

**Danum Valley Center**

Site 72 (N 4.96264, E 117.80294, 160m asl). January 23-24, 2023.

Danum Valley Center (DVC) headquarters near the Danum River: mowed and open areas, and small seeps and streams in nearby forest. Mostly cloudy and cooler with rain in the afternoon and evening one day, cloudy and rainy the second day. Duration of visit: ~6 hours over two days.

Site 73 (N 4.96142, E 117.80329, 150m asl). January 23-24, 2023.

Hillslopes and brush behind DVC headquarters.

Site 74 (N 4.96548, E 117.80236, 167m asl). January 24, 2023.

The Tambun River above confluence with the Danum River; medium-sized river with pools, cobble riffles, and small bedrock rapids (Figure 18). Cloudy and warm with light rain one day, and hot and mostly cloudy the second day. Duration of visit: ~4 hours over 2 days.

Site 75 (N 4.96545, E 117.80053, 215m asl). January 24, 2023.

Deeply shaded forest with dense understory along the West Trail at DVC, near a tiny stream (Figure 19). Hot and sunny. Duration of visit: ~20 minutes.

Site 76 (N 4.96560, E 117.79758, 235m asl). January 24, 2023.

Relatively open understory on a steep slope above a tiny creek in dark forest along the West Trail at DVC. Hot and sunny. Duration of visit: ~20 minutes.

Site 77 (N 4.96565, E 117.79729, 230m asl). January 24, 2023.

A small rocky forest creek with thick understory along the West Trail at DVC. Hot and sunny. Duration of visit: ~30 minutes.

Site 78 (N 4.96574, E 117.79421, 250m asl). January 24, 2023.

Small rocky creek along the West Trail at DVC, with some bedrock and adjacent seep and mucky areas in dense understory. Hot and sunny. Duration of visit: ~1.5 hours.

Site 79 (N 4.96507, E 117.79412, 243m asl). January 24, 2023.

A small rocky creek along the West Trail at DVC with some bedrock cascades and pools in dense understory with sparse open areas from tree falls. Hot and sunny. Duration of visit: ~30 minutes.

Site 80 (N 4.96571, E 117.79938, 220m asl). January 24, 2023.

Along the West Trail at DVC: a tiny mostly dry drainage channel in understory with moist sediment – near an old water sampling station. Hot and sunny. Duration of visit: ~10 minutes.

Site 81 (N 4.95729, E 117.80209, 175m asl). January 25, 2023.

Small creek along trail paralleling the Danum River upstream from the DVC. Cloudy and rainy. Duration of visit: ~30 minutes.

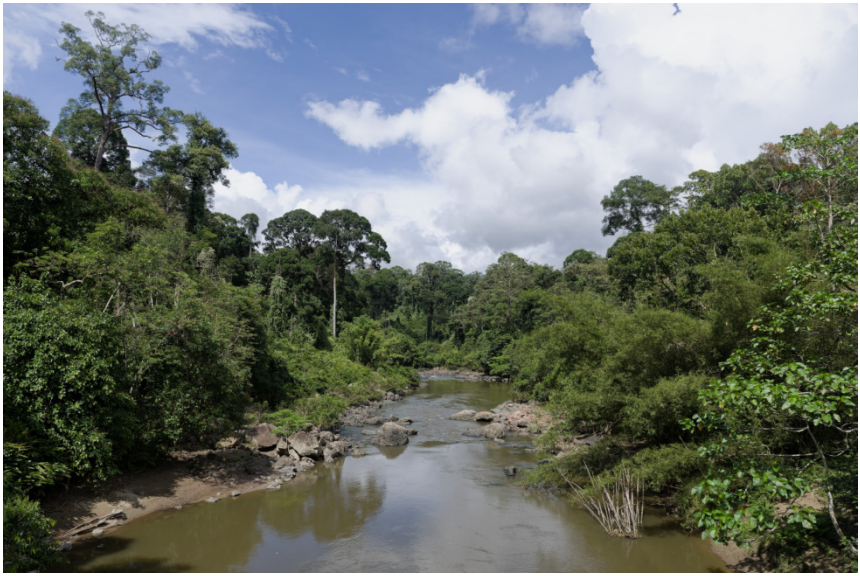


**Figure 18. Site 74, Tambun River above confluence with the Danum River at Danum Valley Center. Photographer: M. Post.**

**Figure 19. Site 75, dense forest understory along the West Trail at Danum Valley Center. Photographer: M. Post.**

Site 82 (N 4.95633, E 117.80239, 185m asl). January 25, 2023.

A small steep creek crossing the trail along the Danum River upstream from DVC HQ. Cloudy and raining. Duration of visit: ~30 minutes.

**Danum Valley Center to Lahad Datu**

Site 83 (N 4.97452, E 117.95571, 245m asl). January 26, 2023.

A small roadside pond along the entrance road to DVC, with emergent sedges, spike rushes, and grasses in shallow areas. Sunny and warm and very active odonates. Duration of visit: ~30 minutes.

Site 84 (N 4.99384, E 118.07437, 165m asl). January 26, 2023.

A large artificial pond at Taliwas with surrounding brushy trails, connected swampy areas with thick vegetation, and a boardwalk (Figure 20). Hot and mostly sunny. Duration of visit: ~2 hours, during which 22 species were photographed. Due to time constraints of our driver, we did not thoroughly survey this site, but it will undoubtedly yield more species if adjacent forest and river habitats are searched. Many active odonates, including uncommon species.

**Lahad Datu to Sepilok**

Site 85 (N 5.54335, E 118.09320, 45m asl). January 27, 2023.

Dense roadside vegetation on the entrance road to Gomantong Caves. Hot and mostly sunny. Duration of visit: ~1.5 hours.

Site 86 (N 5.54230, E 118.08630, 40m asl). January 27, 2023.

Seeps and pooled swampy areas adjacent to the road to Gomantong Caves. Thick brush and abundant emergent vegetation at roadside. Hot and sunny. Duration of visit: ~1 hour.

Site 87 (N 5.53100, E 118.07540, 30m asl). January 27, 2023.

A small sandy and muddy river at bridge, roadsides, brushy swampy areas, and parking areas near Gomantong visitor center. Hot and mostly sunny. Duration of visit: ~2 hours.

**Sepilok Nature Center**

Site 88 N 5.87334, E 117.94252, 40m asl). January 28, 2023.

Small forest seeps and swampy area near sandy stream at the Sepilok Nature Center. Hot and mostly cloudy. Duration of visit: ~45 minutes.

Site 89 (N 5.87531, E 117.94215, 30m asl). January 28, 2023.

Along a small sandy forest stream at the Sepilok Nature Center, with trails, small pond, and swampy seeps (Figure 21). Hot and mostly cloudy. Duration of visit: ~45 minutes.

Site 90 (N 5.87596, E 117.94382, 30m asl). January 28, 2023.

Large main pond at the Sepilok Nature Center entrance area. Brushy edges and narrow strips of emergent vegetation in some places. Weather. Duration of visit: ~1 hour.

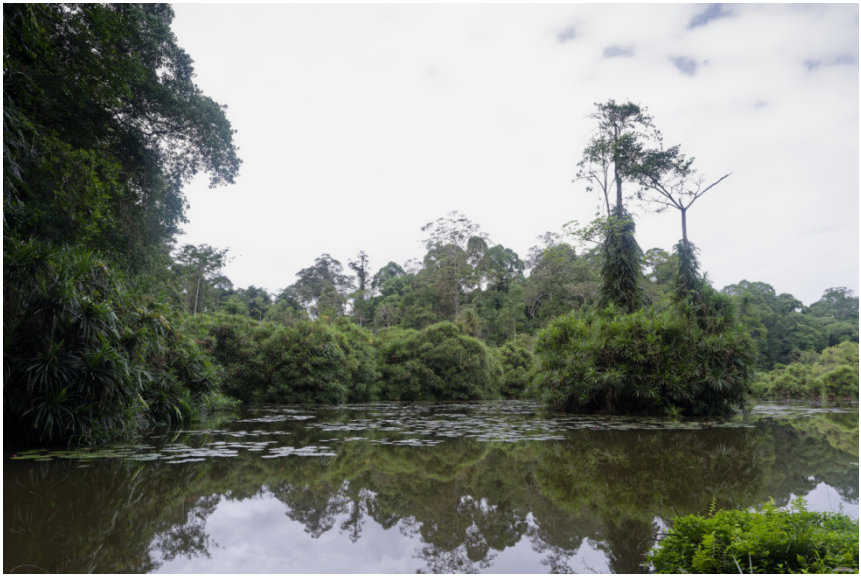


**Figure 20. Site 84, pond at Taliwas, along the entrance road to Danum Valley Center. Photographer: M. Post.**

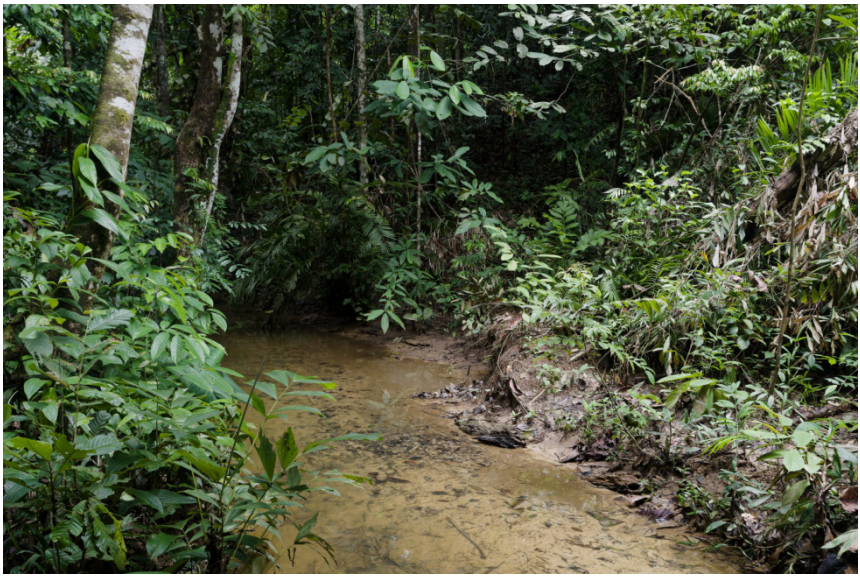


**Figure 21. Site 89, sandy forest stream at the Sepilok Nature Center. Photographer: M. Post.**

Site 91 (N 5.87039, E 117.94352, 20m asl). January 28, 2023.

Two small ponds near the back of the Sepilok Nature Center. Brush and weedy margins with a small headwater seep on one. Hot and cloudy. Duration of visit: ~15 minutes.

Site 92 (N 5.87175, E 117.94221, 20m asl). January 28, 2023.

Small meandering sandy-bottom forest stream in the Sepilok Nature Center. Hot and cloudy. Duration of visit: ~15 minutes.

Site 93 (N 5.87340, E 117.94214, 25m asl). January 28, 2023.

Small sand-bottom meandering forest creek near lower end of Sepilok Nature Center. Hot and cloudy. Duration of visit: ~15 minutes.

Site 94 (N 5.87256, E 117.94197, 28m asl). January 28, 2023.

Brushy meadow under power lines at Sepilok Nature Center. Hot and cloudy. Duration of visit: ~15 minutes.

**Ranau to Kota Kinabalu**

Site 95 (N 5.78219, E 116.34063, 1,460m asl). January 29, 2023.

A steep forested mountain stream with a small clearing and wild banana patch above the road. Sunny and cool, warming through the morning. Odonata activity was low until ~10:30 am, then very active. Duration of visit: 2 hours.

Site 96 (N 5.98457, E 116.08603, 1m asl). January 11 (DM only) and January 29, 2023.

Mangrove swamp and wetlands at the Likas/Kota Kinabalu Wetland Ramsar site (Figure 22). Very hot and sunny. Duration of visit: ~2 hours.

**Figure 22. Site 96, Mangrove swamp and wetlands at the Likas/Kota Kinabalu Wetland Ramsar. Photographer: M. Post.**

**Kota Kinabalu**

Site 97 (N 5.98190, E 116.09103, 4m asl).

January 11 (DM only) and January 30, 2023 (DM and BS). Urban parklands at the Likas Sports Leisure Park, with mixed ponds, mowed areas, wetlands, small canals, and some brushy areas. Very hot and mostly sunny. Many active odonates. Duration of visit: ~4 hours.

**Sepilok Orang Utan Sanctuary area**

Site 98 (N 5.8672, E 117.9489, 20m asl). October 2-3, 2023.

PB worked the grounds of the nearby Sepilok Lodge which had a large man-made pond surrounded by trees. The lowland forest of both the Orang Utan and Sun Bear Sanctuaries were briefly examined and included several small streams and muddy wallows. Species were also photographed at multiple nearby sites around the Sepilok Sanctuary.

**Imbak Canyon Conservation Area**

Site 99 (N 5.1056, E 117.0310, 180m asl). October 3-4, 2023.

PB casually worked the HQ area during the period, habitats included the shallow, gravel-bottomed Sungai Imbak and small roadside ponds. Species were also photographed at multiple nearby sites around Imbak Canyon.

**Deramakot Forest Reserve**

Site 100 (N 5.3674, E 117.4301, 135m asl). October 5-11, 2023

PB made casual observations whilst engaged in other work at or near the Deramakot Conservation Area headquarters. Sites included the pond complex around the accommodation compound and nearby roadside rivulets. A few forested swampy pools were accessed from the main road, but little trail work was attempted.

**Kinabatangan River**

Site 101 (N 5.50553, E 118.27909, 4m asl). October 12-14, 2023.

PB made casual observations here whilst engaged in other work.

## Results

From January 9 to January 30, 2023, BS, PB, DM, and MP visited 97 sites across the Malaysian State of Sabah, in northeastern Borneo. A second trip by PB between October 2 and 14 visited 4 additional sites, bringing the total number of sites visited to 101. At each site, except the ones visited in October, we documented species and approximate numbers observed, habitats, and weather conditions at the time of each visit. All species were documented photographically, and no specimens were collected. Where allowed, a few individuals were netted for in-hand examination and photos, then released. During the October trip, more casual surveys were performed, but these still resulted in uncommon species being documented.

