



AGRION

NEWSLETTER OF THE WORLDWIDE DRAGONFLY ASSOCIATION

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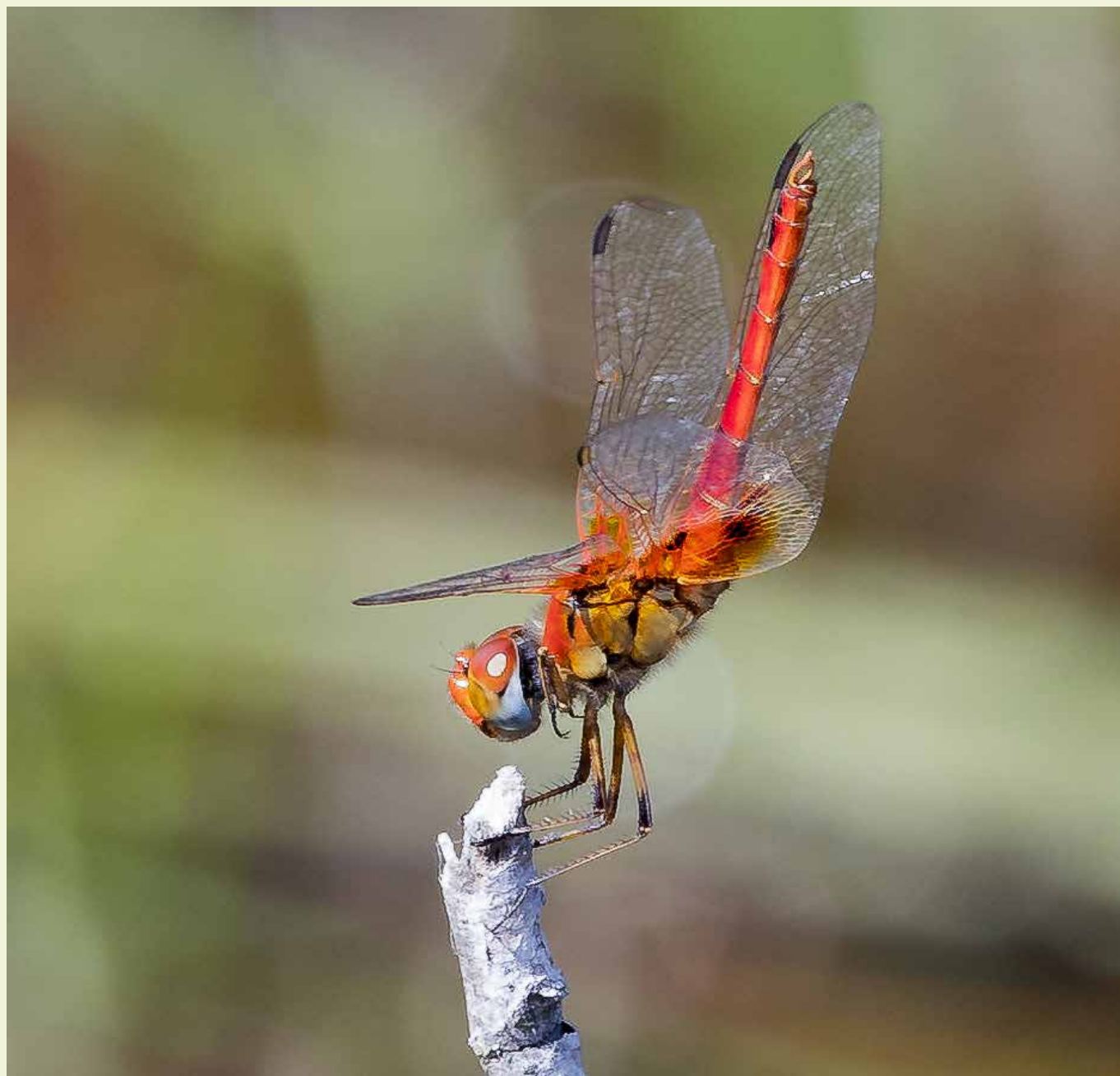
July 2022

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NEWSLETTER OF THE WORLDWIDE DRAGONFLY ASSOCIATION

AGRION is the Worldwide Dragonfly Association's (WDA's) newsletter, which is normally published twice a year in January and July. Occasionally a special issue may be produced, as was the case in May 2020 when a special issue was published in response to the ongoing Covid-19 pandemic. The WDA aims to advance public education and awareness by the promotion of the study and conservation of dragonflies (Odonata) and their natural habitats in all parts of the world. AGRION covers all aspects of WDA's activities; it communicates facts and knowledge related to the study and conservation of dragonflies and is a forum for news and information exchange for members. AGRION is freely available for downloading from the WDA website at [<https://worlddragonfly.org/about/agrion/>]. WDA is a Registered Charity (Not-for-Profit Organization), Charity No. 1066039/0. A 'pdf' of the WDA's Constitution and byelaws can be found at its website link at [<https://worlddragonfly.org/about/>].



Editor's notes

Keith Wilson [kdpwilson@gmail.com]

WDA Membership

Membership signing up and renewal process is now handled by WDA directly from the WDA website [<https://worlddragonfly.org/>]. There are three kinds of WDA membership available, either **Regular** or single (£50/year), which is the standard category, **Family** (£75/year) or **Reduced** (£25/year). The latter is a reduced membership category for students (grade school, undergraduate, graduate, etc.) and anyone (student or not) residing in a developing nation (see [UN list](#)). For further information consult the WDA website at: [<https://worlddragonfly.org/new-changes-in-2021/>]. You can sign up for membership using the WDA's website [<https://worlddragonfly.org/membership-account/membership-levels/>] or by contacting the WDA secretary directly [wda.secretary@gmail.com]. Sponsored memberships are also available for those who cannot afford the cost due to currency restrictions or other reasons. Prior to 2021, membership options were with or without the WDA's journal (*The International Journal of Odonatology*)—in electronic form or hard copy, but as from January 2021 the IJO will only be available in electronic form and will be freely accessible through Open Access. For member benefits see WDA web page under Member Resources [<https://worlddragonfly.org/resources/member-resources/>].

WDA Membership Renewal

Automatic renewal is in place for existing members so they do not have to worry about their membership renewal. A reminder email, notifying members of their upcoming membership payment, will be sent seven days prior to the debit.

Conference news

The International Congress of Odonatology ICO2023

The next ICO will be held in Paphos, Cyprus at the Neapolis University. The Congress was originally scheduled to be held in 2021 but, due to Covid-19 related uncertainties, has now been rescheduled for 25-30 June 2023. For further information consult the WDA website [[Link](#)] or contact David Sparrow, Chair of the Organising Committee [davidrospfo@hotmail.com].



Cover: One of a series of photos taken of *Urothemis abbotti*, photographed for the first time at Trang, Thailand between 1 January 2022 and 1 February 2022 by Markku O. Tunturi. See article on page 34 titled: The rare libellulid *Urothemis abbotti* recorded and photographed in southern Thailand.

European Congress on Odonatology (ECOO) 2020 postponed to 2022 due to Covid-19

After several Covid-19 postponements the Slovene Dragonfly Society announced that the 6th European Congress on Odonatology (ECOO) would be held in the city of Kamnik, Slovenia from 27-30 June 2022. In addition to lectures, poster presentations and a mid-congress trip a 6-day post-congress field trip is planned from 1-6 July. For further information see the ECOO Congress website [<https://ecoo2016.wordpress.com/>].



WDA and social media

WDA has an active social media team that hitherto has been coordinated by Manpreet Kohli. In December 2021 the WDA Board approved a new Social Media Coordinator, Emily Sandal, to replace Manpreet [<https://worlddragonfly.org/about/social-media-team/>]. Thanks to Manpreet for all her hard work over the past few years. Emily is a postdoctoral research associate at the Center for Biodiversity & Global Change at Yale University, USA. Her work focuses on functional traits and global distribution of dragonflies, with a particular focus on larval odonates. Ethan Tolman has also joined the Social Media Team as co-webmaster and he will help Will Kuhn maintain the WDA web site. Other members of the Social Media Team include Rhema Dike and Danielle Husband. Rhema is a student and research assistant at the University of Lagos in Nigeria. He studies the diversity, distribution, and taxonomy of Odonata in Southwestern Nigeria and also studies odonates as indicators of water quality. Danielle is a biology masters student at Texas Tech University. Her research focuses on west Texas odonates at undersampled and imperiled wetlands. The Social Media Team regularly posts information on Facebook and Twitter about Odonata related news and research. WDA's Facebook group can be found at [<https://www.facebook.com/WorldwideDragonflyAssociation>], and its Twitter presence at [<https://twitter.com/worlddragonfly?lang=en>].

Next issue of AGRION

For the next issue of *AGRION*, to be published at the beginning of January 2023, please send your contributions to Keith Wilson [kdpwilson@gmail.com] or Graham Reels [gtreels@gmail.com]. All articles, information and news items related to dragonflies or of interest to WDA members are most welcome and will be considered for publication. Please send all text and figure captions in a Word file by email. Please do not include artwork with the text but provide a separate file or files, ideally in a compressed format (e.g. 'tiff', 'jpeg' or 'gif'). Do not make up plates of multiple photos but send original photo images as separate files.

If you have an odonate photo illustrating any rarely observed aspect of dragonfly biology, or an unusual species, or simply a stunning dragonfly shot, please submit it for consideration for publication on the front cover of *AGRION*.

