

A first survey of the dragonflies (Odonata) of Siem Pang Wildlife Sanctuary, northeast Cambodia

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មូលន័យសង្ខេប

ដែនជម្រកសត្វព្រៃសៀមប៉ាង គឺជាតំបន់ជីវចម្រុះសំខាន់ជាសកលដែលស្ថិតនៅភាគឦសាននៃប្រទេសកម្ពុជា។ លក្ខណៈពិសេសនៃតំបន់នេះគឺមានប្រភពទឹកជាង 200 កន្លែងដែលគេស្គាល់ថាជាត្រពាំង និងមានលក្ខណៈឆាប់រឹងស្ងួត។ ការសិក្សានេះបង្ហាញពីទិន្នន័យដំបូងស្តីពីសត្វកន្ទុយ (លំដាប់ Odonata) នៅដែនជម្រកសត្វព្រៃសៀមប៉ាងដែលមិនធ្លាប់មានការសិក្សាពីមុនមក។ សត្វកន្ទុយចំនួន ៥៧ ប្រភេទ ត្រូវបានកត់ត្រា។ ទាំងនេះរួមមានកំណត់ត្រាលើកទីពីរនៃ *Copera chantaburii* (Asahina, 1984) និងកំណត់ត្រាប្រទេសដំបូងនៃ *Aciagrion paludense* (Fraser, 1922) សម្រាប់ប្រទេសកម្ពុជា ដែលពីមុន *A. paludense* ត្រូវបានគេចាត់ទុកថាជាប្រភេទតែមួយ (synonym species) ទៅនឹង *A. occidentale* (Laidlaw, 1924) ។ ភស្តុតាងសម្រាប់ចំណែកថ្នាក់ *A. paludense* ជាប្រភេទមួយផ្សេងដាច់ដោយឡែកត្រូវបានបង្ហាញផងដែរក្នុងការសិក្សានេះ។

Abstract

Located in northeast Cambodia, Siem Pang Wildlife Sanctuary is an internationally important site for biodiversity. A significant feature of the wildlife sanctuary is the presence of at least 200 water bodies known as trapeangs, which are often ephemeral. This paper presents the first data on the Odonata (dragonfly) fauna of the sanctuary which had not previously been studied. Fifty-seven species were recorded. These include the second record of *Copera chantaburii* (Asahina, 1984) for Cambodia and the first country record for *Aciagrion paludense* (Fraser, 1922), which was formerly considered a junior synonym of *A. occidentale* (Laidlaw 1924). A justification for why *A. paludense* should be considered a distinct species is also provided.

Keywords Dragonflies, lowland deciduous dipterocarp forest, lowland semi-evergreen forest, Odonata, Siem Pang Wildlife Sanctuary.

Introduction

Dragonflies and damselflies belong to the insect order known as Odonata. The term 'dragonflies' is often used to refer to both dragonflies (suborder Anisoptera) and damselflies (suborder Zygoptera) and is used in this paper unless differentiation is required. Dragonflies

and damselflies have similar structure in possessing a head, thorax and a ten-segment abdomen, but differ in the following ways: dragonflies are bigger with broader bodies, whereas damselflies are smaller and more delicate insects. Both have two pairs of wings although dragonflies have unequal sized forewings and rear wings and generally rest with their wings open, whereas damsel-

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flies generally close their wings together when resting, although there are exceptions to this rule. Both have large compound eyes, although unlike dragonflies, the eyes of damselflies are widely spaced. Dragonflies and damselflies are predatory insects which emerge from aquatic larvae. They are voracious predators at all stages of their life cycles. Worldwide, there are currently 6,410 recognized species of dragonfly (Paulson *et al.*, 2023).

Including Thailand, Vietnam, Laos and Cambodia, Indochina supports over 500 species of dragonflies (Hämäläinen, 2004). Hämäläinen (2004) also stated “Thailand has the most diverse and best known odonate fauna, but knowledge of the Laotian and Vietnamese fauna has increased rapidly over the last 10 years”. However, the Odonata of Cambodia remains the most poorly studied within the region (Kosterin, 2016). The exact number of species recorded in Cambodia has not been published but based on information from Oleg Kosterin is currently 203.