Included in this report are a list of sites visited (Appendix 1), a compilation of 1,700 iNaturalist observations representing 1,383 individual odonates (Appendix 2), and a species x site matrix for each taxa observed, at which sites it was documented, approximate number of individuals observed, and determination if the taxa is a new record for Sabah or Borneo (Ap-

pendix 3). Observations and photographs by BS, PB, DM, and MP can also be found here: https://www.inaturalist.org/observations?d1=2023-01-01&place_id=13134&subview=map&taxon_id=47792&user_id=beschwar,philbenstead,denismatthey,posmic

Note that, at the above link, locations for several species are obscured by iNaturalist (e.g. *Rhinagrion elopurae*, strangely, which is ranked as 'Least Concern'), or were not precisely located by iNaturalist users PB and DM when uploaded, but all locations are correct and accurate in Appendix 1 and Appendix 2 using GPS locations recorded in the field by BS. Multiple iNaturalist links are provided for many individuals because we usually had different vantage points and uploaded photos to iNaturalist separately. In these cases, individuals are only counted once, but links to each set of photographs are provided in Appendix 2. Site locations in Appendix 1 are provided as the centroid point in the searched area, rather than as the location for individual observations.

Photographs of a few notable observations are also provided, but links in Appendix 2 should be used for a full review of photos and data. Supporting observations on iNaturalist often include many photographs with close crops of thorax, terminal appendages, secondary genitalia, face, pronotum, and other features that may aid in identification.

Our photographic records of 130 species represent 68% of the 190 taxa known to occur in Sabah prior to this trip (Dow et al., 2022). Except for new or known undescribed species, or taxa which are difficult or impossible to ID from photos, all were identified with high confidence. However, recognizing that photographic identifications to species-level are often difficult or impossible, some identifications assigned in this report may still be incorrect. In some cases, even tentative species-level IDs were impossible because of species differences that can only be ascertained under a microscope, or high levels of intra-specific variability in some genera. The genera *Dysphaea, Devadatta*, and *Coeliccia* are particularly problematic for photographic identification in the regions we visited, even with the best field photos, and likewise most of the species in *Vestalis*. We also documented known- and unknown-undescribed species in some groups.

The genus *Coeliccia* contains multiple recognized undescribed species (Dow et al., 2022). Excepting a few sites where we observed *Coeliccia cyaneothorax* and what we are reasonably confident are *Coeliccia borneensis*, all other records in this genus are identified as either *Coeliccia* cf *nemoricola* or *Coeliccia* cf *nigrohamata*, and within these two groups, there is tremendous diversity in markings on the pronotum, thorax, S8-10, and terminal appendage morphology and coloration; many of these variations may represent distinct taxa.

For *Devadatta*, a female *D. aran* and a single female *D. tanduk* were identified with confidence, based on structures on the prothorax. All other records in this genus could only be identified to genus-level.

In *Dysphaea*, there is no reliable way to consistently differentiate the Sabah species from photographs alone, and in-hand or microscopic investigation is required for positive ID (Hämäläinen et al., 2015). Most individuals are presumed *Dysphaea dimidiata*, based on extent of opaque areas, habitat type, and location, but this may be incorrect. Two individuals found at smaller, shaded, and forested mountain streams may be different species; all others were found on large open rivers.

While most Bornean species of *Vestalis* are impossible or very difficult to identify from photographs, one can be confidently identified: *V. beryllae*. Given these difficulties, most *Vestalis* observations are left at genus-level, or tentatively identified.

### Zygoptera highlights

Among the interesting Zygoptera we photographed is a small/tiny Platystictidae species (smaller than other species in this family that we observed) that was spotted by BS near the West Trail in Danum Valley. Though they were not seen in tandem, we assume, based on similarities in habitat, size, coloration, and proximity, that we photographed both a male and a female of this species. Sufficient detail can be seen of the male anal appendages in some of the photographs to place this taxon in the *Drepanosticta forficula* complex, but more cannot be said without specimens. Behavior was much like that which we observed for *Protosticta joepani*, perching on small twigs near the ground in dark forested slopes near, but not at, very small streams. Even more so than *P. joepani*, this species was extremely cryptic and hard to follow when in flight. A dorsal blue patch on S9 and part of S10 sometimes allowed visual tracking as it flew.

Other notable photographic records of Platystictidae spp. include *T. fugispinosa* (Crocker Range, males and apparently ovipositing female), *Telosticta janeus* (Danum Valley Field Centre (DVC), males and apparently ovipositing female), *Protosticta joepani* (3 males at two sites in Mount Kinabalu NP), *P. kinabaluensis* (Crocker Range, male and apparently ovipositing female), and *Drepanosticta versicolor* (males at DVC and Tawau Hills).

Numerous Chlorocyphidae were photographed, and some sites had several species. A few observations deserve mention. At Tawau Hills, five male *Sundacypha petiolata* were found along a short reach of a brushy and well-shaded low-gradient small forest creek with shallow water over a gravel and sand bottom containing abundant buried and protruding decomposing woody debris. Males were perched on small sticks emerging from the streambed, or on leaves 1-2m above the water, guarding territory. This species was first posted on i-Naturalist at this site by users ‘lunarjade’ and ‘cis88’ on August 20, 2022, which is the first record we are aware of for Sabah. Two more *S. petiolata* were found at a second nearby creek, including the only female we observed. Our only site for *Rhinocypha stygia* was a small rocky creek along the West Trail at DVC. The stream here is a mix of bedrock cascades and pools in dense understory with sparse open areas from tree falls. Three males were found guarding territory on sunny leaves 2m or higher in small open sunny areas. When clouds drifted over, they would fly higher into the canopy and then descend again when the sun returned, but never perched close to the water as many other Chlorocyphidae do. A forest stream (Site 51) along the entrance road to Maliau Basin had 4 species of Chlorocyphidae in just a short section of stream: *Heliocypha biseriata, Libellago phaethon, Rhinocypha cucullata,* and *R. humeralis*.

A stop at a mid/high-elevation stream along Jalan Tambunan – Kota Kinabalu produced several range extensions and photos of three uncommon species. The site was suggested to us by the Sabah naturalist Joe Pan who reported seeing *Rhinoneura villosipes* somewhere along the road. Using a cell-phone photo he took near his vehicle and along the road on the date of discovery, BS was able to use Google Street View images to pinpoint the exact location. We arrived early on a cool morning and, as the sun warmed the area, several males

descended from the forest and were quite active guarding leaves and twigs in sunny areas near the road, as well as on open areas along the forested parts of the stream. *Euphaea basalis* arrived next and often competed with *R. villosipes* for the same perches. This was our only site for these two species, as well as for *Protosticta kinabaluensis* that were found in darker sheltered areas along the stream well up in the forest. Diagnostic photos of a single female *Devadatta aran* additionally provided one of only two confident IDs for any of our observations in this difficult genus. A male *Macromia* sp. (*westwoodii*?) patrolling in a sunny gravelly patch of the stream just above the road also allowed good photo opportunities.

A small pond at the Eagle Wood Garden OYO near Bongawan supplied the first Sabah record for *Aciagrion borneense*. We also photographed this species on the same day at two other nearby coastal sites (at one of these it was the most abundant species), and BS and DM later found it in ponds at the sports complex in Likas. Perhaps this species has been overlooked in Sabah because of its small size and similar coloration to *Ischnura senegalensis*.

Two unidentified large/medium *Amphicnemis* sp. (male and female) were found along the entrance road to Gomantong Caves. Species in this genus are infrequently observed, and positive ID is impossible without specimens, but perhaps future collecting work here will be productive.

A single male blue *Archibasis* sp. was photographed in the Klias Peat Swamp Forest. *Archibasis* are difficult to identify from photographs, but this one appears to be *A. melanocyana*, which can be common in low pH waters. It was larger, and terminal appendages more slender than *Archibasis viola*, which we also photographed elsewhere in the surrounding peat swamp forest. *Archibasis* sp. cf *incisura* was photographed at the Kinabatangan Wildlife Sanctuary, though diagnostic details are not clearly visible.

Two species of *Argiocnemis* were photographed, *A. rubescens rubeola* and a possibly unnamed species (see Note 40 in Dow 2021; this note is about Sarawak populations but applies equally well to Sabah). Males in this species typically have a characteristic purple tip to the abdomen, and yellowish thoracic stripes.

At site 84, an unusual *Pseudagrion* sp. was found which differs significantly from *P. microcephalum* in the markings of the terminal abdominal segments of the male. It may be 1) a species of *Pseudagrion* not previously reported from Borneo, 2) an eastern form of *Pseudagrion lalakense* Orr & van Tol, 2001, or 3) an undescribed species. It was the most abundant odonate at site 84. A pair in tandem was also recorded at site 100, and in another more recent observation in September 2024 at Tabin Wildlife Reserve, posted on iNaturalist by user ‘paulsuth‘.

### Anisoptera highlights

Even though Gomphids were among the most infrequently encountered odonates during our work, they included some of the most notable finds. Excepting the very common *Ictinogomphus decoratus*, only 6 species were observed.

A single male of a possibly undescribed *Orientogomphus* sp. (cf *aemulus*?) found on a stream along the entrance road to Maliau Basin is a new genus record for Borneo. It was found

while walking up a small, shallow, low gradient, sand and gravel-bedded forest stream, with a few small bedrock outcrops. PB noticed it caught in a single strand of cobweb stretched diagonally across the stream approximately 1 m above a wide shallow pool. It appeared to be unharmed, with a spider lurking on the periphery; perhaps cutting the web to remove the huge prey item. After close photographs, it was released.

At Tawau Hills, a very brief appearance of a male *Heliogomphus* provided an opportunity for a few quick photos by PB. This appears to be the species referred to as *Heliogomphus* sp. cf *olivaceus* Lieftinck, 1961 in Dow et al. (2022), which is similar to *H. blandulus* Lieftinck, 1929 but with a larger lateral spur on the superior anal appendages; this is a first record for Sabah. A single *Leptogomphus* sp. cf *pasia* was also seen only a few dozen meters away. *Leptogomphus pasia* and *Leptogomphus sii* have similar markings, but the latter has not been recorded in Sabah and the former is too poorly known to assess the extent of variation that can occur in its markings. However, given that *L. pasia* is the species known to occur in Sabah, parsimony suggests that it was the species photographed. These two records, combined with our only sighting of *Sieboldius japponicus* several hundred meters down the river, make Tawau Hills the most Gomphid-rich site we visited.

A single teneral male *Heliogomphus borneensis* was found on a small tributary to the Danum River at the DVC. Including this Gomphid and the *Drepanosticta forficula* complex taxon, we recorded at least 34 species at the DVC, even though our time in the field was severely limited by heavy rains.

A patrolling male *Pseudothemis jorina* photographed at a pond at Taliwas, and a pair in flight at Deramakot Forest Reserve, are reported here as new records for Sabah. However, note that PB photographed the first Sabah record (a female) at Taliwas in 2008 and that since January 2023 there have been 4 additional sightings of this species at a third site in Sepilok (these additional observations can be found on iNaturalist). This species appears to be more common and widespread than previously known.

An ovipositing female *Idionyx montana* (another first record for Sabah) was photographed in hand near Maliau Basin headquarters. Another ovipositing female *Idionyx* sp. was photographed in flight near Mahua Waterfall but could be either *I. montana* or *I. yolanda*.

Photos of *Leptogomphus coomansi* (6 males at Deramakot Forest Reserve), *Brachydiplax* cf *farinosa* (2 males at Maliau Basin), *Camacinea gigantea* (males on road to DVC, plus males and an ovipositing female at Tawau Hills), *Nesoxenia lineata* (at Taliwas), *Onychothemis coccinea* (hills SE of Kota Kinabalu), *Rhyothemis obsolescens* (a single female), and *Rhyothemis regia* (several sites in SW Sabah) provided records of several other infrequently-photographed Anisoptera.

**Systematic list of species recorded (* = Borneo endemic). Order and taxonomy follows Dow et al. (2024).**

**Zygoptera**

**Lestidae**

*Lestes praevius* Lieftinck, 1940

Sites: **83, 86, 99, 100.**

Notes: most observations were at sites with shallow roadside ditches with pools, where they

were sparse but easy to spot. Pools seemed to be permanent, clear, and organic-rich with reeds, rushes, and sedges around the edges. Previously, there was only one published report of this species occurring in Sabah. In addition, PB recorded single males of this species near Borneo Rainforest Lodge, Danum Valley (N 5.026734 E 117.749980) on 7th October 2007, and at Tabin Wildlife Resort (N 5.186957 E 118.502891) on 21st January 2010. Listed as vulnerable by IUCN (Figure 23).

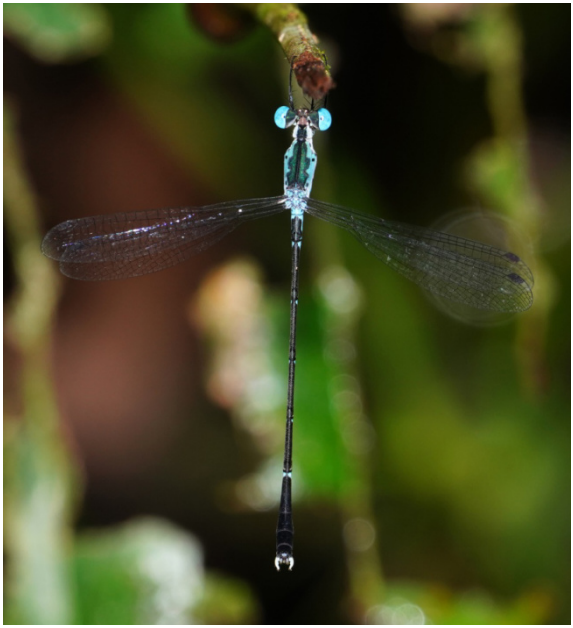


**Figure 23. *Lestes praevius* male at Site 86. Photographer: B. Schwartz.**

*Orolestes wallacei* (Kirby, 1889)

Sites: **55, 84, 86.**

Notes: all observations of this species were at or near low-elevation swampy areas with still water and abundant decaying leaf litter, or at small, isolated pools (Figure 24).

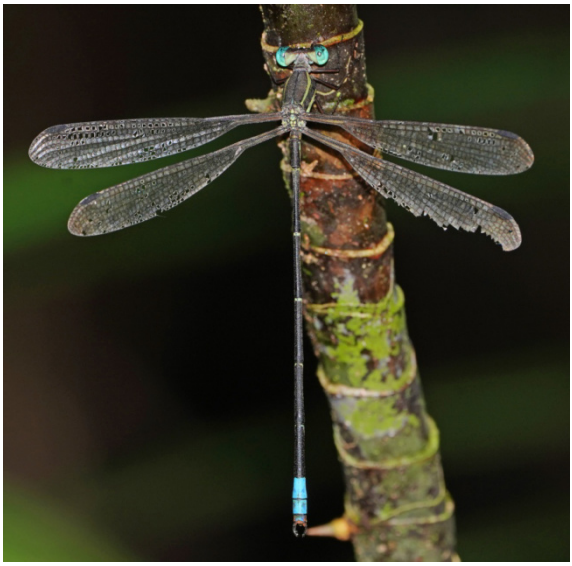


**Figure 24. *Orolestes wallacei* male at Site 84. Photographer: B. Schwartz.**

**Platystictidae**

*Drepanosticta actaeon* Laidlaw, 1934*

Sites: **19, 22, 26, 33, 61, 78, 79.**

Notes: a relatively common damselfly, frequently co-occurring with, or occurring at sites near, *Drepanosticta rufostigma*.