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The rare libellulid *Urothemis abbotti* recorded and photographed in southern Thailand

Markku O. Tunturi [markku.tunturi@iki.fi]

Introduction

During a stay of nearly two months in southern Thailand, from mid-December 2021 to the first week of February 2022, I indulged my latest (for two years now) interest in nature: photographing and observing dragonflies and damselflies.

Knowing very little of these fascinating insects, I photographed practically everything that I saw, and each evening I tried to identify my images with help of the photos posted on Dennis Farrells' website 'Dragonflies and damselflies of Thailand' at <http://thaiodonata.blogspot.com/2013/12/?m=0>. Those photographs which I could not identify were sent to Dennis Farrell. Among them were two images (Fig. 1) of a dragonfly with a red abdomen. He replied that it was a *Urothemis* species, but it did not look like the common *U. signata* (Rambur, 1842) (Fig. 4B-C). He also said that another species *U. abbotti* Laidlaw, 1927 has been found in southern Thailand, but he had never seen any photographs of this species. After returning home to Finland, I contacted Matti Hämäläinen who informed me that the photographs undoubtedly show *U. abbotti*. He also said that these were probably the first field photographs ever taken of this rare species. Noppadon Makbun confirmed that this was the first record from Thailand since Laidlaw's (1927) original description of this species, based on specimens also collected in Trang. He was not aware of any earlier field photographs of this species either.

My records

Urothemis abbotti was recorded and photographed in the surroundings of the Thai Break Resort, Nayong district in Trang Province (WGS84 co-ordinates: 7.483026° N, 99.724994° E). The landscape of this rural, rather open lowland area is dominated by sparsely scattered houses with small gardens, small oil palm or rubber tree plantations, and wasteland. Apart from small water holes and excavations here and there, open waterbodies are scarce. However, there are a few long established, richly vegetated, shallow man-made ponds and lakes. Two small ponds (ca. 0.1 hectares together) and two larger ponds (ca. 0.5 hectares together, Fig 3A) are located very close to the resort. A lake (Fig. 3B), situated about 500 m south-west of the resort, is about 1.5 hectares. Most records were made at this site, which is surrounded by oil palm and rubber tree plantations on three sides, the other side having a number of large trees. The ponds and lake lie at an altitude of 20-22 m asl. Due to the dry season the water level of all three was rather low and parts of them were dry.

U. abbotti individuals were recorded and photographed on several occasions at these three sites between 1 January and 1 February. Most of the *U. abbotti* observations were made at the larger lake on 13, 27 and 31 January (Figs 2 & 4A). At that site at least four *U. abbotti* individuals, including a copulating pair (Fig. 2C) were once seen at the same time. In the other sites only 1 or 2 males were seen at the same time.

Altogether a total of 28 Odonata species were recorded, 21 of them libellulids. Most of these species are common inhabitants of standing freshwater in southern Thailand, but among the libellulids were also *Indothemis limbata* (Selys, 1891) and *Nannophya pygmaea* Rambur, 1842. The



Figure 1A-B. *Urothemis abbotti*, male, Trang, Thailand. 1 January 2022. Photo credits: Markku O. Tunturi.

latter is a rare species in southern Thailand, and according to Noppadon Makbun (pers. comm.) it has not previously been recorded in Trang province. At the smaller lake, *Urothemis signata insignata* (Selys, 1872) was also recorded.

Earlier records

Laidlaw (1927) described *Urothemis abbotti* based on 3 ♂ (holotype and 2 paratypes) and 1 ♀ (allotype) specimens collected in “Trong, Lower Siam” [Trang, South Thailand] by Dr W.L. Abbott. The specimens are preserved at USNM (Washington, DC). The American naturalist William Louis Abbott (1860-1936) made two expeditions to southern Thailand, the first from February 1896 to April 1897 and the second from late December 1898 to March 1899 (Taylor 2014).

Williamson (1904; 1907) reported several Odonata species collected by Abbott in “Khow Sai Dow [Khao Soi Dao] Mountain, 1000 feet, Trong, Lower Siam [Trang, South Thailand], Jan.-Feb. 1899”. However, the different label information suggests that the *U. abbotti* specimens were collected elsewhere in Trang. Laidlaw (1927) also reported from an incomplete [abdomen missing] male specimen of *U. abbotti* from Singapore, sent to Laidlaw by John Coney Moulton (1886-1926). This specimen, collected on 3 March 1921, is presently kept at the BMNH (London); see <https://www.gbif.org/occurrence/1826387004>. It should be noted here that at the BMNH there is also a male specimen from Hanoi (Vietnam) identified by F.C. Fraser as *U. abbotti*. However, this specimen is clearly *U. signata signata*; see <https://www.gbif.org/occurrence/1826387768>.

Lieftinck (1954) listed *U. abbotti* from “Siam, Malaya & Singapore I.” and remarked: “Found at many localities in the Malay States and fairly common around Singapore.” According to Matti Hämäläinen (pers. comm.), details of the records from Malay States referred by Lieftinck have remained unknown, with the exception of a single male specimen present in the collections at RMNH (Leiden). This specimen (identified by Lieftinck) was collected in Terengganu (State) in 1950. Lieftinck’s (1954) statement “fairly common around Singapore” is considered doubtful, since only one specimen from there is known (see above).

Furtado & Mori (1982, p. 289) listed *U. abbotti* among the Odonata species collected by Jose I. Furtado in Tasek Bera,



Figure 2A-C. *Urothemis abbotti*, Trang, Thailand. (A) Male, 13 January 2022. (B) Male, obelisk stance, 1 February 2022. (C) Pair in copula, 13 January 2022. Photo credits: Markku O. Tunturi.

a large freshwater swamp lake in the southern part of Pahang, between August 1971 and April 1972. Norma-Rashid & al. (2001) studied the odonate fauna of Tasek Bera in 1997-2000, but no new records of *U. abbotti* were made.

According to Choong Chen Yen (pers. comm.), two male specimens of *U. abbotti* were collected at Taman Eko-Rimba Sekayu in Terengganu by Sahirah Mohammed and Amirrudin Ahmad on 18-19 September 2020. The habitat was a pond by the edge of a forest.



Figure 3. Habitats of *Urothemis abbotti*. (A) Pond, Trang, Thailand, 28 January 2022. (B) Lake, Trang, 27 January 2022.

Identification in the field and from the photos

The range of *Urothemis abbotti* lies within that of its widespread and common congener *U. signata*, or more precisely with that of the subspecies *U. signata insignata*, the range of which includes the whole Malay Peninsula. Based on my observations, these two species can co-occur at the same sites.

It is possible to distinguish the males of *abbotti* and *signata* (here referring to ssp. *U. signata insignata*, in which the basal wing patches are narrower than in the nominate ssp. *U. signata signata*) in the field by the colour of abdomen and the markings at the wing base; cf. Figs 1, 2 & 4A and Fig 4B-C respectively. In *abbotti* the abdomen is orange red, whereas in *signata* it is brick red. Both have similar black markings on the dorsum of segments 8 and 9. In *abbotti* the base of both fore and hind wing is suffused with golden-brown, more extensively in the hind wing. Within the suffusion in the hind wing, there are two well separated, sharply defined, dark brown patches. In *signata*, the suffusion at the wing base is darker brown and less extensive, distinctly so in the fore wing. In the hind wing the darker area is uniform, not divided into separate spots. As seen in Figs 1A & 2A, in male *abbotti* the venation is reddish in the suffused area, surrounded by a ring of pale veins.

There are also other clear distinguishing characters. The colour of synthorax differs. In *abbotti* the sides of synthorax are pale yellowish-brown with two narrow, black stripes clearly visible (Fig. 4A). In *signata* the sides are reddish-brown, the black stripes rather obscure (Fig. 4C). The colour of the legs differs. In *abbotti*, the legs are distinctly bicolourous; femora are pale yellowish-brown with the apical one fourth black and tibiae pale with a black ridge. In *signata* the legs are rather uniform dark or red. The colour of the eyes also differs, in *abbotti* the basal border of the eyes has a distinct wedge-shaped pale bluish-grey section, which is clearly visible in Figs 1A, 2B and 4A. Based on several photos available on internet, in *signata* male, the eye border is only narrowly pale bluish. (In my photos this character is not clearly visible).

Unfortunately, I do not have any photo of the female *abbotti*, except the one in copula (Fig. 2C), which does not provide sufficient information to distinguish it from *signata*. According to Laidlaw (1927), female is very similar in general appearance to the male, but there are some differences in the colour pattern. My photo shows that the colour of the femora resembles that of the male, in which respect it differs from *signata* female.