The primary aim of this study was to increase knowledge of the odonate fauna of Siem Pang Wildlife Sanctuary in northeast Cambodia (Fig. 1) and the importance of trapeangs (natural waterholes) for these. A secondary aim was to increase knowledge of Cambodian and Indochinese Odonata. Dragonflies are aquatic in their larval stage and are considered key indicators of pollution, habitat quality and landscape disturbance (Šigutová *et al.*, 2022). Because monitoring within the wildlife sanctuary relies on such species information to assess environmental changes, the data provided by this study will enhance understanding of the sanctuary. The dragonflies

of Siem Pang had not been previously studied and the nearest lowland site where these have been surveyed in Cambodia is the Prey Long Wildlife Sanctuary (Kosterin, 2020), which extends into southwest Stung Treng Province.

Methods

Siem Pang Wildlife Sanctuary was visited at the start of the dry season in Cambodia from 10–26 November 2022. The timing was partly chosen to improve access but primarily to maximize time in the field, although it is acknowledged that species diversity may be different or greater during the wet season. At the time of survey, the landscape was in transition from the wet to the dry season, with much standing water remaining. However, most days were dry and sunny which aided observation and daily excursions of varying length were made to various study locations.

Adult dragonflies were photographed and videoed using a Panasonic Lumix GH5S camera with a Panasonic 100–400mm lens. Site coordinates were recorded using a Garmin Fenix 6S Pro watch with the Garmin Explore Application. Photographs of the lectotype and paralectotype of *Aciagion paludense* (Fraser, 1922) from the Natural History Museum, London, were kindly provided by Dan Hall and Benjamin Price and used to review its taxonomic status.

Siem Pang Wildlife Sanctuary covers a total of 132,321 ha in Stung Treng Province. The sanctuary is contiguous to the northwest with Xe Pian National Park in Laos and to the east and southeast in Cambodia with Virachey National Park and Veun Sai-Siem Pang National Park. Virachey National Park borders Chu Mom Ray National Park in Vietnam (Loveridge *et al.*, 2018). This 11,207 km² corridor of protected areas forms one of the largest nominally protected areas in the Mekong Basin (Eang *et al.*, 2021). The elevation of the sanctuary ranges from 60 m a.s.l. at the Sekong River to 400 m a.s.l. on the northwestern boundary with Laos (United States Army Map Service, 1967, as cited by Loveridge *et al.*, 2018).

The wildlife sanctuary has been managed since 2016 by Rising Phoenix, a social enterprise company, in partnership with the Ministry of Environment. The sanctuary consists of two main habitat zones. To the north of the O’Khampa River and the east of the Sekong River, the sanctuary supports lowland semi-evergreen forests with smaller areas of evergreen and deciduous dipterocarp forest. Lowland open deciduous dipterocarp forests occur south of the O’Khampa River and west of the Sekong River (Eames & Costello, 2012) (Fig. 2). The latter

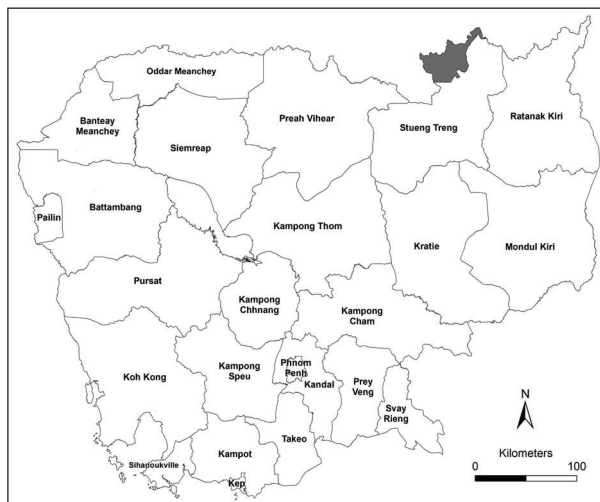


Fig. 1 Location of Siem Pang Wildlife Sanctuary (grey shading) in northeast Cambodia (© Rising Phoenix).

area was previously designated as Siem Pang Khang Lech Wildlife Sanctuary until it was combined with Siem Pang Wildlife Sanctuary in 2019 (Eang *et al.*, 2021).

Within the area of deciduous dipterocarp forest there are at least 200 often ephemeral water bodies known in Khmer as trapeangs (Eames, 2014), a phrase which translates as a natural waterhole or pond. Trapeangs range significantly in size from 100 m² to 10,000 m² and vary in depth and vegetation cover. Domestic buffaloes now use the trapeangs as wallows which serves to maintain these flooded depressions. Historically they would have also been used by wild water buffalo *Bubalus arnee* (now extirpated) and Asian elephants *Elephas maximus*, although the last documented record of the latter was in 2016 (Loveridge *et al.*, 2018).