*Drepanosticta rufostigma* (Selys, 1886)*

Sites: **7, 9, 10, 26, 33, 61, 62, 70.**

Notes: a single male at site 26 had pair of small blue markings on S9; this is a known variation in Sabah populations.

*Drepanosticta* cf *forficula**

Sites: **76, 78.**

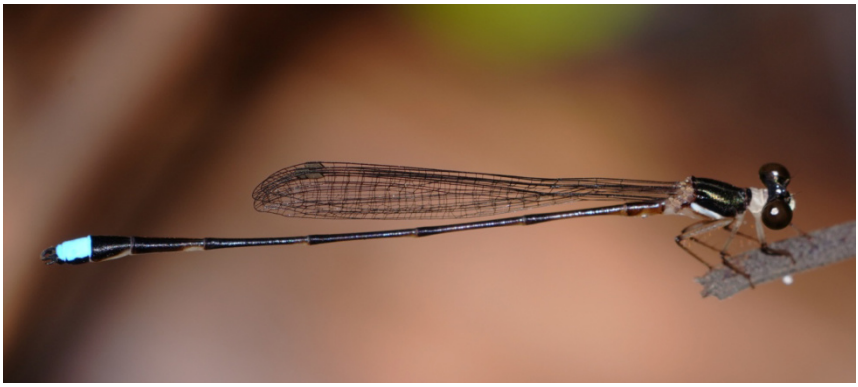


**Figure 25. *Drepanosticta* cf *forficula* male at Site 76. Photographer: B. Schwartz.**

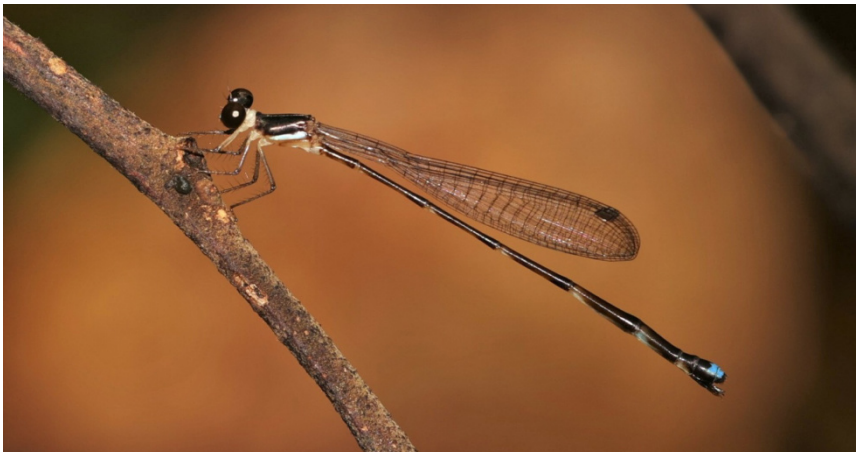


**Figure 26. *Drepanosticta* cf *forficula* female at Site 78. Photographer: D. Matthey.**

Notes: at site 78, a small male platystictid with dorsal blue patches on S9-10, and terminal appendages which place it in the *D. forficula* complex, but more cannot be said about ID without specimens. Flying from small twig to small twig, much the same way that *Protosticta joepani* was observed to do, and very difficult to follow in dark forest conditions. A female was observed nearby at site 76; probably the same species based on similarities in habitat, size, coloration and proximity (Figures 25, 26).

*Drepanosticta versicolor* (Laidlaw, 1913)*

Sites: **70, 72, 75, 77, 78, 81.**

Notes: This dark species was found at or near the heads of lowland swampy seeps, often perched in dark shade, which makes detection and tracking difficult (Figure 27).

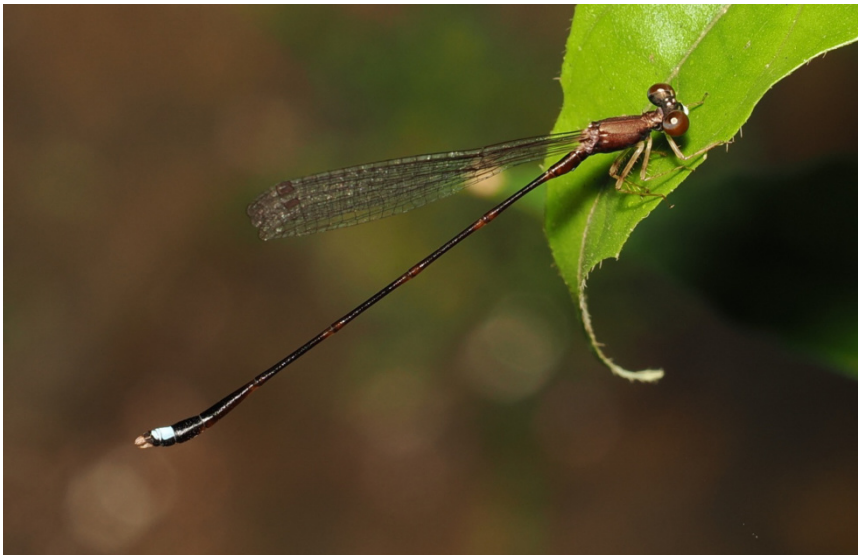


**Figure 27, *Drepanosticta versicolor* male at Site 75, Photographer: P. Benstead.**

*Drepanosticta* sp.

Sites: **36, 62, 76.**

Notes: These observations represent photos of individuals that could not be identified to species with certainty but are probably of species already recorded above. This entry is not included in the final species count.

*Protosticta joepani* Dow, Phan & Choong, 2020*

Sites: **15, 21.**

Notes: A single male at site 21, and two males found perching near each other at site 15, ~20-50 cm off the ground in shade on small dead twigs and branches. Although this species is widespread at higher elevations across northeastern Sarawak and into Sabah (Dow et al., 2020), we only observed it at two locations in the Poring Hot Spring region of Mount Kinabalu NP. Listed as vulnerable by IUCN (Figure 28).

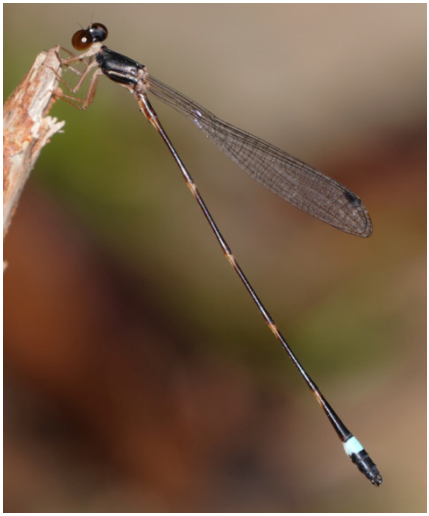


**Figure 28. *Protosticta joepani* male at Site 15, Photographer: B. Schwartz.**

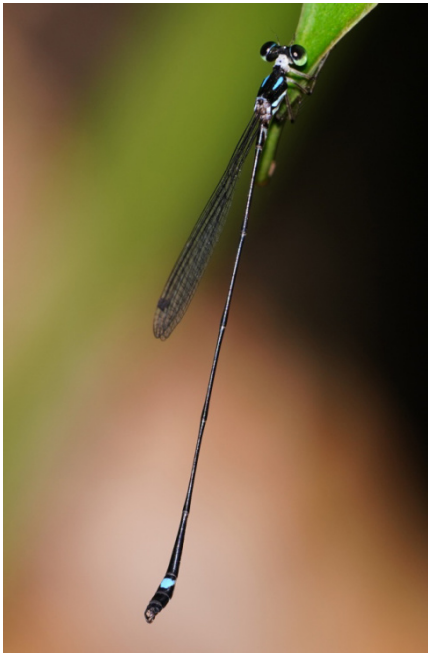


**Figure 29. *Telosticta fugispinosa* male at Site 10, Photographer: B. Schwartz.**

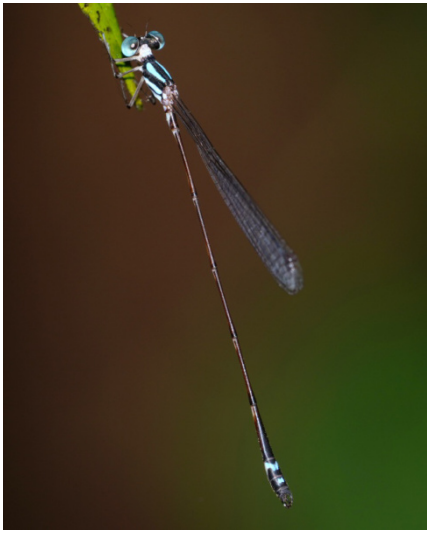


**Figure 30. *Telosticta janeus* male at Site 78, Photographer: B. Schwartz.**

*Protosticta kinabaluensis* Laidlaw, 1915*

Site: **95**.

Notes: Listed as vulnerable by IUCN. A new site for this species, which extends its range to the SW along a string of other high-elevation sites in Sabah.

*Telosticta fugispinosa* Dow, Afendy & Rahman, 2016*

Sites: **7, 10.**

Notes: a female at site 10 was observed presumably ovipositing into a small plant stem on the face of an overhanging drippy streambank. Listed as near threatened by IUCN (Figure 29).

*Telosticta janeus* Dow & Orr, 2012*

Sites: **78, 81.**

Notes: a female at site 81 was observed presumably ovipositing into a small plant stem

in a small seep adjacent to a small forest stream. Listed as near threatened by IUCN (Figure 30).

**Euphaeidae**

*Dysphaea* sp. Selys, 1853

Sites: **49, 51, 57, 62, 74, 100.**

Notes: ID from photos is not possible for this genus in Borneo. Many of the individuals we observed are presumed to be *D. dimidiata*, based on the large open river habitats where they were found. However, individuals observed at sites 51 and 62 could be a different species, as habitats there are in smaller, shaded, higher gradient, forested streams.

*Euphaea basalis* (Laidlaw, 1915)*

Site: **95.**

Notes: listed as near-threatened by IUCN. Several males descended from the forest canopy at site 95 after temperatures warmed and the sun emerged. They mostly defended sunny leaf perches well above the stream, only rarely descending to boulders.

*Euphaea impar* Selys, 1859

Sites: **60, 65, 67, 77, 78, 92, 100.**

Notes: found primarily at small low-elevation tributary streams under dense canopy.

*Euphaea subcostalis* Selys, 1873

Sites: **4, 5, 6, 10, 11, 12, 25, 49, 51, 52, 62, 68, 69, 72, 73, 78, 79, 99.**

Notes: a common species at streams and rivers of various sizes.

*Euphaea subnodalis* (Laidlaw, 1915)*

Sites: **19, 22.**

Notes: This species requires perfectly-oriented photos of the wings to identify without capture and in-hand examination.

*Euphaea* sp.

Sites: **11, 24, 69, 79.**

Notes: Probably all *E. subcostalis*, but unable to definitively rule out *E. subnodalis*.

**Devadattidae**

*Devadatta aran* Dow, Hämäläinen & Stokvis, 2015*

Site: **95.**

Notes: Diagnostic photographs of a female provided a good ID for one individual.

*Devadatta tanduk* Dow, Hämäläinen & Stokvis, 2015*

Site: **79.**

Notes: Diagnostic photographs of a female provided a good ID for one individual. *D. tanduk* is listed as data deficient by IUCN.

*Devadatta* sp.

Sites: **2, 4, 7, 9, 18, 21, 26, 31, 33, 36, 50, 56, 60, 68, 69, 70, 78, 79, 82, 95.**

Notes: Most individuals in this genus are impossible to ID from photos.

**Philosinidae**

*Rhinagrion elopurae* (McLachlan, 1886)*

Sites: **51, 52, 56, 58, 62, 67, 69, 73, 78, 88, 89, 100.**

Notes: a common species at lowland forest streams of various sizes. Despite its IUCN status as 'Least Concern', locations are obscured on iNaturalist.

**Argiolestidae**

*Podolestes orientalis* Selys, 1862

Sites: **48, 56, 58, 86, 89, 90.**

**Calopterygidae**

*Matronoides cyaneipennis* Förster, 1897*

Site: **19.**

Notes: Several males and females photographed at this site (Figures 31, 32).

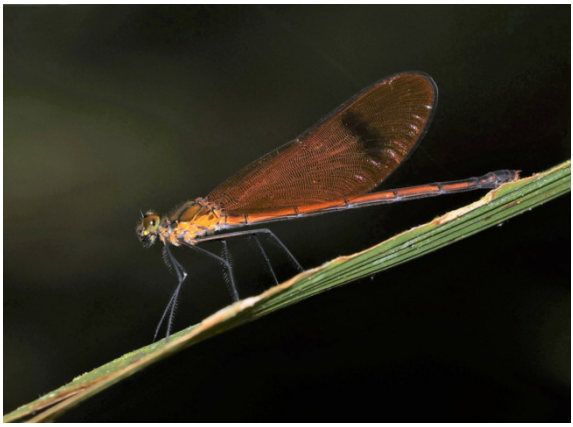


**Figure 31. *Matronoides cyaneipennis* female at Site 19, Photographer: D. Matthey.**

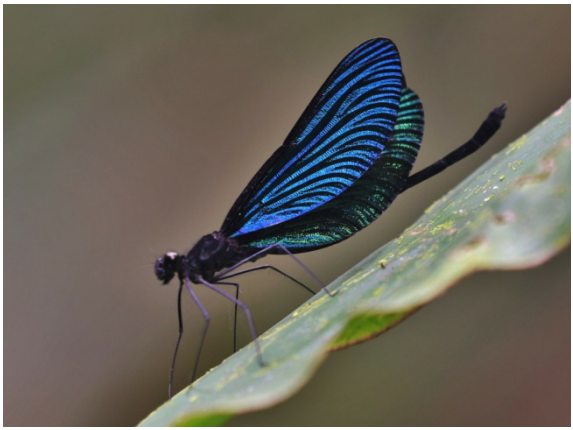


**Figure 32. *Matronoides cyaneipennis* male at Site 19, Photographer: D. Matthey.**

*Neurobasis longipes* Hagen, 1887

Sites: **12, 29, 49, 51, 52, 62, 71, 73, 100.**

Notes: relatively common on medium-sized clear-water mountain streams and rivers.

*Vestalis amabilis*/*amoena*? Lieftinck, 1965

Site: **21.**

Notes: appendages for this individual appear to be *V. amabilis* Lieftinck, 1965, but could also be *V. amoena* Hagen in Selys, 1853.