Concluding remarks

Laidlaw (1927) wrote on *U. abbotti*: "One may surmise that it is an inhabitant of the mangrove swamps." However, this was a mere supposition. Based on the record from Tasek Bera and on the two recent records in

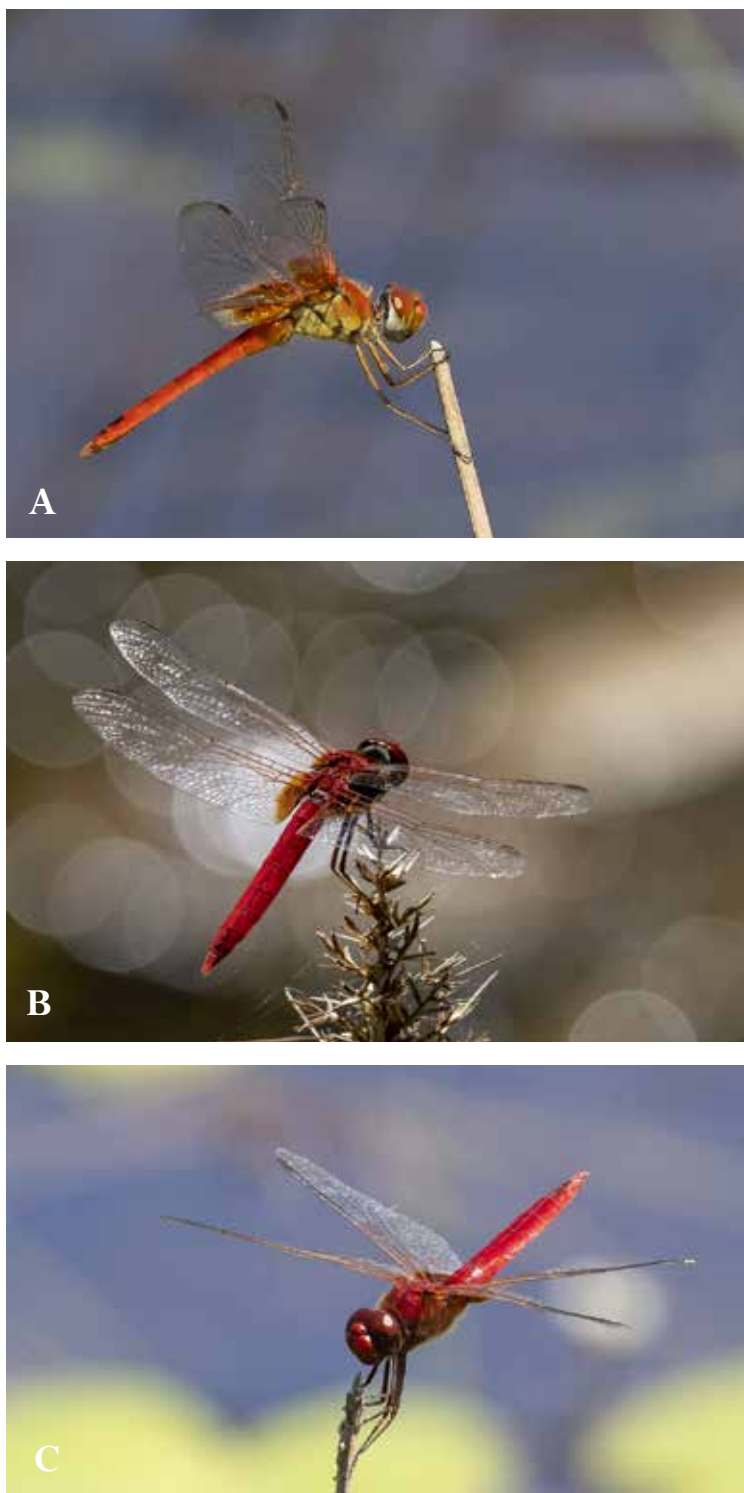


Figure 4. *Urothemis* species recorded at Trang. (A) *Urothemis abbotti* male thorax, Trang, Thailand, 27 January 2022. (B-C) *Urothemis signata insignata*, Trang, Thailand. (B) 9 January 2022. (C) 27 January 2022.

Terengganu and Trang, *U. abbotti* appears to be an inhabitant of richly vegetated ponds and lakes, as suggested by Dow (2009).

Dow (2009) concluded that *U. abbotti* may be declining, and the species was assessed as vulnerable. It is likely that *U. abbotti* has become extinct in the well-researched Singapore (Tang & al. 2010). Although, undoubtedly a very uncommon and local species, the poorly known *U. abbotti* (aptly named 'Rare Basker' in English) may be less rare in Peninsular Malaysia and southern Thailand than the few recent records suggest. The open lowland ponds and lakes in the Malayan Peninsula – swelteringly hot places on sunny days – are without doubt much less favoured hunting grounds by collectors and photographers than forest streams and other, more shaded places. Could this be one reason for the paucity of records of this species?

Acknowledgements

Dennis Farrell helped me to identify the species in my dragonfly photos during my stay in Thailand. His early comment that I may have *Urothemis abbotti* among my photos, encouraged me to work even harder in the field. Later, Matti Hämäläinen confirmed the identity of this species. Matti also provided me with much relevant information and various publications. Moreover, he unselfishly and thoroughly edited and reorganized my preliminary report (aimed at publication in a blog), adding to its content, and turning it into publishable form. Noppadon Makbun, Choong Chen Yen, Robin Ngiam, Rory Dow and Max Caspers, provided information on the past or recent records (the last four of them via Matti Hämäläinen). Philipp and Maggi Karch made my and my wife's life easy and comfortable in the Thai Break Resort, enabling me to concentrate on what is fundamental in life: observing Odonata. Albert Orr kindly edited the text and improved the English expression. I am grateful to all of you who made it possible for me to publish this report on *Urothemis abbotti*, my favourite dragonfly species.

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***Pantala flavescens* collections 2022 Request for material**

Keith Hobson [khobson6@uwo.ca]

The application of stable H isotope techniques to tracking *Pantala flavescens* to natal origins is becoming more and more popular and gives us a tool previously unavailable. The basis of this approach is that the isotopic ($\delta^2\text{H}$) value of the inert wing chitin of this dragonfly can be linked to continental origins based on known long-term precipitation isotope patterns. However, key to the development of this tool is establishing an arithmetic calibration algorithm between the isotope value of water where the larvae was grown and the wing of the emergent adult. It is not clear how well current algorithms, based on dragonflies with long larval stages, can be applied to this species with its short (ca. 6 week) larval stage.

Dr Hiroshi Jinguji is currently experimenting with raising *P. flavescens* in the laboratory on known isotopic waters. He will be measuring water isotope values and those of the wings of emergent adults as well as the exuvia material. However, it would be extremely valuable to compare actual wild data to this effort, especially from a number of widely distributed sites. As such, the following material would be exceptionally helpful.

1. Ideally, water, exuvia and adult wing material corresponding to successful emergence at any given site. OR
2. Just adult wing material from adults emerging from a known site AND/OR exuvia of this species that can be linked to that location.

Note: The water should be stored in a small vial (say 15-25 ml plastic or glass) filled to the brim and kept in a refrigerator but NOT frozen. Adult wings and exuvia could be simply kept dry in an envelope at room temperature. Please record latitude and longitude or GPS coordinates and description of the waterbody (e.g. permanent or ephemeral).

I would be most grateful if you would send samples and data to:

Dr Keith A. Hobson, Ph.D., FRSC.

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Figure 1. Wandering Glider (*Pantala flavescens*) roosting from Koottanad Palakkad, Kerala, India, 9 October 2020. Photo credit: Shino Jacob. Wikimedia Commons [[Link](#)].

Profile of Thursley Common – A *Dragonfly Hotspot* in the UK

Keith DP Wilson [kdpwilson@gmail.com]

Thursley Common, 8 km southwest of Godalming, Surrey, England (51°09'N 00°42'W), and its surrounding heathlands, represent some of the finest remaining heaths in southern England. The site is of national importance for its bird, reptile and invertebrate populations, especially dragonflies. It has been designated as a *Dragonfly Hotspot* by the British Dragonfly Society (BDS).

The area has never been developed for agriculture due to its infertile, acidic soils that are either strongly gritty and sandy or leached, podzolic soils lying, respectively, over the Folkestone and Sandgate Beds; both strata of Lower Greensand. Open heath developed at Thursley following Neolithic (4300 BCE to 2000 BCE) clearance of woodland establishing a range of heathland communities from dry heath through humid and wet heath to mire, dominated by heathers and bog-mosses. A deep layer of peat has developed from the accumulated remains of bog-moss (*Sphagnum* spp.). Today, there is a wide variety of habitats at Thursley ranging from heathland, mixed woodland, permanent grassland and bogs to open water habitats including acidic boggy pools, ditches, ponds and small lakes.

The conservation value and ecological quality of the Thursley mire complex have long been appreciated. Thursley Common and neighbouring heathlands have received many formal designations to officially recognise their importance and help protect them from development. In 1955 Thursley Common and two nearby commons were designated a Site of Special Scientific Interest (Thursley, Hankley and Frensham Commons SSSI, 1838 ha).

In 1977 a two volume study titled: *A Nature Conservation Review* was published by Cambridge University Press (Ratcliffe, 1977). The main purpose of the Review was to identify the most important places for nature conservation in Great Britain. Volume 1 set out in detail a comprehensive rationale and an explanation of the methodologies adopted in the site selection process and in Volume 2 an ecological description of each site selected was provided. The Review identified 735 key representative sites of Britain's principal habitats comprised of coastal sites, woodlands, lowland grasslands, heaths and scrub, open waters, peatlands and upland grasslands and heaths. Thursley was selected as a Grade 1 habitat to represent lowland heaths in the United Kingdom. Following the Review's publication Thursley was subsequently designated a National Nature Reserve (NNR, 323 ha) in July 1978 with small parcels of land added in September 1984.

In February 1994 Thursley Common & Ockley Bog were designated as a Ramsar site (265 ha) and in 2001 Thursley and a large surrounding area of heathland was established as an EU Natura 2000¹ site (Thursley, Ash, Pirbright and Chobham Special Areas of Conservation (SAC, 5138 ha, EU Code: UK012793). For the EU Natura 2000 designation the site is considered to represent one of the best areas in the United Kingdom

¹ Natura 2000 is a network of core breeding and migratory stopover sites for rare and threatened species, and some rare natural habitat types which are protected in their own right. It stretches across all 27 EU countries, both on land and at sea. The aim of the network is to ensure the long-term survival of Europe's most valuable and threatened species and habitats, listed under both the Birds Directive and the Habitats Directive.