The monsoonal climate of northern Cambodia gives rise to significant dry and wet seasons and many trapeangs dry out whereas others retain small amounts of water. Six trapeangs are now managed with the provision of solar-powered water pumps which maintain water levels during the dry season. Some trapeangs have a rich growth of sedges and emergent vegetation whereas others are largely free of plant life and have barren muddy banks such as Trapeang Thamatkon (Fig. 3C) which was not surveyed. Surrounding habitat also varies, as some trapeangs are in open savannah type landscape and others within more shaded forest (Fig. 3).

Trapeangs are an important part of the ecosystem in Siem Pang Wildlife Sanctuary and provide essential feeding and breeding habitats for a variety of animal species. As such, this study provided the opportunity to assess their importance for dragonflies. In addition, the study also looked at two larger waterbodies, Beoung Khampa, which was deepened in early 2022, and Beoung Nava, the site of a Siamese crocodile *Crocodylus siamensis* reintroduction. Both are situated in semi-evergreen forest. The word “Beoung” translates as lake.

Riverine habitats were also visited. These included a small seasonal stream the O’Anchan in deciduous dipterocarp forest. As the visit occurred in the dry season, the stream was not flowing and reduced to pools in the stream bed, although some were ten metres long. Flowing water was found on the Sekong River which bisects Siem Pang Wildlife Sanctuary, and a tributary known as the O’Khampa. Three days were also spent in the northern part of the protected area in semi-evergreen forest close to the Laos border. This included the O’Chongheang River (Fig. 4) which had a mix of narrow fast-flowing water and wider slow-flowing areas. Accessing riverine habitats was often quite difficult due to steep-sided river banks, deep water and muddy riverbeds.

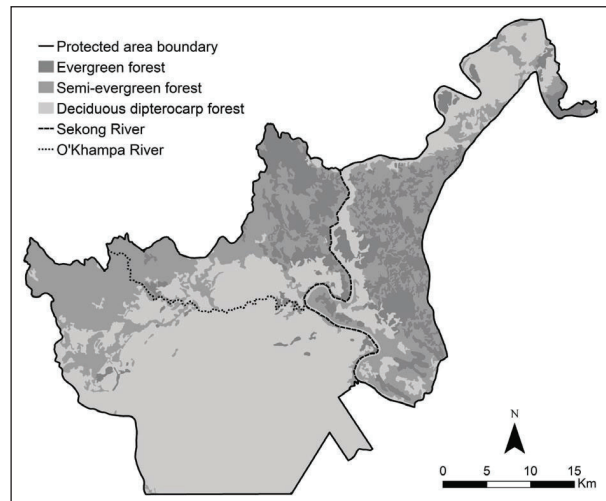


Fig. 2 Major rivers and habitat types in Siem Pang Wildlife Sanctuary (© Rising Phoenix).

Eighteen locations were surveyed in Siem Pang Wildlife Sanctuary which broadly fell into two areas: i) trapeangs and a single stream in deciduous dipterocarp forests south of the O’Khampa River (sites 1–9; Fig. 5) and, ii) areas within semi-evergreen forests north of the O’Khampa River (sites 10–18; Fig. 6). With the exception O’Chongheang River, all locations were visited during daytime excursions from a tented camp (site 9; Fig. 5). The locations surveyed were as follows:

Site 1. Trapeang Lumtea (14.154634°N, 106.277208°E) (Fig. 3A). A medium-sized trapeang covering 2,500 m². This was the most vegetated trapeang visited, with extensive areas of sedge and emergent vegetation surrounding a small area of open water. The area was surrounded by open deciduous dipterocarp forest which did not shade the trapeang. There was evidence of recent domestic buffalo wallows although this was relatively small compared to other trapeangs. Water levels in the trapeang are maintained by a solar-powered water pump. The site was visited more than any other during the study, with four visits in total. All visits were made in the morning, no earlier than 08:00 hrs and not after 12:30 hrs. The dates of visits were 10, 11, 14 and 26 November 2022. Seventeen species were recorded at the location.