*Vestalis amnicola*? Lieftinck, 1965*

Sites: **19, 72.**

*Vestalis amoena*? Hagen in Selys, 1853

Sites: **51, 52.**

*Vestalis anacolosa*? Lieftinck, 1965*

Site: **2.**

*Vestalis beryllae* Laidlaw, 1915*

Sites: **7, 9, 80.**

Notes: Only males were seen; all well away from water and usually along trails in mature forest.

*Vestalis* sp.

Sites: **3, 15, 19, 24, 25, 32, 33, 50, 56, 66, 68, 78, 79, 87, 92.**

**Chlorocyphidae**

*Heliocypha biseriata* (Selys, 1859)*

Sites: **2, 5, 25, 52, 62, 65.**

Notes: *H. biseriata* is likely synonymous with *H. biforata*, but this has not yet been definitively determined.

*Libellago hyalina* (Selys, 1859)

Sites: **44, 48.**

Notes: only seen at peat swamp forest sites.

*Libellago phaethon* (Laidlaw, 1931)*

Sites: **49, 51, 52, 87, 92, 93, 100.**

Notes: listed as near threatened by IUCN.

*Libellago semiopaca* (Selys, 1873)

Sites: **11, 12, 37, 49, 51, 74, 99.**

*Rhinocypha aurofulgens* Laidlaw, 1931*

Sites: **57, 69, 73.**

*Rhinocypha cucullata* Selys, 1873*

Sites: **51, 52, 62, 100.**

*Rhinocypha humeralis* Selys, 1873

Sites: **4, 5, 37, 51, 52, 56, 58, 60, 67, 71, 72, 73, 78, 79, 88, 89, 92, 93.**

*Rhinocypha stygia* Förster, 1897*

Site: **79.**

Notes: three males guarding territory on sunny leaves >2m above a small rocky creek in small openings caused by downed trees over. When clouds drifted over, they would fly higher into the canopy and then descend again when the sun returned, but never perching close to the water as many other Chlorocyphidae will do. This behavior renders the species rather difficult to find, though it is relatively widespread in Sabah. Listed as near threatened by IUCN (Figures 33, 34).

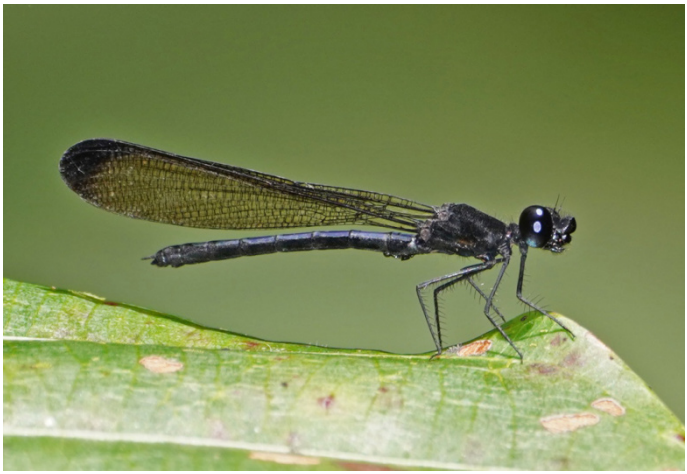


**Figure 33. *Rhinocypha stygia* male at Site 79, Photographer: B. Schwartz.**

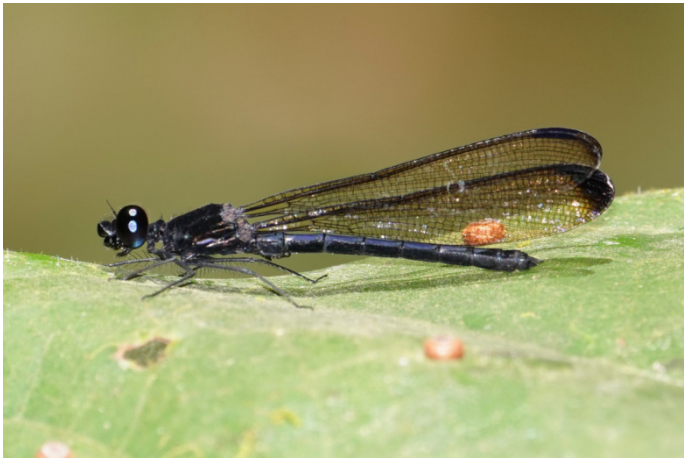


**Figure 34. *Rhinocypha stygia* male at Site 79, Photographer: B. Schwartz.**

*Rhinoneura villosipes* Laidlaw, 1915*

Site: **95.**

Notes: endemic to Sabah. As the sun warmed the site, several *R. villosipes* males arrived

and were quite active guarding leaves and twigs in sunny areas near the road, as well as along the stream (Figure 35). No females were seen. Listed as vulnerable by IUCN.

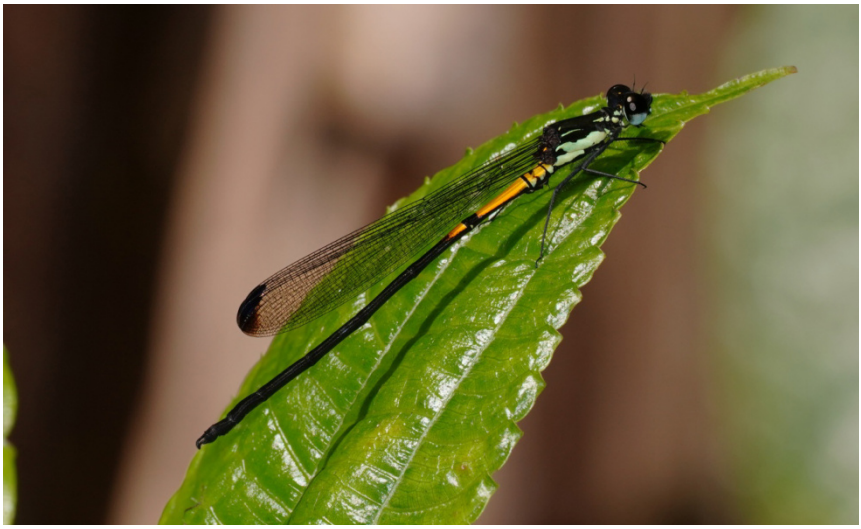


**Figure 35. *Rhinoneura villosipes* male at Site 95, numerous individuals were seen at this new location in Sabah, documented by Sabah naturalist Joe Pan. Also present and representing new records for the species were *Euphaea basalis* and *Protosticta kinabaluensis*. Photographer: B. Schwartz.**

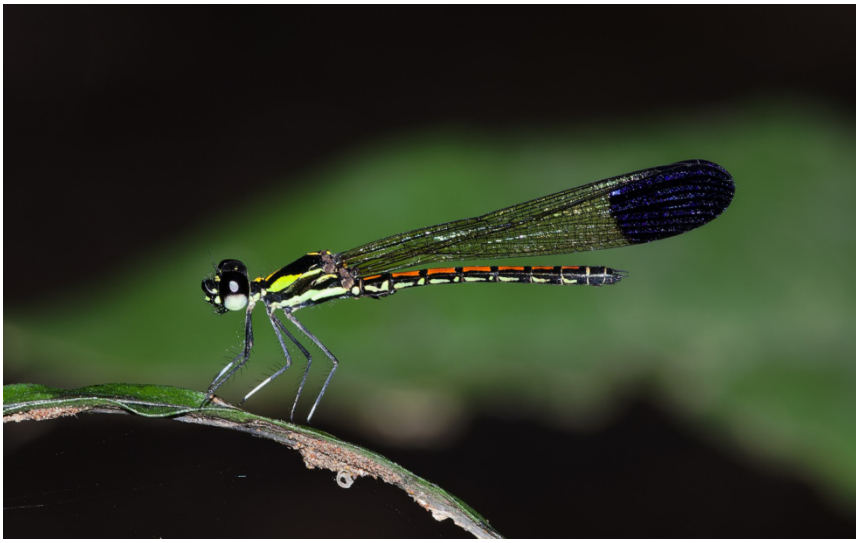


**Figure 36. *Sundacypha petiolata* male at Site 67, Photographer: M. Post.**

*Sundacypha petiolata* (Selys, 1859)

Sites: **67, 68.**

Notes: multiple males at site 67 were guarding territory, perched on small sticks emerging from the streambed or on leaves 1-2m above the water. A male and a female were seen and photographed at site 68 (Figure 36).

**Figure 37. *Coeliccia borneensis* male at Site 9, Photographer: B. Schwartz.**

**Platycnemidae**

*Coeliccia borneensis* (Selys, 1886)*

Sites: **9, 18.**

Notes: habitat seep-specialist (Figure 37).

*Coeliccia cyaneothorax* Kimmins, 1936*

Sites: **19, 62.**

Notes: A single male found perched near a large mountain stream at site 19. A pair and a single male close to each other at site 62, with the female apparently ovipositing in a wet patch of moss on a large boulder in the stream (Figures 38, 39).

*Coeliccia cf nemoricola* Laidlaw, 1912*

Sites: **4, 7, 13, 16, 17, 18, 22, 27, 28, 32, 33, 34, 53, 62, 73, 75, 77, 78, 80, 95, 100.**

Notes: *Coeliccia nemoricola* and its near allies form a difficult group that is being actively worked on. It would be premature to try and put names to individual photographs here, but it should be noted that multiple taxa are probably included here.

*Coeliccia* cf *nigrohamata* Laidlaw, 1918*

Sites: **2, 53, 56, 62, 66, 68, 69, 70, 73, 77, 78, 80, 88, 89, 100.**

Notes: Two distinctly different forms of *Coeliccia* cf *nigrohamata* were photographed together at Site 66, and there was much variation in the presence, size, and shapes of markings on individuals between sites.

**Figure 38. *Coeliccia cyaneothorax* male at Site 19, Photographer: B. Schwartz.**

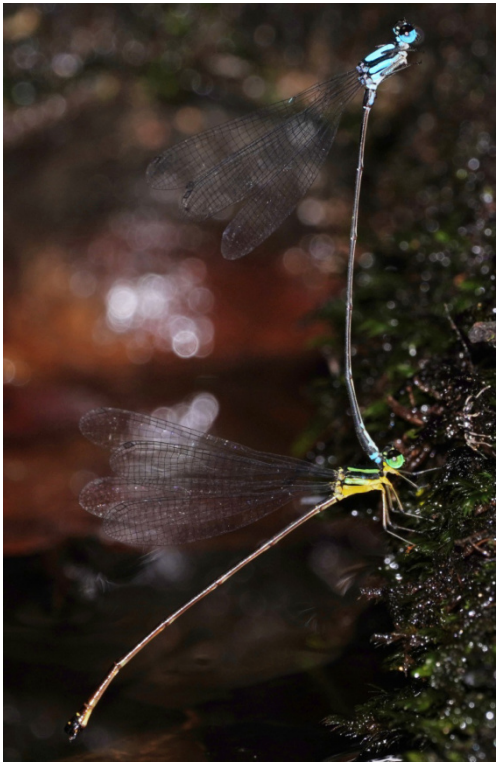


**Figure 39. *Coeliccia cyaneothorax* pair at Site 62, Photographer: B. Schwartz.**

*Copera vittata* (Selys, 1863)

Sites: **5, 28, 50, 54, 56, 64, 68, 70, 84, 85, 86, 88, 98, 100.**

*Copera* sp. (black form *C. vittata*?)

Sites: **45, 48.**

Notes: At site 48 black-form and a single dark individual with lighter legs were present in the ditches. Only black-form individuals were seen deeper in the forest at site 45. See Dow & Singa (2022) for comments about the black form of *Copera vittata*; this taxon is not treated as separate from *C. vittata* in the count of species recorded.

*Elattoneura analis* (Selys, 1860)

Sites: **62, 67, 68, 70, 71, 86, 87, 89, 98, 100.**

Notes: at some sites, only blue-form individuals were observed.

*Onychargia atrocyana* Selys, 1865

Sites: **59, 85, 89.**

*Prodasineura dorsalis* (Selys, 1860)*

Sites: **28, 68, 72.**

*Prodasineura hyperythra* (Selys, 1886)*

Sites: **28, 56, 62, 68, 89, 92, 98, 100.**

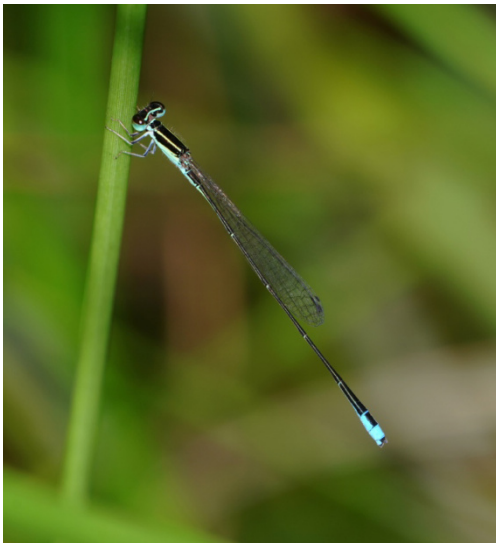


**Figure 40. *Aciagrion borneense* male at Site 42, a new record for Sabah, found at several sites along the NE coastal region. This individual was photographed in a small spike rush-lined freshwater pond very near the coast, where it was the most common species present. Photographer: B. Schwartz.**

*Prodasineura verticalis* (Selys, 1860)

Sites: **11, 12, 37, 49, 51.**

**Coenagrionidae**

*Aciagrion borneense* Ris, 1911

Sites: **39, 42, 43, 97.**

Notes: these are apparently the first records for Sabah (Figure 40). A recent arrival in Sabah or probably overlooked. This species was the most abundant odonate at site 42; a small spike rush-lined freshwater pond very near the coast, where it was the most common species present. Found at several sites along the NE coastal region.

*Agriocnemis femina* (Brauer, 1868)

Sites: **2, 8, 11, 32, 35, 39, 40, 42, 49, 53, 64, 72, 87, 90, 96, 97, 98.**

*Amphicnemis remiger* Laidlaw, 1912*

Site: **46, 48.**

Notes: A single male was found at a tiny pool of water under a root ball in peat swamp forest at site 46. A presumed female was found at site 48. Listed as near threatened by IUCN.

*Amphicnemis* sp.

Site: **85.**

Notes: two unidentified large *Amphicnemis* (a male and female) photographed at this site. Most species of this genus are infrequently observed, and positive ID is impossible without specimens. These appear to be in the *ecornuta*/*amabilis* group.

*Archibasis* cf *incisura*? Lieftinck, 1949

Site: **101.**

Notes: not possible to definitively determine ID from photo.

*Archibasis melanocyana* (Selys, 1877)

Site: **45.**

Notes: a single male was found perched on a sunny leaf ~3m off the ground, within 10m of a small pool in Klias Peat Swamp Forest. *Archibasis* are difficult to identify from photographs, but this one appears to be *A. melanocyana*, which can be common in low pH waters.