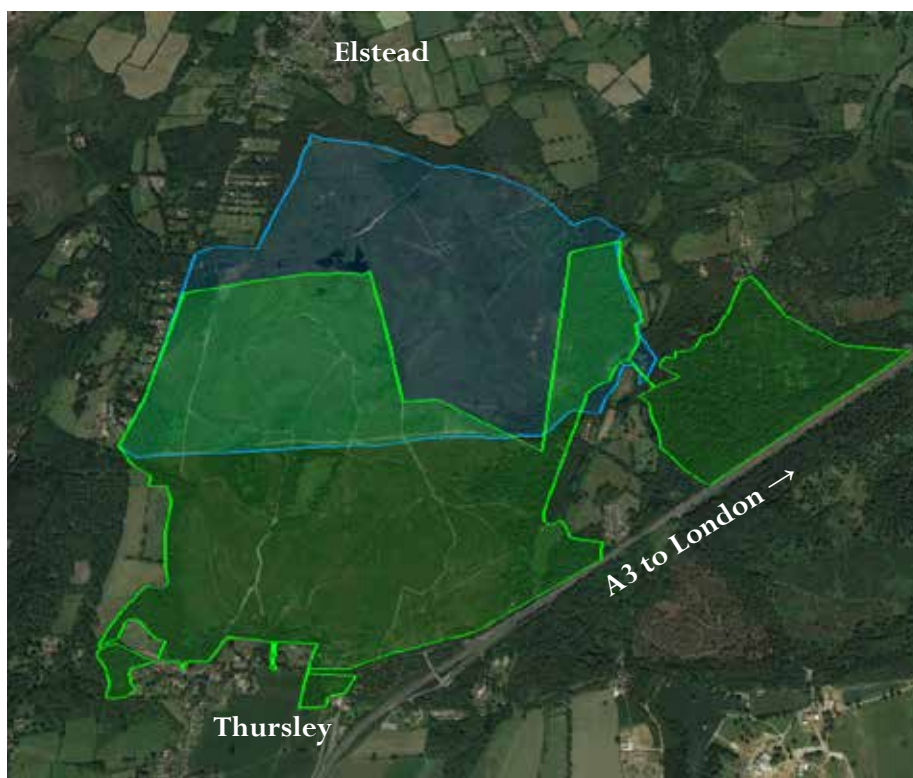


Figure 1. Pale green denotes the area designated Thursley National Nature Reserve, Surrey, UK. The pale blue area marks the Thursley Common & Ockley Bog Ramsar site.



for northern Atlantic wet heath, dominated by Cross-leaved Heath (*Erica tetralix*). Specifically, the site supports depressions on peat substrates of the Rhynchosporion character² for which Thursley is considered to be one of the best areas in the United Kingdom.

On 22nd August 2019 the British Dragonfly Society (BDS) officially launched Thursley Common as a *Dragonfly Hotspot* with speeches given by the society's Records Officer, David Hepper and special guests invited from Natural England³, namely Lord Blencathra (Deputy Chair) and David Askew (Director Evidence). Natural England's Deputy Chairman Lord Blencathra said: 'It's fantastic to receive this badge of honour from the British Dragonfly Society. Recognition as a *Dragonfly Hotspot* will make Thursley an open secret, helping to put it on the map for the rich and varied wildlife that call it home, while opening up opportunities for



² Summary of EU Natura 2000 Rhynchosporion habitat (7150) [Link]. Depressions on peat substrates of the Rhynchosporion pioneer communities of humid exposed peat or sometimes sand, with White Beak-sedge (*Rhynchospora alba*), Brown Beak-sedge (*R. fusca*), Oblong-leaved Sundew (*Drosera intermedia*), Round-leaved Sundew (*D. rotundifolia*), Staghorn Clubmoss (*Lycopodiella inundata*), forming on cutover. Includes areas of blanket or raised bogs, but also on naturally seep- or frost-eroded areas of wet heaths and bogs, in flushes and in the fluctuation zone of oligotrophic pools with sandy, slightly peaty substratum (European Commission 2007). These communities, which are rare at European scale, have a short-lived existence and occur in fragmentary stands.

³ Natural England is the UK government's adviser for the natural environment, helping to protect England's nature and landscapes for people to access and enjoy. It is a non-departmental public body mainly funded by Grant in Aid (90%) provided by the Dept. for Environment, Food and Rural Affairs.



Figure 2. Thursley Common, 22 June 2022. (A) Mire habitat with acidic boggy pools. (B) Bog margin with bog-moss (*Sphagnum* spp.) and Hare's-tail Cotton-grass (*Eriophorum vaginatum*). (C) Boardwalk crossing the mire habitat.



Figure 3. (A-C) Thursley Common, dragonfly sculpture perched on a former electricity pylon, 22 June 2022. The sculpture was designed and created by Lucy Quinnell and Adam Boyde. The artwork took eleven weeks to make and was erected in August 2016. The finished dimensions of the sculpture are 1.57 m long by a wingspan of 1.2 m.

people to engage and learn from it'. BDS *Dragonfly Hotspots* are sites carefully chosen by the society as ideal places for odonate species to live and thrive. Thursley was the fourth Dragonfly Hotspot site to be declared in the UK by the BDS.

Thursley is less than an hour's travel from central London and is very popular with nature enthusiasts, cyclists and walkers. The boggy areas can be accessed by a raised boardwalk, built in 2012 with the help of Thursley's volunteers (Fig. 2C). The boardwalk forms part of a 1.3 km easy access Dragonfly Nature Trail, allowing visitors to take in the varied landscape supported by interpretation boards and viewing areas, including 3D etched panels for the visually impaired (Fig. 6). Sadly, parts of the boardwalk trail are currently inaccessible due to damage caused by a serious fire that took place in May 2020. Work is ongoing to rebuild damaged sections of the boardwalk, which should be completed in late 2022.

There is a very impressive and striking metal dragonfly sculpture (Fig. 3) on the trail, that was designed and created by local sculptor Lucy Quinnell and blacksmith husband Adam Boyde. The darter dragonfly sculpture is perched on the top part of a former electricity pylon. A series of pylons used to dominate the Thursley Common landscape before they were all replaced with underground cables. The sculpture is made from 316 stainless steel, which was electropolished to really make the dragonfly shine.

Twenty-six dragonflies can be observed at Thursley; not a huge number by tropical standards, but this figure represents almost half the total number of odonates recorded in the UK, which is 57. I remember encountering the White-faced Darter (*Leucorrhinia dubia*) at Thursley Common in the early 1980s but this species has declined over the past 35 years and had disappeared from Thursley by the 1990s⁴. Indeed, it is no longer recorded in southern UK. Its preferred habitat of oligotrophic peat bog pools with semi-submerged sphagnum moss rafts is still found but this Holarctic species appears to be retreating northwards and declines have occurred throughout much of its southern range in southwest Europe, perhaps as a result of climate change.

Thursley Common is also part of the Wealdon Heath Important Bird and Biodiversity Area (IBA) designated by BirdLife International in 2007⁵. Prior to 2007 Woolmer Forest and Thursley were treated as separate IPAs. Thursley is a key site in the UK for breeding heathland birds, notably

4 Trevor Beebe, 2018. *Climate Change and British Wildlife*. Bloomsbury Publishing Plc, London.

5 Important Bird Areas in Europe – United Kingdom, the Channel Islands and the Isle of Man pp 715-820 (In: Heath, M.F., Evans, M.I., Hoccom, D.G., Payne, A.J. and Peet, N.B. (eds) (2000) *Important Bird Areas in Europe: priority sites for conservation*. Volume 1: Northern Europe Cambridge, UK: BirdLife International.



Figure 4. A selection of commonly occurring dragonflies representing the eight different families found at Thursley Common. A total of 26 dragonflies are currently recorded at the site.

Dartford Warbler (*Sylvia undata*, Fig. 5B), Eurasian Nightjar (*Caprimulgus europaeus*), Woodlark (*Lullula arborea*, Fig. 5C), Tree Pipit (*Anthus trivialis*) and Hobby (*Falco subbuteo*, Fig. 5A). The moorland breeding European Curlew (*Numenius arquata*) also successfully nests. In recognition of its important breeding heathland birds the site forms part of the EU designated Thursley, Hankley & Frensham Commons Special Protection Area (SPA, 1870 ha, 2002, EU code: UK9012131).

The Hobby is a specialist feeder on large insects and hirundines. Several pairs breed at Thursley Common and the surrounding Surrey heaths. Sizeable insects, especially dragonflies, supplement the Hobby's diet before egg-laying and when the fledged young are learning to hunt⁶. The falcons can be seen hunting for dragonflies and Swallows (*Hirundo rustica*) over the mire and large bodies of water at Thursley (Fig. 5A).

Six native reptile species occur including Smooth Snake (*Coronella austriaca*) and Sand Lizard (*Lacerta anguils*). Also, for the UK, there is a very high diversity of invertebrate species, especially in the dry heath areas. There are several species considered rare in the UK. Thursley is regarded as one of the top UK sites for ground nesting Hymenoptera (bees, wasps and ants). The European Beewolf (*Philanthus triangulum*)—a solitary wasp specialising in hunting honey bees—was recently considered rare in the UK, but is now locally common (Fig. 5E). Twelve species of Orthoptera (grasshoppers and crickets) can be found including the nationally rare Large Marsh Grasshopper (*Stethophyma grossum*). The UK Biodiversity Action Plan (BAP) species, Hornet Robberfly (*Asilus crabroniformis*) is regularly recorded at Thursley (Fig. 5D). Other notable invertebrates include Silver-studded Blue (*Plebejus argus*), Grayling (*Hipparchia semele*), Wood Tiger-beetle (*Cicindela sylvatica*), Mottled Bee-fly (*Thyridanthrax fenestratus*) and Fen Raft Spider (*Dolomedes fimbriatus*).