Site 2. Trapeang Thymea (14.179192° N, 106.289633° E). This trapeang covers 2,500 m², similar to Trapeang Lumtea, but it was difficult to access sedges and emergent due to high buffalo wallowing activity during the visit. Only one species, *Diplacodes trivialis*, was commonly seen although the trapeang was judged to have far more potential given the extent of vegetation and open water. This site was visited for just 15 minutes on 10 November

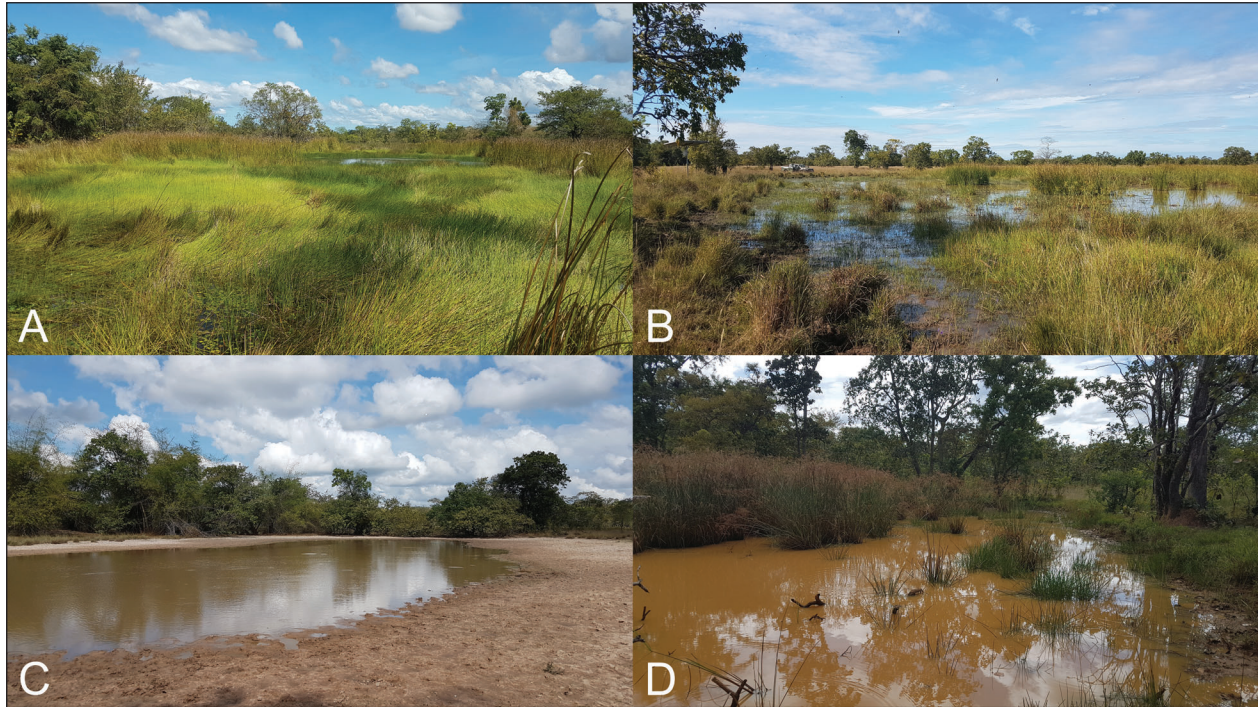


Fig. 3 Examples of trapeangs in Siem Pang Wildlife Sanctuary: A) Trapeang Lumtea, B) Trapeang K'Dung, C) Trapeang Tamatkon, D) Trapeang Buon Ch'rung.

2022 but was often briefly visited as an unrecorded stop while returning to camp from other sites and the heat of the day may have also reduced dragonfly activity.

Site 3. Trapeang Lumpon (14.186599° N, 106.261940° E). A trapeang measuring $2,500\text{ m}^2$ with muddy edges and a small amount of surface vegetation. The site was only visited for 15 minutes on the morning of 11 November 2022, with just five species of dragonflies noted.

Site 4. Trapeang K'mun (14.170951° N, 106.232289° E). A muddy-edged trapeang similar in size to Trapeang Lumpon. This was visited briefly for 15 minutes on the morning of 11 November 2022 and no dragonflies were recorded.