*Archibasis viola* Lieftinck, 1949

Site: **48.**

Notes: males were seen on the edges of drainage ditches around the Klias headquarters.

*Argiocnemis rubescens rubeola* Selys, 1877

Sites: **8, 39, 54, 55, 59, 64, 84, 85, 86, 91.**

Notes: Two species of *Argiocnemis* were photographed, *A. rubescens rubeola* and a possibly unnamed species below (see Note 40 in Dow 2021; this note is about Sarawak populations but applies equally well to Sabah).

*Argiocnemis* sp.

Sites: **39, 56, 59, 83, 99.**

Notes: A few males at these sites had distinctive purple/lilac coloring on S8-9, and yel-

low to orange thoracic stripes. Males were observed paired with unusually colored females at some sites, suggesting that the different coloration is not related to the level of maturity.

*Ceriagrion bellona* Laidlaw, 1915*

Sites: **32, 50, 100.**

Notes: at site 50 a concrete-lined roadside drainage channel had dozens of mating and single individuals. In addition, PB recorded this species at Borneo Rainforest Lodge, Danum Valley (N 5.02673 E 117.74998) on 7 October, 2004 and again there on 7 October, 2007 (Figure 41).

*Ceriagrion cerinorubellum* (Brauer, 1865)

Sites: **1, 8, 37, 39, 40, 41, 42, 48, 59, 84, 90, 91, 97, 100.**

*Ischnura senegalensis* (Rambur, 1842)

Sites: **1, 8, 35, 39, 42, 96, 97.**

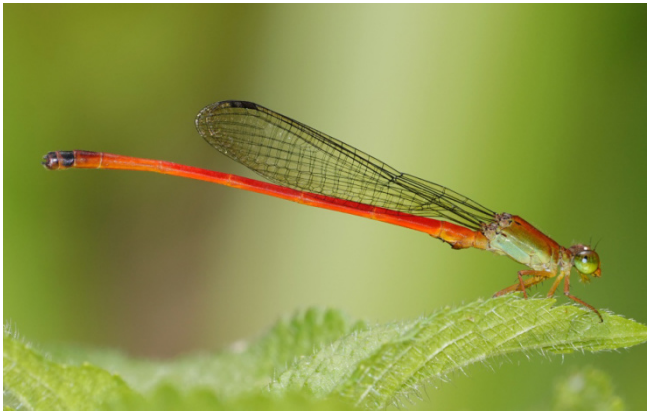


**Figure 41. *Ceriagrion bellona* male at Site 32, Photographer: B. Schwartz.**

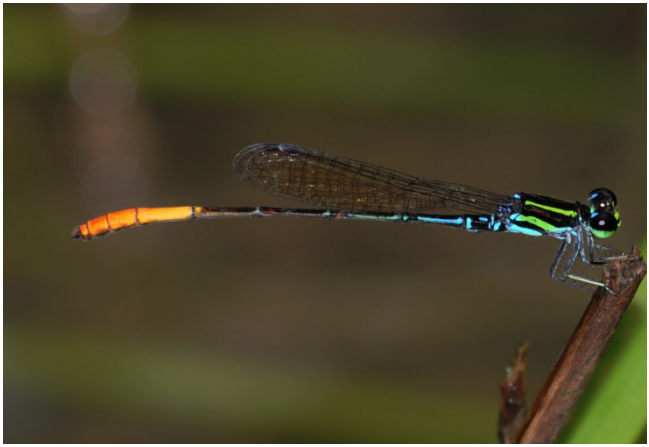


**Figure 42. *Mortonagrion alcyone* male at Site 85, Photographer: B. Schwartz.**

*Mortonagrion alcyone* (Laidlaw, 1931)*

Sites: **84, 85, 86, 90, 98, 100** (Figure 42).

*Pseudagrion microcephalum* (Rambur, 1842)

Sites: **8, 37, 38, 39, 42, 43, 48, 53, 90, 97.**

*Pseudagrion pilidorsum* (Brauer, 1868)

Sites: **11, 25, 28, 37, 49, 51, 86, 88, 100.**

*Pseudagrion* sp.

Sites: **84, 100.**

Notes: a very abundant *Pseudagrion* sp. at site 84. Differs significantly from *P. microcephalum* in the markings of the terminal abdominal segments (Figures 43, 44).

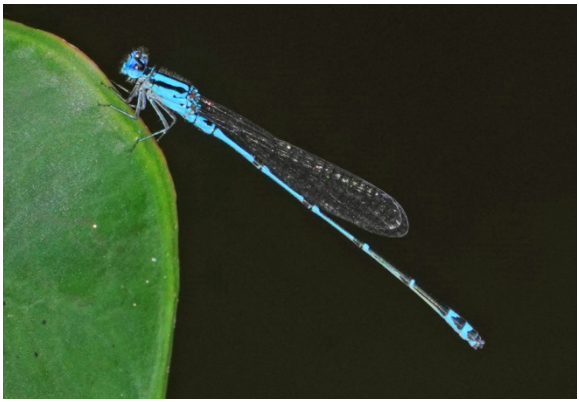


**Figure 43. *Pseudagrion* sp. male at Site 84, Photographer: B. Schwartz.**

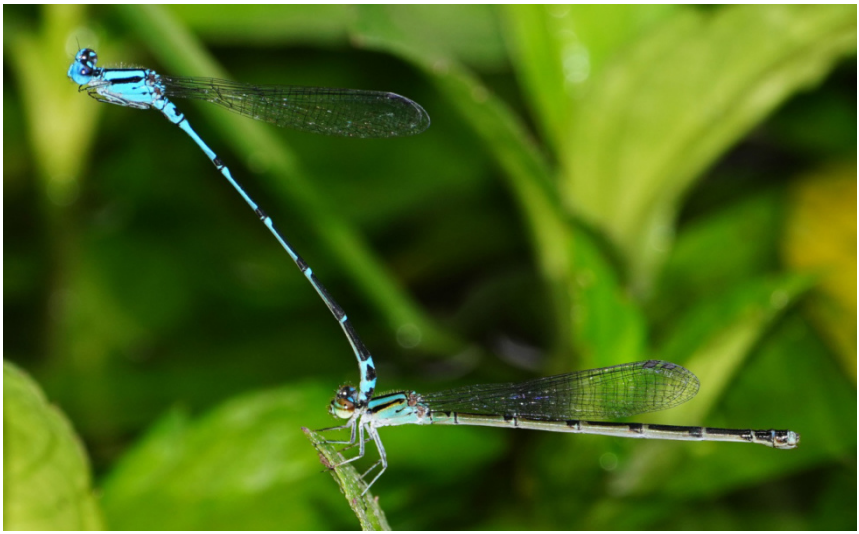


**Figure 44. *Pseudagrion* sp. pair at Site 84, Photographer: B. Schwartz.**

*Stenagrion dubium* (Laidlaw, 1912)*

Sites: **9, 17, 18, 36** (Figure 45).

*Teinobasis laidlawi* Kimmins, 1936*

Sites: **83, 84, 85, 86, 89, 90, 91, 101.**

Teinobasis rajah Laidlaw, 1912

Site: **48.**

*Xiphiagrion cyanomelas* Selys, 1876

Sites: **53, 63, 72, 90, 97, 98.**

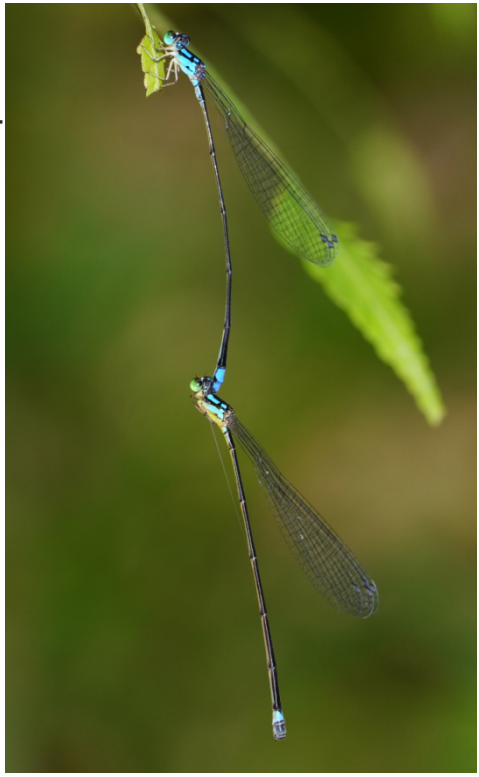


**Figure 45. *Stenagrion dubium* pair at Site 17, Photographer: B. Schwartz.**

**Anisoptera**

**Aeshnidae**

*Anax panybeus* Hagen, 1867

Sites: **14, 28, 64.**

Notes: A dead female in the hot spring at site 14 appears to be the first record for Kinabalu NP.

*Gynacantha* sp.

Site: **48.**

Notes: Despite reasonably good photos, the identity of this female remains uncertain. The status of various candidate species in this genus on Borneo is unclear.

*Heliaeschna* sp. Krüger, 1899

Sites: **48, 89.**

Notes: Two females observed ovipositing in muddy areas near the edge of peat swamp pools and a small sandy stream. Identification of and differentiation between female *H. crassa* and *H. idae* is not possible from photos.

*Indaeschna grubaueri* (Förster, 1904)

Site: 23.

Notes: A single individual was seen flying over small forest pools in deep shade.

**Gomphidae**

*Heliogomphus borneensis* Lieftinck, 1964*

Site: **82.**

Notes: a single teneral individual was flushed from the edge of a small stream.

*Heliogomphus* sp. cf *olivaceus*

Site: **69** (Figure 46).

Notes: This appears to be the species referred to as *Heliogomphus* sp. cf *olivaceus* in Dow et al. (2022), which is similar to *H. blandulus* Lieftinck, 1929 but with a larger lateral spur on the superior anal appendages; this is a first record for Sabah.

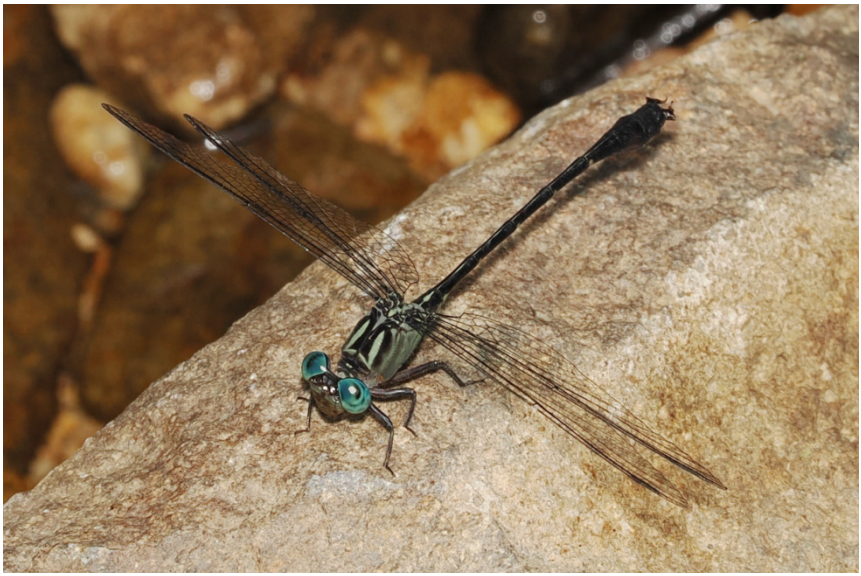


**Figure 46. *Heliogomphus* sp. cf *olivaceus*, male at site 69. Photo by P. Benstead.**

*Ictinogomphus decoratus melaenops* (Selys, 1858)

Sites: **53, 84, 90, 100.**

*Leptogomphus coomansi* Laidlaw, 1936*

Site: **100.**

Notes: only males (6) were seen at this site, on territory along a roadside runnel (Figure 47).

*Leptogomphus* sp. cf *pasia* Van Tol, 1990*

Site: **69.**

**Figure 47. *Leptogomphus coomansi* male at Site 100, photo by P. Benstead.**

Notes: Leptogomphus pasia and L. sii have similar markings. The latter has not been recorded in Sabah and the former is too poorly known to assess the extent of variation that can occur in its markings but given that it is the species known to occur in Sabah, parsimony suggests that it is the species photographed.

*Orientogomphus* sp. cf *aemulus* (Lieftinck, 1937)*

Site: **51.**

Notes: a single live male *Orientogomphus* was discovered trapped but unharmed in a spiderweb over a small low gradient, sand and gravel-bedded shallow stream along the entrance road to Maliau Basin. After numerous photographs, it was released. *Orientogomphus aemulus* is known from just two locations, one in Sumatra and the other in Peninsular Malaysia. It is listed as vulnerable by IUCN. This represents the first record of the genus for Borneo (Figure 48A, 48B).

*Sieboldius japponicus* Selys, 1854

Site: **71.**

Notes: single territorial male on a boulder in a river.