In early summer bright purple Early Marsh-orchids (*Dactylorhiza incarnata puchella*, Fig. 5F) abound in the damp bog margins amongst the white plumes of Hare's-tail Cotton-

⁶ Parr, S. J., 1985. The breeding ecology and diet of the Hobby *Falco subbuteo* in southern England. *Ibis* 127: 60-73.



Figure 5. (A) Eurasian Hobby (*Falco subbuteo*) with captured dragonfly in its talons, Borit, Gojal, Gilgit-Baltistan, Pakistan. Photo credit: Imran Shah [Link]. (B) Dartford Warbler (*Sylvia undata*), Thursley Common, 3 June 2022. (C) Woodlark (*Lullula arborea*), Thursley Common, 3 June 2022. (D) Hornet Robberfly (*Asilus crabroniformis*), Thursley Common, 7 August 2018. Photo credit: Glenn Alder. (E) European Beewolf (*Philanthus triangulum*), Thursley Common, 22 August 2019. Photo credit: Glenn Alder. (F) Early Marsh-orchid (*Dactylorhiza incarnata puchella*), Thursley Common, 3 June 2022. (G) Bog Asphodel (*Narthecium ossifragum*), 4 August 2020.



grass (*Eriophorum vaginatum*). Later, swathes of bright yellow Bog Asphodels (*Narthecium ossifragum*) flourish (Fig. 5G) in the wet flushes and bog margins. Other mire plants of note include Cranberry (*Vaccinium oxycocco*), Brown Beak-sedge (*Rhynchospora fusca*), Stagshorn Clubmoss (*Lycopodiella inundata*), Bog-bean (*Menyanthes trifoliata*), Bog-myrtle (*Myrica gale*), Marsh St John's-wort (*Hypericum elodes*), Bog Pimpernel (*Anagallis tenella*), Bog Hair-grass (*Deschampsia setacea*), and Royal Fern (*Osmunda regalis*).

Several insectivorous plants can be found in the oligotrophic waterbodies and wet nutrient deficient soils. These include Lesser Bladderwort (*Utricularia minor*), Long leaved Sundew (*Drosera intermedia*), and Common Sundew (*Drosera rotundifolia*). Figure 6D depicts Common Blue Damselflies (*Enallagma cyathigerum*) being slowly digested by a sundew.

Grazing by cattle was re-introduced to Thursley NNR in 2009, after an absence of some 90 years, to help reduce natural succession of the open heath areas to scrub and woodland. In partnership with Surrey Wildlife Trust a herd of black and white Belted Galloway cattle are deployed for conservation grazing. This hardy breed of cattle, originating from the lowlands of Scotland, will eat tough scrub and coarse grasses avoided by most other breeds of cattle.



Figure 6. Natural England information boards along the 1.3 km easy access Dragonfly Nature Trail, 22 June 2022. (A) General information panels, highlighting Hobby and Dartford Warbler. (B) Board describing the 12 most commonly encountered dragonflies at Thursley Common. (C) British Dragonfly Society *Dragonfly Hotspot* information board sponsored by the John Spedan Lewis Foundation. (D) Common Blue Damselflies (*Enallagma cyathigerum*) being consumed by Great Sundew (*Drosera anglica*), Duck Lake, Oregon, 20 July 2005. Photo credit: Noah Elhardt [Link].



**‘A tall “jungle-man” with deep-set, feverishly burning eyes’ –
a portrait of Wilhelm Stüber (1877-1942), and further notes
on the collector extraordinaire of New Guinean dragonflies**

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In the July 2016 issue of *Agrion* there appeared an article: *Wilhelm Stüber (1877-1942) collector extraordinaire of New Guinean dragonflies, discoverer of the fabulous Sepik blue orchid, tragic victim of war* (Hämäläinen & Orr 2016).

Between the years 1930-1939 Stüber collected a total of ca 13,800 odonate specimens from the Hollandia [Jayapura] area in north-east Dutch New Guinea. These he sent to Maurits Anne Lieftinck (1904-1985), then stationed in Buitenzorg [now Bogor], Java. These collections represented ca 165 species, including 92 species that Lieftinck described as new, along with 10 new subspecies, nearly all of which were published in his 1932-1949 seven-part monograph of New Guinean odonates. It is clear that Wilhelm Stüber's assiduous collecting activity was key to enabling Lieftinck to become the leading authority on New Guinean dragonflies and damselflies.

A newspaper article on Stüber in 1934

For the 2016 article, the authors (MH and AGO) searched in vain for a photograph of Wilhelm Stüber. Not even his living descendants could provide one. However, in May 2021 the authors were pleased to receive an email from Marc Argeloo (Haarlem, the Netherlands), who sent a Dutch newspaper article from the year 1934 (Voorhoeve 1934), which included a sketch portrait of Stüber (Fig. 1). The article titled (translated) *Visiting Captain Stüber – The acquaintance of Jack London* was written by Rudolf Voorhoeve (1896-1982), a Dutch adventurer and author, who, with one of his companions, first visited Stüber for two nights, probably in early 1930, at his plantation at Pim, near Hollandia town. The article was part of a series on a gold prospecting expedition made by three men in which Voorhoeve participated. Voorhoeve had arrived in New Guinea sometime in 1929 (probably between March and June) and he left at the end of 1931 (see below).

Voorhoeve's first impression of Stüber on the front veranda of his house, was one of some amazement. He wrote (translated) ‘Grimm [one of the members of the expedition] was already standing on the front veranda by Stüber and had apparently noticed us. Stüber himself, a tall “jungle-man” with deep-set, feverishly burning eyes, looked as though I could push him into a corner with my finger. Great was my astonishment when [rising], he took from us in one hand an 80 kg package, with which Pen [another expedition member] and I were struggling between us to hold out to him, and set it down a little further, without any noticeable effort.’

Being cut off from the outside world for years, Stüber was always pleased to receive western visitors, and the men sat down to talk for several hours, smoking and drinking lemon water. Stüber didn't care so much for outside news, but listened with great interest to Voorhoeve's stories about hunting elephants and other big game in Sumatra. ‘In the wild we came upon the human inhabitants and I could not tell him enough about the different inhabitants of the interior of Palembang.’ Then it was Stüber's turn to talk. Voorhoeve – who after a few years, when back in the Netherlands, begun his career as the author of adventure books set in the New Guinean



Figure 1. A sketch portrait of Wilhelm Stüber by an unspecified artist in the newspaper article by Voorhoeve (1934). The text reads: “The jungle-man tells.”

and Sumatran jungle – was especially impressed by Stüber's knowledge of Jack London's books. He wrote '... the hours flew by under his stories, for the terrain with which he acquainted us, we only knew through Jack London's books. Stüber appeared to have known this writer personally and knew several details about the heroes of his stories which are not mentioned in the books'. The romantic islands of the South Pacific no longer held many secrets for Stüber, having tossed about in his own schooner for more than twenty years. We listened open-mouthed and it was well past midnight when we finally crawled into our mosquito nets.'

Of course, Stüber could never have personally met Jack London, but his excited imagination made it easy for him to add details about the heroes in London's books. Stüber himself had written a manuscript of over 100 handwritten pages (sent to Lieftinck for comments in February 1931) on his travels in New Guinea and later also other shorter manuscripts of various topics. His manuscripts included much that was pure fantasy, at times touching on erotic themes (see Hämäläinen & Orr 2016, p. 75).

It is certain that the drawing of Wilhelm Stüber was executed in the Netherlands by an artist who had never met him, so one might doubt its accuracy. However, we sent a copy of the drawing to Stüber's grandson Dave Fransz, who showed it to his mother Ida Rosalie (Stüber's daughter, born in the late 1920's). She stated that she saw in it a strong resemblance to her father. Judging from her reaction, we wonder if the artist based his sketch on a photograph. Dave Fransz told us that he knew of a photo of Wilhelm Stüber, but unfortunately, he has not yet managed to locate it in his mother's house.

'Captain Moth' showing his dragonfly catch to Voorhoeve, and waiting for a letter from Lieftinck

The third author (MA) discovered several notes on Wilhelm Stüber in Voorhoeve's archives, which included unpublished manuscripts, memoirs and other documents. After their first meeting, which was recounted in the newspaper article, the two men met several times and became friends. In his memoirs Voorhoeve jocularly called Stüber "Captain Moth". Doubtless Stüber had told Voorhoeve of his earlier efforts collecting butterflies and moths for a Dutch amateur entomologist, but perhaps he was unaware of this new nickname.

During Voorhoeve's stay (1929-1931), Hollandia town was no more than a collection of simple wooden huts. The first visitors ('colonists') from western countries were looking for company, and Voorhoeve and Stüber loved sharing their experiences and 'making plans for a trek'.

As noted in Hämäläinen & Orr (2016, pp. 70-73), Stüber was paid rather inadequately for the scientifically priceless dragonfly collections he amassed for the Buitenzorg Museum, and eventually disputes arose over the remuneration he was receiving. By July 1931 he had already sent eight shipments, but had so far only been paid for the first three. The Great Depression had by then reached the Dutch East Indies and the museum no longer had money to pay for them. However, since M.A. Lieftinck was eager for more material, later he began paying Stüber privately.

Voorhoeve was clearly aware of this as he mentions the miserly payments on two occasions in his memoirs. We present here the relevant extracts of these incidents, which must have taken place in 1931 (translated from Dutch).