Site 5. O'Anchan stream (14.177317° N, 106.254600° E). The stream was largely reduced to a series of stagnant pools along a high-sided streambed surrounded by areas of thick bamboo and deciduous dipterocarp forest. Much of the stream was heavily shaded and offered potential for interesting dragonflies not found in the trapeangs. The site was visited four occasions, although three comprised brief stops at the bridge on the way to and from other sites. One full morning on 15 November 2022 was spent exploring the area and ten species were recorded.



Fig. 4 O'Chongheang River, Siem Pang Wildlife Sanctuary.

Site 6. Trapeang K'Dung (14.181020° N, 106.219584° E) (Fig. 3B). A fairly large trapeang within an open savannah grassland known as Veal Kree. The site had extensive sedge borders and quite a lot of open water with small amounts of emergent vegetation. Water levels are maintained with a pump and there was some evidence of buffalo wallows. This site was visited on 11 and 13 November 2022. Each visit lasted approximately one hour and the first visit was in mid-afternoon and the second was in mid-morning. Surprisingly few dragon-

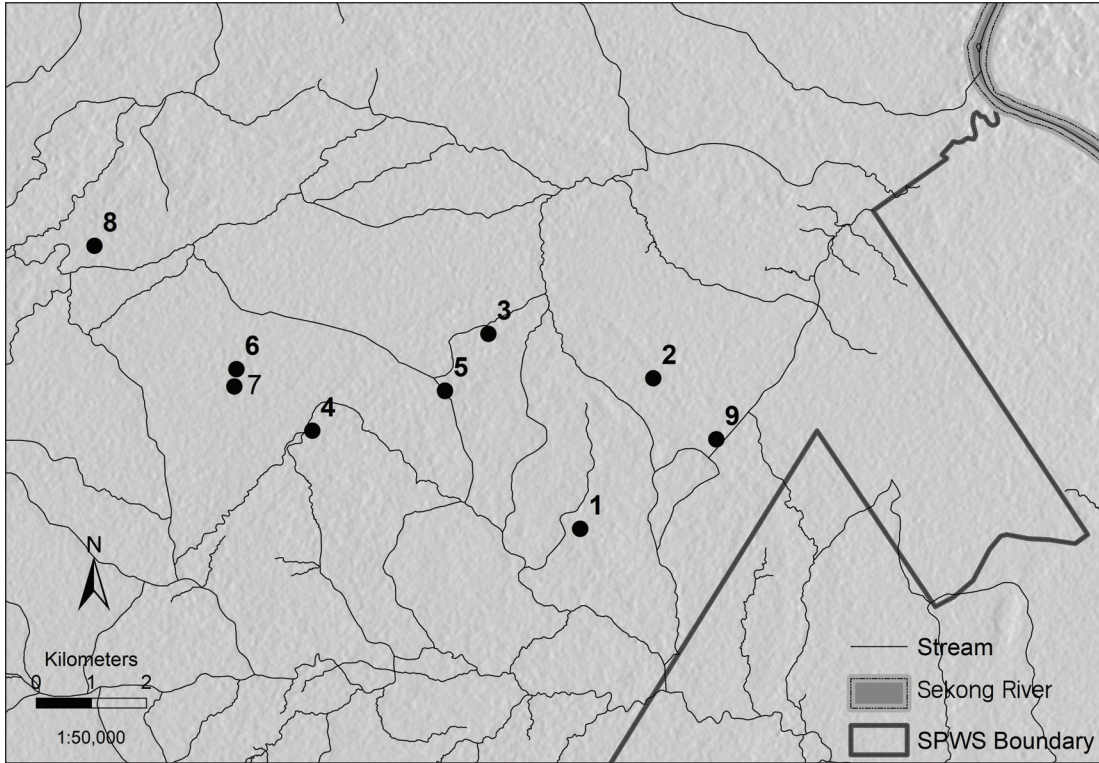


Fig. 5 Areas visited in deciduous dipterocarp forest south of the O'Khampa River (© Rising Phoenix).



Fig. 6 Areas visited in semi-evergreen forest north of the O'Khampa River (© Rising Phoenix).

flies were present, although plenty of fish were present and it is unknown if these may have reduced the diversity of dragonflies. Seven species were recorded at this location.

Site 7. Trapeang Trau (14.178204° N, 106.219224° E). A small trapeang close to Trapeang K'Dung and on the edge of Veal Kreel and so surrounded by large deciduous dipterocarp trees and large tracts of bamboo. Very little emergent vegetation. There were significant areas of buffalo wallows which made access difficult. The site was visited once on 13 November 2022 from 08:10 to 09:00 hrs. Five species were recorded at this location.