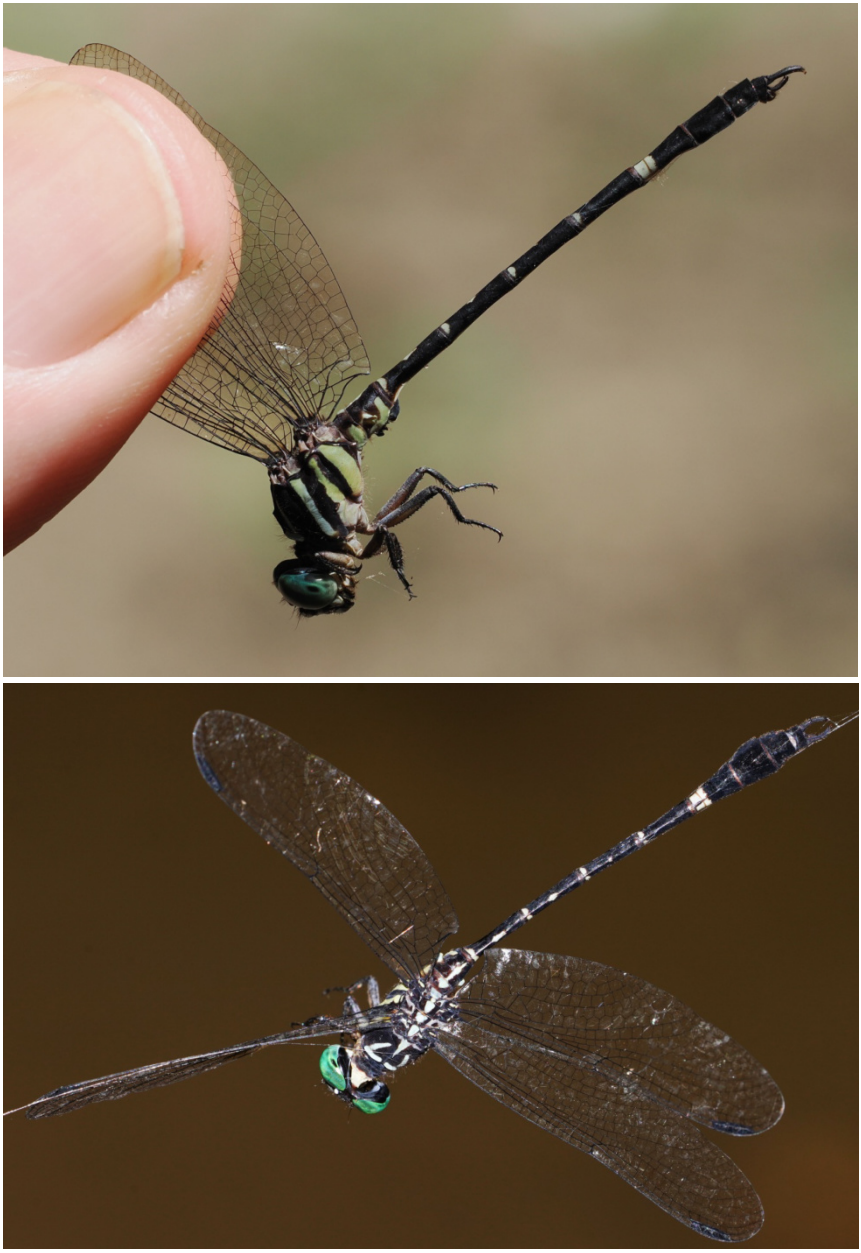


**Figure 48A, 48B. *Orientogomphus* sp. male at Site 51, Photographers: P. Benstead (48A), B. Schwartz (48B).**

**Macromiidae**

*Epophthalmia vittigera* (Rambur, 1842)

Sites: **53, 84, 90.**

*Macromia cincta* Rambur, 1842

Site: **48.**

Notes: A single perched male found over a blackwater peat swamp forest drainage canal around the Klias Forest Reserve headquarters area.

*Macromia* sp. (*westwoodii*?)

Sites: **10, 22, 95.**

Notes: *Macromia euterpe* is endemic to Sabah but is likely synonymous with *westwoodii*. Either way, ID to species is not possible from our photos.

**Libellulidae**

*Acisoma panorpoides* Rambur, 1842

Sites: **8, 53, 97, 100.**

*Aethriamanta gracilis* (Brauer, 1878)

Sites: **39, 53, 63, 84, 97, 100.**

*Agrionoptera insignis* (Rambur, 1842)

Sites: **28, 45, 54, 55, 59, 64, 84, 85, 86, 89, 97, 98, 101.**

*Agrionoptera sexlineata* Selys, 1879

Site: **44.**

*Brachydiplax chalybea* Brauer, 1868

Sites: **8, 38, 39, 43, 45, 48, 53, 54, 59, 64, 83, 89, 91, 97, 100.**

*Brachydiplax* cf *farinosa* Krüger, 1902 Sites: 54, 55.

Notes: Dow et al. (2016) indicates that two species are included in *Brachydiplax farinosa*. Problems determining seniority (the type from Sumatra is a female and undiagnosable) have made resolution of this issue difficult. Only one of these species is recorded from Borneo.

*Brachygonia oculata* (Brauer, 1878)

Sites: **45, 48.**

*Camacinia gigantea* (Brauer, 1867)

Sites: **64, 83, 99, 100.**

Notes: a female *C. gigantea* was photographed at site 64 ovipositing using an interesting method of hovering just above the water surface and slowly and gently lowering and raising her abdomen vertically into and out of the water repeatedly for 2-3 minutes; almost as if dipping a candle. A series of photos of this individual documented a slowly enlarging patch of yellow eggs in the water.

*Cratilla lineata* (Brauer, 1878)

Sites: **55, 59, 72.**

*Cratilla metallica* (Brauer, 1878)
Sites: **5, 28, 53, 72, 100.**
*Diplacodes trivialis* (Rambur, 1842)
Sites: **1, 2, 8, 11, 12, 14, 39, 41, 53, 72, 90, 97.**
*Hydrobasileus croceus* (Brauer, 1867)
Sites: **44, 53, 84, 100.**
*Lyriothemis biappendiculata* (Selys, 1878)
Sites: **56, 58, 68, 100.**
*Lyriothemis cleis* Brauer, 1868
Sites: **45, 99.**
*Macrodiplax cora* (Kaup in Brauer, 1867)
Sites: **96, 97.**
*Nannophya pygmaea* Rambur, 1842
Sites: **1, 48.**
*Nesoxenia lineata* (Selys, 1879)
Site: **84.**
Neurothemis fluctuans (Fabricius, 1793)
Sites: **1, 2, 8, 38, 39, 40, 41, 42, 44, 45, 49, 50, 53, 55, 59, 64, 72, 85, 89, 90, 91, 97.**
*Neurothemis ramburii* (Brauer, 1866)
Sites: **2, 5, 11, 14, 28, 72, 96, 97.**
*Neurothemis terminata* Ris, 1911
Sites: **2, 16, 44, 45, 72, 84, 85, 97, 100.**

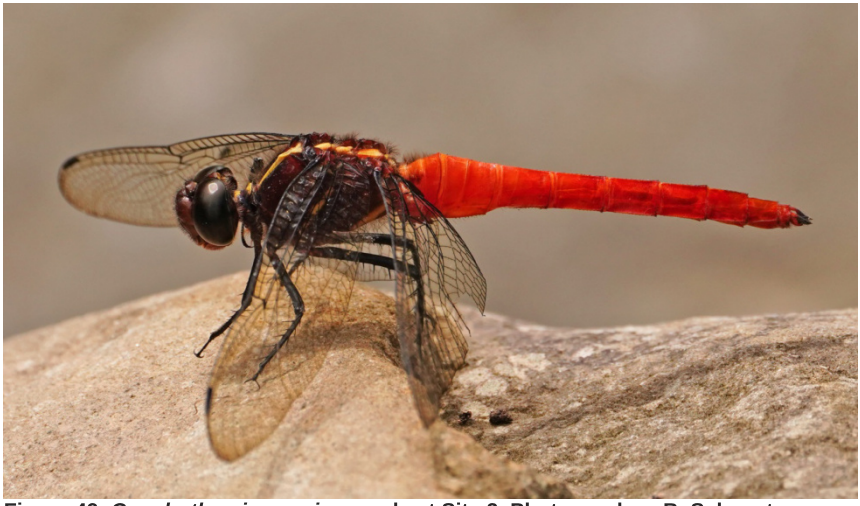


**Figure 49. *Onychothemis coccinea* male at Site 2, Photographer: B. Schwartz.**

*Onychothemis coccinea* Lieftinck, 1953

Site: **2.**

Notes: a single male was observed rapidly patrolling 50-100m of river, including over a bouldery rapid, and returning to the same emergent boulders every 20-30 seconds. This was our only observation of the species during the trip (Figure 49).

*Orchithemis pulcherrima* Brauer, 1878

Sites: **45, 48.**

*Orthetrum chrysis* (Selys, 1891)

Sites: **4, 28, 45, 48, 50, 54, 58, 64, 68, 84, 89.**

*Orthetrum glaucum* (Brauer, 1865)

Sites: **5, 6, 12, 14, 28, 32, 49, 53, 69, 72, 87, 100.**

*Orthetrum sabina* (Drury, 1773)

Sites: **2, 8, 11, 14, 32, 35, 38, 41, 48, 63, 84, 90, 96, 97.**

*Orthetrum schneideri* Förster, 1903

Sites: **5, 14, 24, 28, 32, 36, 50, 56, 93, 95, 99.**

*Orthetrum testaceum* (Burmeister, 1839)

Sites: **5, 11, 28, 30, 32, 35, 54, 59, 64, 72, 83, 84, 85, 87, 94, 97.**

*Pantala flavescens* (Fabricius, 1798)

Sites: **8, 28, 72.**

*Pseudothemis jorina* Förster, 1904

Sites: **84, 100.**

Notes: a male *Pseudothemis jorina* at site 84 was the first male documented in Sabah and only the second observation (a female was photographed at the same site by PB on October 7, 2008).

*Raphismia bispina* (Hagen, 1867)

Sites: **41, 96.**

*Rhodothemis rufa* (Rambur, 1842)

Sites: **8, 39, 43, 48, 63, 84, 90, 91, 97.**

*Rhyothemis aterrima* Selys, 1891

Site: **44.**

*Rhyothemis obsolescens* Kirby, 1889

Sites: **38, 44.**

*Rhyothemis phyllis* (Sulzer, 1776)

Sites: **8, 38, 39, 44, 48.**

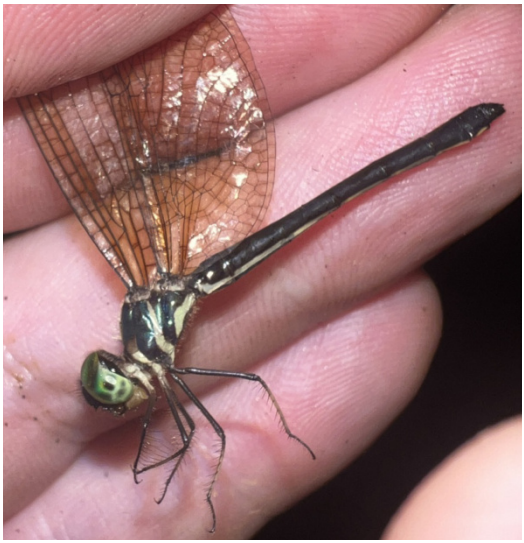
*Rhyothemis regia* (Brauer, 1867)

Sites: **53, 63, 83, 100.**

*Rhyothemis triangularis* Kirby, 1889

Sites: **53, 59, 63, 64, 84, 90, 91, 100.**

*Tetrathemis hyalina* Kirby, 1889
Sites: **55, 56, 59, 64, 83, 84, 86, 88, 90, 100.**
*Tholymis tillarga* (Fabricius, 1798)
Sites: **8, 20, 42, 43, 97.**
*Tramea* ?*transmarina* Selys, 1878
Sites: **63, 64, 97, 100.**
*Tramea* sp. cf *virginia* (Rambur, 1842)
Site: **63.**
*Trithemis aurora* (Burmeister, 1839)
Sites: **6, 12, 30, 49, 51, 84, 87, 94, 100.**
*Trithemis festiva* (Rambur, 1842)
Sites: **2, 5, 28, 49, 69, 100.**
*Tyriobapta kuekenthali* (Karsch, 1900)
Sites: **44, 45, 47, 48.**
Notes: listed as near threatened by IUCN.
*Tyriobapta torrida* Kirby, 1889
Sites: **51, 54, 68, 83, 85, 91, 99, 100.**
*Urothemis signata insignata* (Selys, 1872)
Sites: **39, 53, 84, 100.**
*Zygonyx ida errans* Lieftinck, 1953
Site: **49.**



Notes: See Dow et al. (2018) on the placement of this subspecies.
*Zyxomma obtusum* Albarda, 1881
Sites: **64, 72.**
*Zyxomma petiolatum* Rambur, 1842
Sites: **43, 98.**

**Incertae sedis**

*Idionyx montana* Karsch, 1891
Site: **56** (Figure 50).
Notes: A first record for Sabah. Photos of an in-hand female confirmed the ID.

**Figure 50. *Idionyx montana*, female at site 56. Photo by B. Schwartz.**

*Idionyx* sp. Karsch, 1891

Site: **34.**

Notes: An unidentified female was flying rapidly in the deep shade and ovipositing (dropping eggs) in mucky areas between waist-high emergent vegetation.

*Macromidia fulva* Laidlaw, 1915*

Site: **75.**

Notes: A single male was flushed in deep shade along the trail. It re-hung high in dark branches and allowed photos.

## Discussion

The photographic records present.ed in this report are a snapshot of species richness and total and relative abundances that might be found in the month of January. Certainly, more (many more at some sites) species would have been documented if we had spent more time at each site.

We visited sites that both have (e.g., Mount Kinabalu NP, Maliau Basin, Klias Peat Swamp Forest, and DVC) and have not been visited by odonatologists. At all sites, our observations either generated a baseline list of species or added to previously published lists of species. For example, at the Klias Peat Swamp Forest, we photographed at least 28 species, including many peat swamp specialists, and our findings add to the ~18 species reported at this site from a prior survey of the Klias and Binsulok Forest Reserves (Yagi & Kitagawa, 2001). Highlights here were *Archibasis viola, A. melanocyana, Nannophya pygmaea, Teinobasis rajah, Amphicnemis remiger, Podolestes orientalis* (preying on *T. rajah*), *Heliaeschna* sp., *Macromia cincta, Rhyothemis aterrima, Tyriobapta keukenthali, Lyriothemis cleis, Brachygonia oculata*, and *Orchithemis pulcherrima*. Several 'black-form' *Copera* sp. (Orr, 2001; Dow & Singa, 2022) were photographed, including at the entrance station where one with more typical orange-legs was also flying. Finally, the only *Gynacantha* sp. seen during the trip was found perched in brush near the entrance station.

Likewise, in Mount Kinabalu NP, 2 days of visits to multiple sites documented *Anax panybeus, Prodasineura dorsalis*, and *Pseudagrion pilidorsum*, all of which apparently represent additions to the published list of species documented in the park, and bring the total number to at least 74 (Choong & Dawood, 2021).

Notable observations include eight new records for the state of Sabah or all of Borneo (Dow et al., 2022; Dow et al., 2024): *Drepanosticta* sp. *forficula* complex, *Sundacypha petiolata, Aciagrion borneense, Pseudagrion* sp. (possibly new for Borneo), *Heliogomphus* cf *olivaceus*, *Orientogomphus* sp. (a new genus for Borneo), *Pseudothemis jorina*, and *Idionyx montana*.

We did not find or photograph several species we hoped to see, and we expected to find some species in greater abundance. Some of this can probably be attributed to poor weather, but equally likely factors could be the time of year or the time of day we visited sites. Examples include: *Indaeschna grubaueri* (only fleeting glimpses and poor photos), and *Macromidia fulva* (a single male photographed), which is a widespread and common species in Borneo but it is most active very early in the morning and at dusk and its behavior

typically makes it hard to detect at other times of day. We expected to find more species from the Aeshnidae, though unidentified crepuscular Aeshnidae were observed flying in a few locations.

For all the new or uncertain taxa, future work with collection permits is required to resolve unanswered questions and provide materials for descriptions of new species.

## Acknowledgements

Joe Pan, for providing a new location for *Euphaea basalis* and *Rhinoneura villosipes*, and a lovely dinner.