A meeting at Stüber's plantation

"You will be pleased to find me at home", said Stüber, "because I have just returned from a trip up [country] and I have found beautiful new species; they will be amazed at Weltevreden [here meaning a well-to-do neighbourhood in the south of Batavia, present-day Jakarta]. If they express their surprise in big money orders, it might still be good." The new species he was speaking about were entirely new species of dragonflies, which he had collected for the Buitenzorg Museum [in present day Bogor]. With each mail delivery he receives enthusiastic letters about the splendid finds: "it is the most beautiful collection ever brought together" and "science will be eternally grateful to him", but nowadays they send such small amounts [of money] that these payments are by no means sufficient to cover the expenses incurred on the trips.'

'But Stüber was a bit vain, and over there folk knew very well how to prey upon that vanity. Stüber showed me his new finds and mentioned names of dragonfly families they resembled, but to which they didn't actually belong, because as you see.... And then followed [an exposition on] all kind of peculiarities which I would not have noticed and which in fact did not interest me, because I knew nothing about it, but about which he himself was so childishly delighted that I did not dare tell him this and only pretended to be interested. Then he carefully put away his dragonflies again and quietly lit his pipe, inviting me to tell him another episode from my life. He was always most interested in hunting stories, in which the habits of humans and animals came to the fore.'

1 In 1908 Jack London and his wife Charmian Kittretche London visited Guadalcanal and a few other southern islands within the Solomon Islands for about four months at the end of their Pacific voyage in the yacht 'The Snark'. It seems that most westerners they met in the Solomon Islands are named, including several sea captains. However, as expected, the published detailed daily log entries of this voyage do not mention 'Captain Stüber' (then residing in German New Guinea, 1,600 km away).

A meeting at Post Office

'This time the post had finished the sorting early and the window through which the letters were distributed, was already open. A group of eager settlers milled around. I met my friend Captain Moth yearning for an answer from the museum in Buitenzorg about his latest shipments of dragonflies and the payment for them. We sat together on the edge of the concrete gallery and made plans for a journey which we will undertake inland. ... Stüber! [shouted the deliverer] – he sprung up with a swiftness one would not expect at his age – a signed letter from the museum. With fingers, trembling with excitement, he tore open the envelope and, first of all, [I saw] a banknote disappearing swiftly into his breast pocket. Then he deciphered the contents of the letter with visible pleasure. He had had great success with his insect collection, but the financial results were far from proportionate to the services he had rendered to science.'

An American millionaire visits Hollandia and hires Stüber to collect orchids

Just after Christmas 1931, the wealthy American businessman Julius Fleischmann, Jr. visited Hollandia for 2-3 days. Fleischmann and his family were on an eight month cruise in the Pacific with their luxury yacht – the *Camargo*, which had the reputation of being the most expensive luxury yacht in the world at that time. Fleischmann met both Voorhoeve and Stüber, and both of them benefited from his visit.

Fleischmann (1935, pp. 148-149) wrote the following in his book 'Footsteps in the sea': "We went ashore at Hollandia and found nothing but a group of nondescript shacks occupied by Malays and Chinese storekeepers. Before the exportation of bird-of-paradise feathers was prohibited, Hollandia boomed as the headquarters of the trade, but with its decline the town died a natural death. In the afternoon we went about six miles down the harbour and climbed a mountain road to a pass from which we obtained a magnificent view of the entire bay on one side and the back country on the other. Captain Small and Mynheer Voorhoeve went down to see Mr. W. Stüber, a former seafaring man who has a good knowledge of the coast, and our skipper got some information from him. The rest of us returned to the launch and went over to the village of Tobadi." ... "We returned to the other side of the bay to pick up the Captain and Mynheer Voorhoeve. Herr Stüber returned to *Camargo* with us and before the evening was over, various decisions had been made. Mynheer Voorhoeve was to accompany us to Java. On the way he would interpret for us in the islands, his knowledge of Malay equalling that of his mother tongue. Herr Stüber was to depart early in January on an inland expedition², financed by us, to secure a black orchid and thirty other species of unknown plants of the same family for our collection, an expedition which would occupy a month and necessitate the services of ten bearers. The next morning Dorette, Tom and I went to see Herr Stüber's orchid collection and to make final arrangements for the expedition. It was quite a walk up to the mountain and down the other side, but to one interested in these plants it was decidedly worthwhile, for the branches of the trees were full of collected specimens, while hundreds more hung on racks in the deep shade underneath."

Voorhoeve wrote in his memoirs that he became ill before his departure from New Guinea to Java (on board *Camargo*) and Stüber took care of him. Before leaving he exchanged some of his belongings, including a sewing machine and two guns, for Stüber's ethnographic collection. The collection included various New Guinean native artefacts, such as spears, arrows and trophy heads. En route to Java, Fleischmann purchased this collection from Voorhoeve for \$US 500 (the equivalent of more than \$US 9000 today). Presumably, Stüber never learned what a poor deal he had made in his exchange with Voorhoeve! The collection is now preserved in the Cincinnati Museum Center, among other material acquired by Fleischmann during his cruise.

Acknowledgements. Marc Argeloo thanks Marina Voorhoeve (daughter of Voorhoeve) and Menno Huizinga (grandson of Voorhoeve) for providing access to Voorhoeve's archive. We are grateful to Dave Franz (grandson of Wilhelm Stüber) for valuable information.

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2 During this expedition to the Lake Sentani area (ca 100-120 km SW of Hollandia) in January 1932, Stüber also collected dragonflies for Lieftinck. Lieftinck's archives include a list of 35 species (227 specimens) collected there. The lot included specimens of three undescribed damselfly species, among them a long series of a colourful species presently known as *Nososticta callisphaena* (Lieftinck, 1937).

**Range extension of an endangered Sydney Hawk Dragonfly
Austrocordulia leonardi (Anisoptera, Libelluloidea incertae sedis)
population in the Nepean River, near Sydney, Australia**

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Abstract A targeted survey for exuviae of the Sydney Hawk Dragonfly *Austrocordulia leonardi* Theischinger, 1973 was undertaken along the Nepean River and Cataract River in the Sydney basin, over four days in December 2021. The aim of the survey was to determine if the population of *A. leonardi* occupied riverine habitats upstream from its known location at Maldon Bridge and downstream to Menangle weir. Where accessible, riverine emergence structures were inspected using an inflatable boat as transport. However due to instream barriers several sections of river and habitats were navigable only by foot. A total of 324 *A. leonardi* exuviae were recovered from emergence habitats spanning 26km of the Nepean River, and seven *A. leonardi* exuviae were recovered from the lower reaches of the Cataract River, representing a new river system in which the species resides. Additional inspections undertaken in Kangaroo Creek in December 2019, 2020 and 2021, and the Woronora River in December 2019 indicate that the species is either present in other previously known locations in very small numbers or not at all.

Introduction or History of discovery

Adults and exuviae of *A. leonardi* were first discovered from a weir pool in the Woronora River near Heathcote in 1968, which provided the type locality and specimens from which the species and habitats were described by Theischinger (1973). By this time, the species had also been recorded from Kangaroo Creek at Audley, and in 1980 the species was discovered in the Nepean River at Maldon bridge where it was thought to be common (Theischinger & Watson 1984; Theischinger 1997). In the early 2000's, an early instar larva was found in the Karuah River, which provided an indication that the species exists north of the populations south of Sydney (Theischinger et al. 2013). Extensive sampling and targeted searches failed to detect the presence of *A. leonardi* from other seemingly suitable locations, and the species was listed as endangered under the NSW *Fisheries Management Act 1994* in 2007, owing to its extremely limited distribution and rarity (Theischinger et al. 2009). In light of the threatened species listing, targeted searches were undertaken by experts in the 2008-2009 emergence season in several locations considered suitable based on the available habitat descriptions, which yielded new evidence of a population occurring in the Georges River catchment near Campbelltown (Theischinger et al. 2009). Whilst *A. leonardi* larvae had previously been found in the Georges River near Campbelltown in 1997 and 1998 during routine Sydney Water compliance monitoring, these specimens were not confirmed by an expert until 2014, seven years after the species was listed. This was followed by a single adult female being discovered along the Chichester River by Dutch odonatologist Vincent Kalkman, which confirmed the existence of the species north of the populations south of Sydney (Theischinger et al. 2013). In May 2019, four larvae were found at the Maldon Bridge site, and a single *A. leonardi* larva was found during a targeted search for the species in the Nepean River below Menangle weir, around 22km downstream from the only known location in the Nepean River at Maldon Bridge (Grieve & Theischinger 2020).

Targeted surveys for *A. leonardi* exuviae were also undertaken by the first author in the Woronora River in December 2019 and annually in Kangaroo Creek between December 2019 and December 2021. While the December 2019 surveys yielded no records of *A. leonardi* at either location, one exuvia of *A. leonardi* was recorded from Kangaroo Creek in 2020 (compared to 33 of its congener *A. refracta* in the same year and 61 *A. refracta* in 2021). In April 2022 the Threatened Species Scientific Committee listed the *A. leonardi* as endangered under the national *Environment Protection and Biodiversity Conservation Act 1999*.