Site 8. Trapeang Buon Ch'run (14.201366° N, 106.195833° E) (Fig. 3D). Quite different from other trapeangs in being quite small and shaded by tall deciduous dipterocarp forest. The water was stagnant and muddy from wallowing buffaloes. Extensive areas of sedge but little other emergent vegetation was present. Four species were recorded at this location which was visited once for 45 minutes around noon on 13 November 2022.

Site 9. Tented camp (14.169157° N, 106.300168° E). The camp was situated in deciduous dipterocarp forest adjacent to a small strip of semi-evergreen woodland. A small trapeang occurs behind the camp which is fenced and has little emergent vegetation. This is surrounded by channels which were dry at the time of the survey but contain water during the wet season. Six species were recorded at the camp.

Site 10. Beoung Nava (14.303005° N, 106.179607° E). A sedge-filled lake in the northwest of the sanctuary. The lake had some open water and large areas of boggy margins. At the western end, there was a boggy area which received a lot of shade from small trees. The area is situated in semi-evergreen forest. The lake was visited on 12 and 17 November 2022. The first visit was from 14:20 to 16:00 hrs and the second was from 11:00 to 12:30 hrs. Eighteen species were recorded at the location, although it may support more dragonfly species.

Site 11. Stream near Beoung Nava (14.307832° N, 106.189416° E). Surveyed on 17 November 2022 from 13:00 to 13:45 hrs. It was quite well shaded within semi-evergreen forest and thick bamboo. Five species were recorded at this location.

Site 12. Beoung Khampa (14.302597° N, 106.217422° E). A large lake that was deepened in early 2022. There was open water with areas of sedge in the middle. The site is close to the O'Khampa River and surrounded by a mixture of semi-evergreen and deciduous dipterocarp forest. Considering significant digging had occurred

as part of the deepening work less than ten months before my visit, the site was regenerating very well and numerous dragonflies were present during my first visit. The site was visited from 11:20 to 13:30 hrs on 12 November and from 14:30 to 16:00 hrs on 17 November 2022. The first visit was far more productive and 23 species were recorded at the location.

Site 13. Unnamed trapeang on approach track to Beoung Khampa (14.314928° N, 106.272947° E). An overgrown trapeang which was visited for 50 minutes at 10:00 hrs on 12 November 2022. The actual trapeang was not accessed but a small area of tall grassland adjacent to it was searched. Two species were recorded.

Site 14. Koh Dat Tum, Sekong River Island (14.312215° N, 106.340867° E). This river island was visited from 08:30 to 10:00 hrs on 16 November 2022. The habitat was really just a large sand bank with little vegetation in the middle of the Sekong River. Six species were recorded at this location.

Site 15. Section of O'Khampa River approximately 2 km upstream from the confluence with the Sekong River (14.297723° N, 106.287076° E). A deep-sided, slow-flowing river approximately 20 m wide and bordered by thick semi-evergreen dipterocarp gallery forest. All observations were made from a boat. Attempts were made to walk on the riverside but this proved difficult and probably influenced the number of species observed. The location was visited from 10:30 to 14:00 hrs on 16 November 2022 and 13 species were recorded.

Site 16. O'Khampa River, on the Sekong River side of old bridge (14.214326° N, 106.319378° E). A narrower section of the O'Khampa River. Entered below the bridge and easier to access on foot than site 15, although wading chest deep in the river was required to survey the area. The river was faster flowing than downstream areas and the banks were a little more open with smaller shrubs rather than trees. The location was visited from 09:00 to 13:00 hrs on 19 November 2022 and seven species were recorded.

Site 17. O'Khampa River, west of the new bridge (14.296045° N, 106.281176° E). Significant areas of damage were evident due to construction of the new bridge but a small area of rocky rapids warranted investigation. The location was visited from 13:30 to 14:30 hrs on 16 November 2022 and 11 species were recorded.

Site 18. O'Chongheang River (14.350838° N, 106.254641° E to beyond 14.352010° N, 106.253729° E) (Fig. 4). Located in semi-evergreen forest in the northern part of Siem Pang Wildlife Sanctuary, three days were spent at the river from 21 to 23 November 2022. Each

day we walked upstream through some narrow, faster-flowing areas and some wider, slower-flowing areas, all of which were in semi-evergreen gallery forest. Water depths varied from shallow to chest deep. The substrate was generally stony in the fast-flowing sections and silty in slower-flowing sections. Looking at the area after our visit, I felt we did not explore far enough upstream as an area of rocky river bed, visible on Google Earth, would have warranted exploration. Walking downstream could also have been beneficial. However, the areas we did visit were interesting, with 27 species recorded, making it the most productive of all sites visited.