## References

Choong, C.Y. & Dawood, M.M. 2021. Dragonflies and Damselflies (Odonata) of Kadamaian, Kinabalu Park, Sabah. Journal of Tropical Biology & Conservation (JTBC) 18: 71–79. doi.org/10.51200/jtbc.v18i.3444

Dow, R.A., 2021. An annotated checklist of the Odonata (Insecta) known from Sarawak with records to district level. Sarawak Museum Journal LXXXI, No. 101 (New Series); Special Issue 10: 313–422.

Dow, R.A., Choong, C.Y., Grinang, J. & Lupiyaningdyah, P. 2022. Revised Checklist of Odonata (dragonflies and damselflies) of Borneo. Malayan Nature Journal 74(2): 217-240.

Dow, R.A., Choong, C.Y.; Grinang, J.; Lupiyaningdyah, P.; Ngiam, R.J.W. & Kalkman, V.J. 2024. Checklist of the Odonata (Insecta) of Sundaland and Wallacea (Malaysia, Singapore, Brunei, Indonesia and Timor Leste). Zootaxa 5460(1): 1-122.

Dow, R.A., Choong, C.Y. & Ng, Y.F. 2016. Records of Odonata from Perlis, Malaysia in August 2015, with a checklist of species recorded from the state. Faunistic Studies in Southeast Asian and Pacific Island Odonata 16: 1-22.

Dow, R.A., Choong, C.Y.; Robi, N.J.; Butler, S.G.; Ngiam, R.J.W. & Reels, G.T. 2018. Odonata from the Lanjak Entimau Wildlife Sanctuary, Sarawak. International Dragonfly Fund Report 115: 1–50.

Dow, R.A. & Singa, H. 2022. Previously unpublished Odonata records from Sarawak, Borneo, part IX: More Odonata from Limbang Division, including the first records from Gunung Buda National Park. International Dragonfly Fund Report 173: 1–32.

Hämäläinen, M., Dow, R.A. & Stokvis, F.R. 2015 Revision of the Sundaland species of the genus *Dysphaea* Selys, 1853 using molecular and morphological methods, with notes on allied species (Odonata: Euphaeidae). Zootaxa 3949(4): 451–490. doi.org/-10.11646/zootaxa.3949.4.1

Orr, A.G., 2001. An annotated checklist of the Odonata of Brunei with ecological notes and descriptions of hitherto unknown males and larvae. International Journal of Odonatology 4(2): 167-220.

Yagi, T. & Kitagawa, K. 2001. A survey of the dragonflies in the Klias and Binsulok Forest Reserves, Sabah, Malaysia. Nature and Human Activities 6: 31-39.

## Appendix 1

**Table of site numbers and corresponding location (WGS84), elevation, and date visited.**

| Site # | North | East | Elevation [masl] | Date visited [yyyy-mm-dd] |
|---|---|---|---|---|
| 1 | 6,15513 | 116,15677 | 5 | 2023-01-09 |
| 2 | 5,94383 | 116,21270 | 220 | 2023-01-10 |
| 3 | 5,95396 | 116,18017 | 420 | 2023-01-10 |
| 4 | 5,95163 | 116,19075 | 400 | 2023-01-10 |
| 5 | 5,94470 | 116,20868 | 255 | 2023-01-10 |
| 6 | 5,95189 | 116,19121 | 405 | 2023-01-10 |
| 7 | 5,95968 | 116,17913 | 288 | 2023-01-10 |
| 8 | 5,89500 | 116,05690 | 12 | 2023-01-10 |
| 9 | 5,85497 | 116,13816 | 500 | 2023-01-11 |
| 10 | 5,85456 | 116,14007 | 450 | 2023-01-11 |
| 11 | 5,90314 | 116,18332 | 50 | 2023-01-11 |
| 12 | 5,90836 | 116,18560 | 70 | 2023-01-11 |
| 13 | 6,01835 | 116,53711 | 1650 | 2023-01-12 |
| 14 | 6,04802 | 116,70210 | 510 | 2023-01-13 |
| 15 | 6,05224 | 116,70008 | 600 | 2023-01-13 |
| 16 | 6,05368 | 116,69799 | 705 | 2023-01-13 |
| 17 | 6,05672 | 116,69622 | 815 | 2023-01-13 |
| 18 | 6,05846 | 116,69592 | 840 | 2023-01-13 |
| 19 | 6,06235 | 116,69156 | 920 | 2023-01-13 |
| 20 | 5,97927 | 116,68007 | 560 | 2023-01-13 |
| 21 | 6,05069 | 116,70272 | 510 | 2023-01-14 |
| 22 | 6,05153 | 116,70231 | 530 | 2023-01-14 |
| 23 | 6,05145 | 116,70131 | 560 | 2023-01-14 |
| 24 | 6,04858 | 116,70180 | 530 | 2023-01-14 |
| 25 | 6,04506 | 116,70380 | 510 | 2023-01-14 |
| 26 | 6,04465 | 116,70320 | 530 | 2023-01-14 |
| 27 | 6,04507 | 116,70290 | 520 | 2023-01-14 |
| 28 | 6,04555 | 116,70290 | 515 | 2023-01-14 |
| 29 | 6,05172 | 116,70369 | 485 | 2023-01-14 |
| 30 | 6,05604 | 116,70535 | 480 | 2023-01-14 |
| 31 | 5,79781 | 116,40632 | 1110 | 2023-01-15 |
| 32 | 5,79694 | 116,40849 | 1050 | 2023-01-15 |
| 33 | 5,79841 | 116,40878 | 1110 | 2023-01-15 |
| 34 | 5,79744 | 116,40798 | 1090 | 2023-01-15 |
| 35 | 5,67266 | 116,36366 | 580 | 2023-01-15 |
| 36 | 5,40082 | 116,10318 | 975 | 2023-01-16 |
| 37 | 5,54722 | 115,98068 | 55 | 2023-01-16 |
| 38 | 5,62945 | 115,91515 | 10 | 2023-01-16 |
| 39 | 5,54147 | 115,63250 | 10 | 2023-01-16 |
| 40 | 5,52514 | 115,57693 | 5 | 2023-01-16 |
| 41 | 5,52390 | 115,58096 | 5 | 2023-01-16 |
| 42 | 5,52960 | 115,76151 | 1 | 2023-01-16 |
| 43 | 5,52694 | 115,84895 | 10 | 2023-01-16 |
| 44 | 5,32460 | 115,67134 | 10 | 2023-01-17 |
| 45 | 5,32018 | 115,66098 | 10 | 2023-01-17 |

| Site # | North | East | Elevation [masl] | Date visited [yyyy-mm-dd] |
|---|---|---|---|---|
| 46 | 5,32360 | 115,66362 | 10 | 2023-01-17 |
| 47 | 5,32320 | 115,66628 | 10 | 2023-01-17 |
| 48 | 5,32534 | 115,67305 | 10 | 2023-01-17 |
| 49 | 4,66501 | 116,55416 | 280 | 2023-01-18 |
| 50 | 4,60768 | 116,94337 | 420 | 2023-01-18 |
| 51 | 4,65278 | 116,94005 | 265 | 2023-01-18 |
| 52 | 4,70477 | 116,95660 | 270 | 2023-01-18 |
| 53 | 4,73673 | 116,97616 | 240 | 2023-01-18 |
| 54 | 4,73933 | 116,97429 | 225 | 2023-01-19 |
| 55 | 4,74011 | 116,97411 | 225 | 2023-01-19 |
| 56 | 4,73758 | 116,97221 | 240 | 2023-01-19 |
| 57 | 4,74258 | 116,97287 | 215 | 2023-01-19 |
| 58 | 4,73842 | 116,97549 | 230 | 2023-01-19 |
| 59 | 4,74241 | 116,97427 | 220 | 2023-01-19 |
| 60 | 4,73874 | 116,96956 | 230 | 2023-01-19 |
| 61 | 4,73808 | 116,96943 | 240 | 2023-01-19 |
| 62 | 4,69826 | 116,90732 | 518 | 2023-01-20 |
| 63 | 4,63785 | 116,94290 | 280 | 2023-01-20 |
| 64 | 4,39944 | 117,88920 | 280 | 2023-01-21 |
| 65 | 4,39814 | 117,88861 | 275 | 2023-01-21 |
| 66 | 4,40014 | 117,88883 | 290 | 2023-01-21 |
| 67 | 4,40047 | 117,89045 | 292 | 2023-01-21 |
| 68 | 4,41131 | 117,89382 | 310 | 2023-01-21 |
| 69 | 4,41296 | 117,89210 | 330 | 2023-01-21 |
| 70 | 4,41268 | 117,89217 | 330 | 2023-01-22 |
| 71 | 4,40983 | 117,89446 | 310 | 2023-01-22 |
| 72 | 4,96264 | 117,80294 | 160 | 2023-01-23 |
| 73 | 4,96142 | 117,80329 | 150 | 2023-01-23 |
| 74 | 4,96548 | 117,80236 | 167 | 2023-01-24 |
| 75 | 4,96545 | 117,80053 | 215 | 2023-01-24 |
| 76 | 4,96560 | 117,79758 | 235 | 2023-01-24 |
| 77 | 4,96565 | 117,79729 | 230 | 2023-01-24 |
| 78 | 4,96574 | 117,79421 | 250 | 2023-01-24 |
| 79 | 4,96507 | 117,79412 | 243 | 2023-01-24 |
| 80 | 4,96571 | 117,79938 | 220 | 2023-01-24 |
| 81 | 4,95729 | 117,80209 | 175 | 2023-01-25 |
| 82 | 4,95633 | 117,80239 | 185 | 2023-01-25 |
| 83 | 4,97452 | 117,95571 | 245 | 2023-01-26 |
| 84 | 4,99384 | 118,07437 | 165 | 2023-01-26 |
| 85 | 5,54335 | 118,09320 | 45 | 2023-01-27 |
| 86 | 5,54230 | 118,08630 | 40 | 2023-01-27 |
| 87 | 5,53100 | 118,07540 | 30 | 2023-01-27 |
| 88 | 5,87334 | 117,94252 | 40 | 2023-01-28 |
| 89 | 5,87531 | 117,94215 | 30 | 2023-01-28 |
| 90 | 5,87596 | 117,94382 | 30 | 2023-01-28 |

| Site # | North | East | Elevation [masl] | Date visited [yyyy-mm-dd] |
|---|---|---|---|---|
| 91 | 5,87039 | 117,94352 | 20 | 2023-01-28 |
| 92 | 5,87175 | 117,94221 | 20 | 2023-01-28 |
| 93 | 5,87340 | 117,94214 | 25 | 2023-01-28 |
| 94 | 5,87256 | 117,94197 | 28 | 2023-01-28 |
| 95 | 5,78219 | 116,34063 | 1460 | 2023-01-29 |
| 96 | 5,98457 | 116,08603 | 1 | 2023-01-29 |
| 97 | 5,98190 | 116,09103 | 4 | 2023-01-30 |
| 98 | 5,86460 | 117,94919 | 20 | 2023-10-02 |
| 99 | 5,10589 | 117,03099 | 175 | 2023-10-03 |
| 100 | 5,36740 | 117,43005 | 140 | 2023-10-05 |
| 101 | 5,50553 | 118,27909 | 15 | 2023-10-12 |
| | | | | |

## Appendix 2

**List of all iNaturalist records with corresponding site number, location, location accuracy, and taxon name. Also noted is whether an observation is a duplicate of another, with individuals numbered and counted accordingly.**

**https://dragonflyfund.org/wp-content/uploads/2025/07/FSSEAPIO_Schwartz_et_al_2025_Appendix.pdf**

## Appendix 3

**Table of all taxa observed, with sites where species were documented, and approximate number of individuals observed (note that counts for many common taxa are likely under-counts). Also noted is whether each taxon is a new record for Sabah (Y/N).**

| Species Count | New to Sabah Y/N | Taxa | Authority | Sites | # observed and photographed |
|---|---|---|---|---|---|
| 1 | N | *Lestes praevius* | Lieftinck, 1940 | 83, 86, 99, 100 | 7 |
| 2 | N | *Orolestes wallacei* | (Kirby, 1889) | 55, 84, 86 | 4 |
| 3 | N | *Drepanosticta actaeon* | Laidlaw, 1934 | 19, 22, 26, 33, 61, 78, 79 | 19 |
| 4 | Y | *Drepanosticta* cf *forficula* | | 76, 78 | 2 |
| 5 | N | *Drepanosticta rufostigma* | (Selys, 1886) | 7, 9, 10, 26, 33, 61, 62, 70 | 13 |
| | | *Drepanosticta* sp. | | 36, 62, 76 | 3 |
| 8 | N | *Drepanosticta versicolor* | Laidlaw, 1913 | 70, 72, 75, 77, 78, 81 | 10 |
| 6 | N | *Protosticta joepani* | Dow, Phan & Choong, 2020 | 15, 21 | 3 |
| 7 | N | *Protosticta kinabaluensis* | Laidlaw, 1915 | 95 | 4 |
| 9 | N | *Telosticta fugispinosa* | Dow, Afendy & Rahman, 2016 | 7, 10 | 5 |
| 10 | N | *Telosticta janeus* | Dow & Orr, 2012 | 78, 81 | 7 |
| 11 | | *Dysphaea* sp. | Selys, 1853 | 49, 51, 57, 62, 74, 100 | 8 |
| 12 | N | *Euphaea basalis* | (Laidlaw, 1915) | 95 | 3 |
| 13 | N | *Euphaea impar* | Selys, 1859 | 60, 65, 67, 77, 78, 92, 100 | 14 |
| 14 | N | *Euphaea subcostalis* | Selys, 1873 | 4, 5, 6, 10, 12, 25, 49, 51, 52, 62, 68, 69, 72, 78, 79, 99 | 33 |
| 15 | N | *Euphaea subnodalis* | (Laidlaw, 1915) | 19, 22 | 2 |
| | | *Euphaea* | | 11, 24, 69, 79 | 5 |
| 16 | N | *Devadatta aran* | Dow, Hämäläinen & Stokvis, 2015 | 95 | 1 |
| 17 | N | *Devadatta tanduk* | Dow, Hämäläinen & Stokvis, 2015 | 79 | 1 |
| | | *Devadatta* | | 2, 4, 7, 9, 18, 21, 26, 31, 33, 36, 50, 56, 60, 68, 69, 70, 78, 79, 82, 95 | 35 |
| 18 | N | *Rhinagrion elopurae* | (McLachlan in Selys, 1886) | 51, 52, 56, 58, 62, 67, 69, 73, 78, 88, 89, 100 | 19 |
| 19 | N | *Podolestes orientalis* | Selys, 1862 | 48, 56, 58, 68, 86, 89, 90 | 8 |
| 20 | N | *Matronoides cyaneipennis* | (Förster, 1897) | 19 | 6 |
| 21 | N | *Neurobasis longipes* | Hagen, 1887 | 12, 29, 49, 51, 52, 62, 71, 73, 100 | 17 |
| | N | *Vestalis amabilis/amoena* | Lieftinck, 1965 | 21 | 1 |
| 22 | N | *Vestalis amnicola* | Lieftinck, 1965 | 19, 72 | 2 |
| 23 | N | *Vestalis amoena* | Hagen in Selys, 1853 | 51, 52, 87 | 4 |
| 24 | N | *Vestalis anacolosa* | Lieftinck, 1965 | 2 | 1 |
| 25 | N | *Vestalis beryllae* | Laidlaw, 1915 | 7, 9, 80 | 4 |
| | | *Vestalis* sp. | | 3, 15, 19, 24, 25, 32, 33, 50, 56, 66, 68, 78, 79, 80, 87, 92 | 25 |
| 26 | N | *Heliocypha biseriata* | (Selys, 1859) | 2, 5, 25, 52, 62, 65 | 16 |
| 27 | N | *Libellago hyalina* | (Selys, 1859) | 44, 48 | 10 |
| 28 | N | *Libellago phaethon* | (Laidlaw, 1931) | 49, 51, 52, 87, 92, 93, 100 | 9 |
| 29 | N | *Libellago semiopaca* | (Selys, 1873) | 11, 12, 37, 49, 51, 74, 99 | 29 |
| 30 | N | *Rhinocypha aurofulgens* | Laidlaw, 1931 | 49, 57, 69, 73 | 7 |
| 31 | N | *Rhinocypha cucullata* | Selys, 1873 | 51, 52, 62, 100 | 20 |
| 32 | N | *Rhinocypha humeralis* | Selys, 1873 | 4, 5, 37, 51, 52, 56, 58, 60, 67, 71, 72, 73, 78, 79, 88, 89, 92, 93 | 31 |
| 33 | N | *Rhinocypha stygia* | Förster, 1897 | 79 | 3 |
| 34 | N | *Rhinoneura villosipes* | Laidlaw, 1915 | 95 | 5 |
| 35 | Y | *Sundacypha petiolata* | (Selys, 1859) | 67, 68 | 7 |
| 36 | N | *Coeliccia borneensis* | (Selys, 1886) | 9, 18 | 2 |
| 37 | N | *Coeliccia cyaneothorax* | Kimmins, 1936 | 19, 62 | 4 |