2021 Nepean River Survey Methods

Figure 1 shows the survey locations for the December 2021 Nepean River survey. The Nepean River study area covers a distance of 34km between the upstream Site 1 and downstream Site 4. An inflatable boat equipped with a 4hp outboard motor was used to navigate suitable stretches of riverine habitats. In sections where boat access

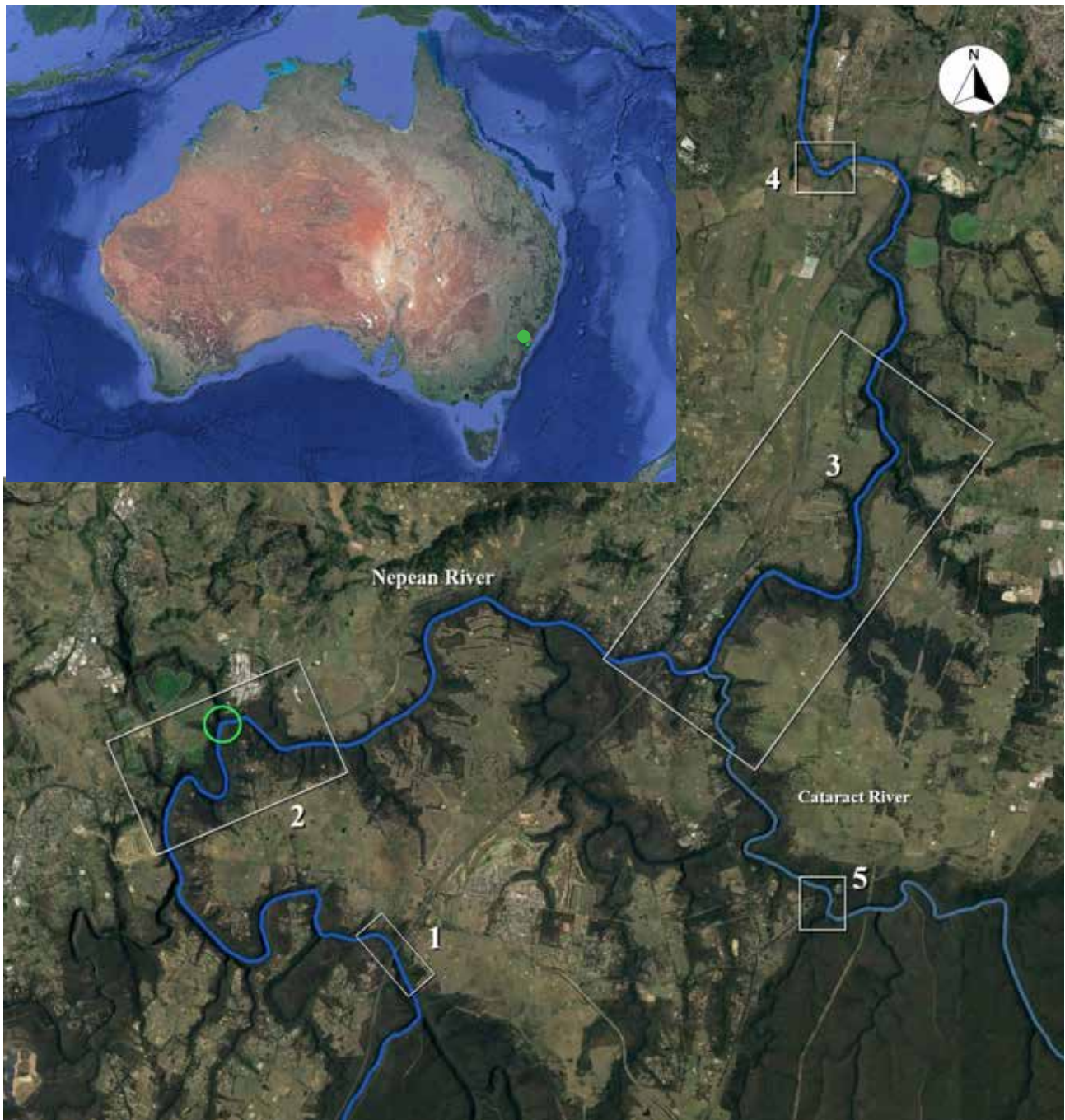


Figure 1. Nepean River study area from upstream (Site 1) to downstream (Site 4) including the length of Cataract River (Sites 3 and 5), and the original study area and known distribution of the Nepean River *A. leonardi* population (green ring).

was restricted due to boulder rock cascades, riffles or shallow depths, targeted surveys were undertaken by foot along the riparian corridor and by wading. At each site, edge banks and outcrops were inspected for exuviae with particular focus on the known ‘preferred’ emergence structures (sandstone bedrock outcrops), however other emergent edge bank structures were also inspected (e.g. vegetation, logs, concrete).

Note that targeted searches were not exhaustive throughout the site lengths, as suitable emergence structures were checked on both sides of the river with the intention of covering as much distance as possible (i.e., targeted searches were not undertaken along every metre of edge bank within a location). In addition to *A. leonardi* specimens, exuviae of the morphologically similar Eastern Hawk Dragonfly (*A. refracta*) were also collected throughout the survey.

Results

Table 1 shows the total number of sexed *A. leonardi* and *A. refracta* exuviae recorded from the individual site emergence habitats, including the length of sites inspected, as shown in Figure 1.

Table 1. Numbers of *Austrocordulia exuviae*

Location	River	River Length (m)	<i>A. leonardi</i>		<i>A. refracta</i>	
			Male	Female	Male	Female
Site 1	Nepean R.	480	0	0	10	12
Site 2	Nepean R.	4550	91	102	3	6
Site 3	Nepean R.	8600	61	58	2	2
	Cataract R.	700	2	4	5	4
Site 4	Nepean R.	400	6	6	0	0
Site 5	Cataract R.	310	0	1	54	48

The results from the targeted survey are as follows:

- Whilst there were subtle spatial differences in the ratios of male to female exuviae, the overall composition of gender for the entire Nepean River study area was roughly equal (49% and 51% respectively).
- Only 3% of the number of exuviae were recorded on emergence structures other than sandstone boulders or bedrock, which included riparian *Casuarina* tree trunks, emergent logs and vegetation (mat-rush *Lomandra longifolia* leaf blades).
- Around 97% of exuviae were found on sandstone surfaces that ranged from vertical to overhanging horizontal surfaces (i.e., cave roofs), with the remainder being found on surfaces just less than vertical.
- Throughout the survey, most of the *A. leonardi* exuviae recorded from the Nepean River sites were positioned within 50cm of the water surface, however the only specimens found in the constricted (gorge) sections of Site 2 were positioned much higher (1.5 to 1.8m above the water surface).
- *A. leonardi* adults were observed on the wing at Site 2, and there were two adult males caught at Maldon weir on the 15th December. Unfortunately, the sampling days were mostly cloudy, and the overall activity of adult Odonata was low.

Discussion

Previous targeted searches for *A. leonardi* have involved navigating riverine riparian and aquatic habitats by foot and by wading or swimming. Accessing riverine habitats by boat yielded consistent recoveries of exuviae, however whilst this method is much more efficient than the former, it is restricted to river sections with open pools of sufficient depth. The main findings and thoughts from the current survey and how they relate to ecology are as follows:

- The *A. leonardi* population range was found to extend throughout the Nepean River between Myrtle Creek confluence and Menangle Rd bridge crossing and to extend from the Nepean River into the lower limits of the Cataract River.
- It appears as though *A. refracta* may replace *A. leonardi* at the distributional limit of its population range in the Nepean River and possibly the Cataract River, and that in river systems where *A. leonardi* has been noted previously as common (Woronora River and Kangaroo Creek), *A. refracta* is now the dominant species according to the number of exuviae found on emergence structures.
- The resident Nepean River *A. leonardi* population has been subjected to extreme weather events over the past four years including intensification of drought conditions 2018 to 2019, and subsequently above average rainfall conditions in 2020 and 2021 with multiple flood events. During the December 2021 survey, several *A. leonardi* exuviae were recorded from a constricted section of the Nepean River just below Maldon weir which was subjected to flooding and powerful turbulence in March 2021 (Fig. 2A).
- The vast majority of exuviae were recovered from vertical or overhanging sandstone surfaces. This needs to be taken into account when planning or conducting targeted searches or habitat assessments for detecting *A. leonardi*, as sections of river with no vertical or overhanging rock faces may not provide evidence of occupation. This was the case in the Cataract River, where in the absence of vertical rock structures, larvae emerged on other structures that were vertical or overhanging (Fig. 2B).



Figure 2. (A) Looking downstream at the Nepean River Maldon weir on March 25, 2021 showing the location where exuviae were later found in December 2021 (blue arrow). Water gauging data indicates that flow rates at the time of inspection (6,161 ML/day) were receding from the flood peak three days prior (39,349 ML/day). (B) *A. leonardi* hanging on the underside of *Lomandra longifolia* leaf. (C-D) *A. leonardi* from the Nepean River December 2021. (C) Larval exuviae. (D) Adult male. Photo credits: Adrian Grieve.

Conclusions

To date, viable populations of *A. leonardi* have been known only from four locations around the Sydney basin, namely the Woronora River, Kangaroo Creek at Audley, the Nepean River and Georges River. While the current survey results increase the range of the endangered *A. leonardi* population in the Nepean River, the species remains in very small numbers in locations where it has previously been noted as common (Kangaroo Creek) or has apparently disappeared (Woronora River), leaving only two locations where a valid population resides. Furthermore, the success of targeted searches over recent years may indicate a favourable response by the species to three years of sustained river flows due to consistent rainfall (following a drought which concluded in early 2020), as previous targeted searches for the species at the Maldon Bridge site have been unsuccessful. Taking this into account it is therefore concluded that the species remains of high conservation concern.