Results

A total of 57 dragonfly species were recorded during the survey, comprising 50 species recorded north of and including the O'Khampa River and 32 species south of this (Table 1). Survey results are presented in the order of species provided in the *World Odonata List* (September 2023 revision) by Paulson *et al.* (2023) which is based on Bybee *et al.* (2021) in turn.

Euphaeidae

1. *Euphaea inouei* Asahina, 1977 (Fig. 7)

Males were seen daily along faster flowing stretches of the O'Chongheang River. The highest count was of 12 individuals on 23 November.

Philosinidae

2. *Rhinagrion hainanense* Wilson & Reels 2001 (Fig. 8)

Only recorded on the O'Chongheang River. All individuals were found along a steep-sided section of river-bank which was heavily shaded by bankside vegetation. Six individuals were observed over two days, including three males and two females on 22 November.

Calopterygidae

3. *Neurobasis chinensis* (Linnaeus, 1758) (Fig. 9)

Only recorded in two locations in semi-evergreen forest north of the O'Khampa River. A single female was recorded at a stream near Beoung Nava on 17 November and the species was recorded daily as common (>20 individuals) on the O'Chongheang River.

4. *Vestalis gracilis* (Rambur, 1842)

Commonly encountered in three locations where streams were surrounded by lush vegetation and shaded by the tree canopy. Often encountered in surrounding forest.

Maximum daily counts of ten individuals were recorded on the streams near Beoung Nava and the O'Chongheang River. The species was also recorded on each visit to dry dipterocarp forests alongside the O'Anchan Stream.

Chlorocyphidae

5. *Heliocypha biforata* (Selys, 1859)

Recorded in low numbers in two locations. A single immature male was collected on the O'Anchan Stream on 13 November and the species was recorded daily on the O'Chongheang River with a maximum count of three.

6. *Libellago lineata* (Burmeister, 1839) (Fig. 10)

Recorded in three locations. One record of a single female at the tented camp on 17 November was unusual, and the only record in dry dipterocarp forest. However, the species was abundant along the O'Khampa and O'Chongheang rivers, with daily numbers exceeding hundreds.

Platycnemididae

7. *Copera chantaburii* Asahina, 1984

Only recorded on the O'Anchan Stream. Initially overlooked among the more common *Copera marginipes*. Examination of photographs proved at least three individuals were present in the shaded streambed on 15 November. Photographs (Figs. 11 & 12) and video were taken of an individual male and a copulating pair. More individuals were likely present and overlooked. Identification of the male was based on the pale abdomen tip being reduced to abdominal segment 10 and not extending into segments 8 and 9 (as it does in the case of *C. marginipes*) and most importantly, short paraprocts (Asahina, 1984). *Copera chantaburri* occurs in neighbouring Thailand and Vietnam but is largely unobserved in Cambodia. The first record for Cambodia was in June 2018 in Prey Long Wildlife Sanctuary (Kosterin, 2020).

8. *Copera marginipes* (Rambur, 1842)

The species was recorded at four locations where it was generally common. Common (≥ 20 individuals) at the O'Anchan Stream on 15 November, where it far outnumbered the similar *C. chantaburri*. Only two individuals were noted at Beoung Khampa on 17 November, although the species was common on all three days spent at the O'Chongheang River.

9. *Onychargia atrocyana* Selys, 1865

A single female was observed on 12 November at an unnamed and overgrown trapeang on the track leading to Beoung Khampa.

Table 1 Locations of dragonflies recorded during the study in Siem Pang Wildlife Sanctuary. Numbers indicate survey sites described in the methods section.