| Species Count | New to Sabah Y/N | Taxa | Authority | Sites | # observed and photographed |
|---|---|---|---|---|---|
| 38 | N | *Coeliccia* cf *nemoricola* | | 4, 7, 13, 16, 17, 18, 22, 27, 28, 32, 33, 34, 53, 62, 73, 75, 77, 78, 80, 95, 100 | 54 |
| 39 | N | *Coeliccia* cf *nigrohamata* | | 2, 53, 56, 62, 66, 68, 69, 70, 73, 77, 78, 80, 88, 89, 100 | 30 |
| 40 | N | *Copera vittata* | (Selys, 1863) | 5, 28, 50, 54, 56, 64, 68, 70, 84, 85, 86, 88, 98, 100 | 34 |
| | | *Copera vittata? (black form)* | | 45, 48 | 9 |
| 41 | N | *Elattoneura analis* | (Selys, 1860) | 62, 67, 68, 70, 71, 86, 87, 89, 98, 100 | 15 |
| 42 | N | *Onychargia atrocyana* | Selys, 1865 | 59, 85, 89 | 4 |
| 43 | N | *Prodasineura dorsalis* | (Selys, 1860) | 28, 68, 72 | 6 |
| 44 | N | *Prodasineura hyperythra* | (Selys, 1886) | 28, 56, 62, 68, 89, 92, 98, 100 | 8 |
| 45 | N | *Prodasineura verticalis* | (Selys, 1860) | 11, 12, 37, 49, 51 | 19 |
| 46 | Y | *Aciagrion borneense* | Ris, 1911 | 39, 42, 43, 97 | 32 |
| 47 | N | *Agriocnemis femina* | (Brauer, 1868) | 2, 8, 11, 35, 39, 40, 42, 49, 53, 64, 72, 87, 90, 96, 97, 98 | 134 |
| 48 | N | *Amphicnemis remiger* | Laidlaw, 1912 | 46, 48 | 2 |
| 49 | | *Amphicnemis* sp. | | 85 | 2 |
| 50 | N | *Archibasis incisura* | Lieftinck, 1949 | 101 | 1 |
| 51 | N | *Archibasis melanocyana* | (Selys, 1877) | 45 | 1 |
| 52 | N | *Archibasis viola* | Lieftinck, 1949 | 48 | 2 |
| 53 | N | *Argiocnemis rubescens rubeola* | Selys, 1877 | 8, 39, 54, 55, 59, 64, 84, 85, 86, 91 | 29 |
| 54 | N | *Argiocnemis* sp. | | 39, 56, 59, 83, 99 | 5 |
| 55 | N | *Ceriagrion bellona* | Laidlaw, 1915 | 32, 50, 100 | 23 |
| 56 | N | *Ceriagrion cerinorubellum* | (Brauer, 1865) | 1, 8, 37, 39, 40, 41, 42, 48, 59, 84, 90, 91, 97, 100 | 27 |
| 57 | N | *Ischnura senegalensis* | (Rambur, 1842) | 1, 8, 35, 39, 42, 96, 97 | 19 |
| 58 | N | *Mortonagrion alcyone* | (Laidlaw, 1931) | 84, 85, 86, 90, 98, 100 | 7 |
| 59 | N | *Pseudagrion microcephalum* | (Rambur, 1842) | 8, 37, 38, 39, 42, 43, 48, 53, 90, 97 | 88 |
| 60 | N | *Pseudagrion pilidorsum* | (Brauer, 1868) | 11, 25, 28, 37, 49, 51, 86, 88, 100 | 16 |
| 61 | Y | *Pseudagrion* sp. | | 84, 100 | 32 |
| 62 | N | *Stenagrion dubium* | (Laidlaw, 1912) | 9, 17, 18, 36 | 8 |
| 63 | N | *Teinobasis laidlawi* | Kimmins, 1936 | 83, 84, 85, 86, 89, 90, 91, 101 | 18 |
| 64 | N | *Teinobasis rajah* | Laidlaw, 1912 | 48 | 7 |
| 65 | N | *Xiphiagrion cyanomelas* | Selys, 1876 | 53, 63, 72, 90, 97, 98 | 42 |
| 66 | N | *Anax panybeus* | Hagen, 1867 | 14, 28, 64 | 3 |
| 67 | | *Gynacantha sp.* | | 48 | 1 |
| 68 | N | *Heliaeschna sp. idae/crassa* | Krüger, 1899 | 48,89 | 2 |
| 69 | N | *Indaeschna grubaueri* | (Förster, 1904) | 23 | 1 |
| 70 | N | *Heliogomphus borneensis* | | 82 | 1 |
| 71 | Y | *Heliogomphus* cf *olivaceus* | | 69 | 1 |
| 72 | N | *Ictinogomphus decoratus* | (Selys, 1854) | 53, 84, 90, 100 | 8 |
| 73 | N | *Leptogomphus coomansi* | Laidlaw, 1936 | 100 | 6 |
| 74 | N | *Leptogomphus* cf *pasia* | Dow, Stokvis & Ngiam, 2017 | 69 | 1 |
| 75 | Y | *Orientogomphus* sp. | | 51 | 1 |
| 76 | N | *Sieboldius japponicus* | Selys, 1854 | 71 | 1 |
| 77 | N | *Epophthalmia vittigera* | (Rambur, 1842) | 53, 84, 90 | 4 |
| 78 | N | *Macromia cincta* | Rambur, 1842 | 48 | 1 |

| Species Count | New to Sabah Y/N | Taxa | Authority | Sites | # observed and photographed |
|---|---|---|---|---|---|
| 79 | N | *Macromia* sp. (*westwoodii?*) | | 10, 22, 95 | 3 |
| 80 | N | *Acisoma panorpoides* | Rambur, 1842 | 8, 53, 97, 100 | 6 |
| 81 | N | *Aethriamanta gracilis* | (Brauer, 1878) | 39, 53, 63, 84, 97, 100 | 12 |
| 82 | N | *Agrionoptera insignis* | (Rambur, 1842) | 28, 45, 54, 55, 59, 64, 72, 84, 85, 86, 89, 97, 98, 101 | 21 |
| 83 | N | *Agrionoptera sexlineata* | Selys, 1879 | 44 | 8 |
| 84 | N | *Brachydiplax chalybea* | Brauer, 1868 | 8, 38, 39, 43, 45, 48, 53, 54, 59, 64, 83, 89, 91, 97, 100 | 21 |
| 85 | N | *Brachydiplax* cf *farinosa* | | 54, 55 | 2 |
| 86 | N | *Brachygonia oculata* | (Brauer, 1878) | 45, 48 | 10 |
| 87 | N | *Brachythemis contaminata* | (Fabricius, 1793) | 101 | 1 |
| 88 | N | *Camacinia gigantea* | (Brauer, 1867) | 64, 83, 99, 100 | 8 |
| 89 | N | *Cratilla lineata* | (Brauer, 1878) | 55, 59, 72 | 5 |
| 90 | N | *Cratilla metallica* | (Brauer, 1878) | 5, 28, 53, 72, 100 | 7 |
| 91 | N | *Diplacodes trivialis* | (Rambur, 1842) | 1, 2, 8, 11, 12, 14, 39, 41, 53, 72, 90, 97 | 25 |
| 92 | N | *Hydrobasileus croceus* | (Brauer, 1867) | 44, 53, 84, 100 | 4 |
| 93 | N | *Lyriothemis biappendiculata* | (Selys, 1878) | 56, 58, 68, 100 | 8 |
| 94 | N | *Lyriothemis cleis* | Brauer, 1868 | 45, 99 | 6 |
| 95 | N | *Macrodiplax cora* | (Kaup in Brauer, 1867) | 96, 97 | 6 |
| 96 | N | *Nannophya pygmaea* | Rambur, 1842 | 1, 48 | 4 |
| 97 | N | *Nesoxenia lineata* | (Selys, 1879) | 84 | 1 |
| 98 | N | *Neurothemis fluctuans* | (Fabricius, 1793) | 1, 2, 8, 38, 39, 40, 41, 42, 44, 45, 49, 50, 53, 55, 59, 64, 72, 85, 89, 90, 91, 97 | 56 |
| 99 | N | *Neurothemis ramburii* | (Brauer, 1866) | 2, 5, 11, 14, 28, 37, 72, 96, 97 | 34 |
| 100 | N | *Neurothemis terminata* | Ris, 1911 | 2, 16, 44, 45, 72, 84, 85, 97, 100 | 21 |
| 101 | N | *Onychothemis coccinea* | Lieftinck, 1953 | 2 | 1 |
| 102 | N | *Orchithemis pulcherrima* | Brauer, 1878 | 45, 48 | 3 |
| 103 | N | *Orthetrum chrysis* | (Selys, 1891) | 4, 28, 45, 48, 50, 54, 58, 64, 68, 84, 89 | 14 |
| 104 | N | *Orthetrum glaucum* | (Brauer, 1865) | 5, 6, 12, 14, 28, 32, 49, 53, 69, 72, 87, 100 | 25 |
| 105 | N | *Orthetrum sabina* | (Drury, 1773) | 2, 11, 14, 32, 35, 38, 41, 48, 53, 63, 84, 90, 96, 97 | 33 |
| 106 | N | *Orthetrum schneideri* | Förster, 1903 | 5, 14, 24, 28, 32, 36, 50, 56, 93, 95, 99 | 13 |
| 107 | N | *Orthetrum testaceum* | (Burmeister, 1839) | 5, 11, 28, 30, 32, 35, 37, 54, 59, 64, 72, 83, 84, 85, 87, 94, 97 | 36 |
| 108 | N | *Pantala flavescens* | (Fabricius, 1798) | 8, 28, 72 | 6 |
| 109 | Y | *Pseudothemis jorina* | Förster, 1904 | 84, 100 | 3 |
| 110 | N | *Raphismia bispina* | (Hagen, 1867) | 41, 96 | 21 |
| 111 | N | *Rhodothemis rufa* | (Rambur, 1842) | 8, 39, 43, 48, 63, 84, 90, 91, 97 | 18 |
| 112 | N | *Rhyothemis aterrima* | Selys, 1891 | 44 | 2 |
| 113 | N | *Rhyothemis obsolescens* | Kirby, 1889 | 38, 44 | 2 |
| 114 | N | *Rhyothemis phyllis* | (Sulzer, 1776) | 8, 38, 39, 44, 48 | 8 |
| 115 | N | *Rhyothemis regia* | (Brauer, 1867) | 53, 63, 83, 100 | 7 |
| 116 | N | *Rhyothemis triangularis* | Kirby, 1889 | 53, 59, 63, 64, 72, 84, 90, 91, 100 | 12 |
| 117 | N | *Tetrathemis hyalina* | Kirby, 1889 | 55, 56, 59, 64, 83, 84, 86, 88, 90, 100 | 20 |
| 118 | N | *Tholymis tillarga* | (Fabricius, 1798) | 8, 20, 42, 43, 97 | 6 |
| 119 | N | *Tramea transmarina?* | Brauer, 1867 | 63, 64, 97, 100 | 5 |
| 120 | N | *Tramea* sp. cf *virginia* | | 63 | 1 |

| Species Count | New to Sabah Y/N | Taxa | Authority | Sites | # observed and photographed |
|---|---|---|---|---|---|
| 121 | N | *Trithemis aurora* | (Burmeister, 1839) | 6, 12, 30, 49, 51, 84, 87, 94, 100 | 14 |
| 122 | N | *Trithemis festiva* | (Rambur, 1842) | 2, 5, 28, 49, 69, 100 | 19 |
| 123 | N | *Tyriobapta kuekenthali* | (Karsch, 1903) | 44, 45, 47, 48 | 11 |
| 124 | N | *Tyriobapta torrida* | Kirby, 1889 | 51, 54, 68, 83, 85, 91, 99, 100 | 15 |
| 125 | N | *Urothemis signata insignata* | (Rambur, 1842) | 39, 53, 84, 100 | 6 |
| 126 | N | *Zygonyx ida errans* | Selys, 1869 | 49 | 2 |
| 127 | N | *Zyxomma obtusum* | Albarda, 1881 | 64, 72 | 4 |
| 128 | N | *Zyxomma petiolatum* | Rambur, 1842 | 43, 98 | 3 |
| 129 | Y | *Idionyx montana* | Selys, 1871 | 56 | 1 |
|  | N | *Idionyx* sp. | Selys, 1871 | 34 | 1 |
| 130 | N | *Macromidia fulva* | Laidlaw, 1915 | 75 | 1 |

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