To guarantee the existence of the species into the future, further research is needed to better understand the ecology of *A. leonardi*. Given the rarity and protection status of *A. leonardi*, research options are limited to non-invasive and observational techniques, and the following recommendations are made in line with the conservation and recovery actions proposed in the *A. leonardi* Primefact (NSW Fisheries 2016):

- Develop standardised techniques to estimate population densities in known locations (using exuvial surveys) to provide a benchmark from which temporal population assessments can be compared.
- Characterise the water quality, flow conditions and aquatic habitat requirements for the larval stage of the life cycle. Although aquatic habitats have previously been described from known locations, it remains unclear as to why the species is found in particular stretches of river and not in adjoining sections which possess similar habitat attributes.
- Measure environmental triggers (e.g. water temperature, daylight hours) to identify temporal cues for emergence.
- Conduct targeted searches for the northern locations where the species has been found (Chichester River and Karuah River), to determine the extent of occupation and the population status, which can be taken into consideration for catchment-based development assessments and potential threats.
- Inform councils, NSW Fisheries and determining authorities.

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New books

A Photographic Field Guide to the Dragonflies & Damselflies of Singapore

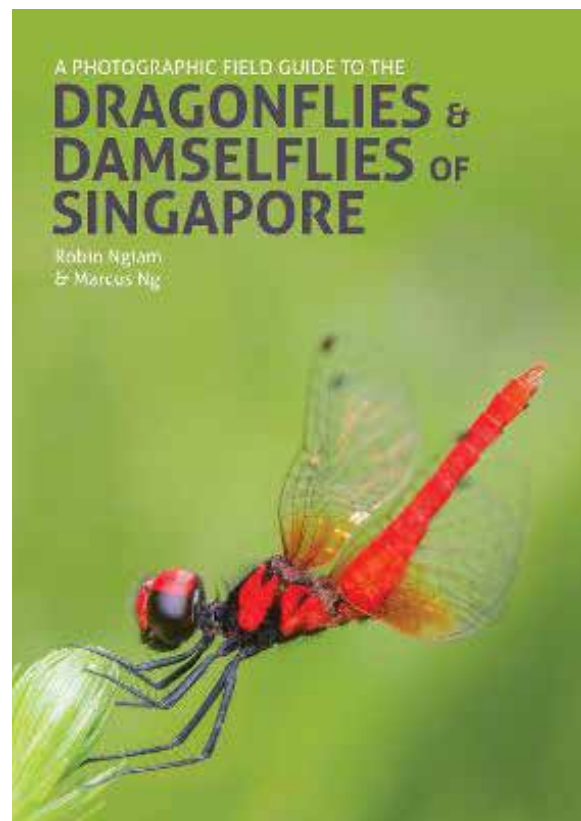
Authors: Robin Ngiam & Marcus Ng
Published By: John Beaufoy Publishing Ltd.
ISBN: 9781912081400

Due October 2022

Available for Pre-order. NHBS £39.99 [[Link](#)]; Pemberley £34.99 [[Link](#)]

There has been an intense interest in Singapore's odonate fauna in recent years resulting in many new discoveries. In 2008 117 odonate species recorded from Singapore were catalogued, many of them only recently discovered (Norma-Rashid et al., 2008; Cheong et al., 2008). Just two years later, in 2010, a book titled: *A Photographic Guide to the Dragonflies of Singapore* (Tang, et al., 2010) was published, which covered 124 odonate species recorded within Singapore's territorial limits, seven of which were discovered within the two years prior to publication. This book is now out of print. Six years later Ngiam & Cheong (2016) published an updated checklist of 131 odonate species recorded from Singapore. Following a couple of further new discoveries Soh et al. (2019) produced another updated checklist cataloging 133 species. Marcus Ng (2020) reported in *Agrion* that: 'It may surprise many, including a fair number of locals, but this island [Singapore] (at 725.7 sq km, smaller than New York City and less than half the area of Greater London) is home to 124 extant odonates (133 including [nine] locally extinct species), despite its highly urbanised state'.

The captioned photographic field guide, scheduled to be published in October 2022, is authored by Ngiam Robin & Marcus Ng. This comprehensive field guide covers the now 136 species of dragonfly and damselfly recorded from Singapore. With stunning, close-up photographs from the authors, each species is illustrated with multiple variants. The general introduction provides a comprehensive overview of dragonfly anatomy, feeding habits, courtship and reproduction. Topics also covered include dragonfly research and conservation plus the best places for dragonfly watching in Singapore. The accounts for each species includes key features for field identification, comparison with similar species, habitat and habits, etymology, distribution in Singapore, wider distribution, national and IUCN conservation status, and larval features. Additionally, a QR code links to detailed larvae images from the Lee Kong Chian Natural History Museum website. The final section provides a checklist of the country status and conservation status of all of Singapore's odonates.



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New book

**Dragonflies and Damselflies of Madagascar
and the Western Indian Ocean Islands/
Libellules et Demoiselles de Madagascar
et des Iles de l'Ouest de l'Océan Indien**

Authors: Klaas-Douwe Dijkstra and Callan Cohen
Bilingual edition - Translators: Vanessa Aliniana & Vincent Nicolas

Publisher: Association Vahatra in Antananarivo,
Published: March 2022

Paperback 194 pages, 205 colour photos
ISBN: 9782957099726

University of Chicago Press US\$45 [[Link](#)]; Pemberley £36 + p&p [[Link](#)]

A highly illustrated guide to the spectacular dragonflies and damselflies of the Malagasy Region. This is the first book on the spectacular dragonflies and damselflies of the Malagasy Region, covering over 190 species known from Madagascar, as well as thirty-six additional species found in the archipelagos of the Comoros, Mascarenes, and Seychelles. About 180 species, four of every five present, live nowhere else on Earth. Over 205 photographs illustrate 138 species, many in print for the first time.

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Identification / Identification

Glossaire définissant les termes utilisés / Glossary of terms

Partie 2. Les odonates de la Région malgache / **Part 2.** The Odonata of the Malagasy Region

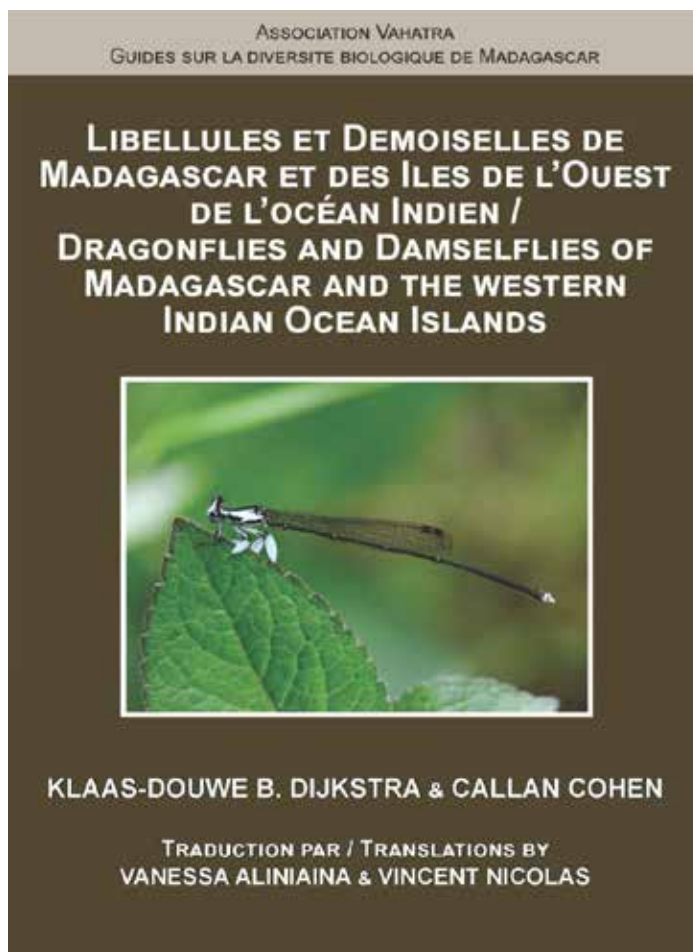
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New book

**Dragonflies of Russia: Illustrated Photo Guide
(in Russian)**

Authors: Vladimir Viktorovich Onishko and Oleg Engelsovich Kosterin
Preface: Nikita Vikhrev

Publisher: Fiton XXI

ISBN: 9785906811912

Hardback. Published January 2021

479 pages, 1000+ colour photos

Language: Russian with scientific nomenclature

Ruslania € 67.0 [\[Link\]](#). NHBS: £29.99 [\[Link\]](#)

The book offers the first detailed description of the appearance, life history, distribution and diagnostic characteristics of all 156 species of dragonflies and damselflies (Odonata) known to date from the territory of the Russian Federation, based on the authors' extensive experience and scientific literature. Each species is illustrated with original natural photographs of both sexes as well as examples of intraspecific variation.

Additionally, for each species there are short descriptions of the imagos of both sexes, and its change with age are given. Many recently revealed facts are published here for the first time. There are no distribution maps as the actual range borders of Odonata in Russia remain largely unknown. As is usual in guides based on illustrations, there are no identification keys but diagnostic differences between similar species are provided.

The introduction leads a reader through the structure, life cycle, habits and classification of dragonflies. The combination of thorough descriptions of differences between similar species, rich illustrations and a detailed introduction allows readers to identify dragonfly species without keys or any specialized knowledge. This book unites the features of a popular atlas with an academic work and fills the gap existing in Russian literature concerning such a conspicuous and attractive group of flying insects as the dragonflies. The book is aimed at a broad range of nature lovers but, as a compilation of all existing knowledge of dragonflies of the country, it will be useful for entomologists as well.