#	Species	Locations		#	Species	Locations	
		Dry dipterocarp forest south of the O'Khampa River	Semi-evergreen forest north of the O'Khampa River			Dry dipterocarp forest south of the O'Khampa River	Semi-evergreen forest north of the O'Khampa River
1	<i>Euphaea inouei</i>		18	31	<i>Acisoma panorpoides</i>	1	10, 12
2	<i>Rhinagrion hainanense</i>		18	32	<i>Brachydiplax farinosa</i>	1	12
3	<i>Neurobasis chinensis</i>		11, 18	33	<i>Brachydiplax sobrina</i>	1	
4	<i>Vestalis gracilis</i>	5	11, 18	34	<i>Brachythemis contaminata</i>	9	10, 12, 15–17
5	<i>Heliocypha biforata</i>	5	11, 18	35	<i>Crocothemis servilia</i>	6	10, 12, 17
6	<i>Libellago lineata</i>	9	15, 16, 18	36	<i>Diplacodes nebulosa</i>	1, 6, 8	10, 12
7	<i>Copera chantaburii</i>	5		37	<i>Diplacodes trivialis</i>	1–3, 5, 6, 8, 9	10, 12, 17, 18
8	<i>Copera marginipes</i>	5	12, 15, 18	38	<i>Hydrobasileus croceus</i>		12
9	<i>Onychargia atrocyana</i>		13	39	<i>Indothemis limbata</i>	1, 7	10, 12
10	<i>Prodasineura autumnalis</i>		11, 15, 16, 18	40	<i>Lathrecista asiatica</i>		18
11	<i>Prodasineura coerulescens</i>		15, 16	41	<i>Neurothemis fulvia</i>	5, 7–9	12, 18
12	<i>Pseudocopera ciliata</i>		10	42	<i>Neurothemis intermedia</i>		10, 12
13	<i>Aciagrion borneense</i>	1	10, 12	43	<i>Neurothemis tullia</i>	1	10, 12, 18
14	<i>Aciagrion pallidum</i>	5	10, 18	44	<i>Orthetrum chrysis</i>	5	15, 17, 18
15	<i>Aciagrion paludense</i>	1		45	<i>Orthetrum pruinosum</i>		11, 17, 18
16	<i>Agriocnemis minima</i>	1, 6, 7	10, 12	46	<i>Orthetrum sabina</i>	1, 3, 5–7, 9	10, 12, 14–18
17	<i>Agriocnemis nana</i>	7	13, 18	47	<i>Pantala flavescens</i>		12, 14, 17, 18
18	<i>Ceriagrion cerinorubellum</i>		10	48	<i>Potamarcha congener</i>	3, 8	
19	<i>Ceriagrion indochinense</i>	1		49	<i>Pseudothemis jorina</i>		15
20	<i>Ceriagrion malaysei</i>	1	10	50	<i>Rhodothemis rufa</i>		16
21	<i>Ceriagrion olivaceum</i>	1		51	<i>Rhyothemis triangularis</i>	1	
22	<i>Ischnura senegalensis</i>	3	12	52	<i>Rhyothemis variegata</i>	1	12
23	<i>Paracercion calamorum</i>		12	53	<i>Tholymis tillarga</i>		11, 18
24	<i>Pseudagrion australasiae</i>	1	10, 12	54	<i>Trithemis aurora</i>	3, 5, 9	10, 12, 14–18
25	<i>Pseudagrion microcephalum</i>		18	55	<i>Trithemis festiva</i>		17, 18
26	<i>Pseudagrion pruinosum</i>		18	56	<i>Trithemis pallidinervis</i>	6	10, 12, 14, 15, 17
27	<i>Pseudagrion rubriceps</i>		12, 15–18	57	<i>Zyxomma petiolatum</i>		18
28	<i>Pseudagrion williamsoni</i>		12, 18				
29	<i>Anax aurantiacus</i>		15				
30	<i>Ictinogomphus decoratus</i>		15				



Fig. 7 Male *Euphaea inouei*, O'Chongheang River, 21 November 2022.



Fig. 8 Male *Rhinagrion hainanense*, O'Chongheang River, 23 November 2022.



Fig. 9 Female *Neurobasis chinensis*, stream near Beoung Nava, 17 November 2022.



Fig. 10 Male *Libellago lineata*, O'Khampa River, 19 November 2022.



Fig. 11 Male *Copera chantaburri*, O'Anchan stream, 15 November 2022.



Fig. 12 Male and female tandem pair of *Copera chantaburri*, O'Anchan stream, 15 November 2022.

10. *Prodasineura autumnalis* (Fraser, 1922) (Fig. 13)

The species was recorded in four locations. A single male was recorded on a stream near Beoung Nava on 17 November and the species was otherwise found to be common (≥ 20 individuals) on every visit to the O'Khampa and O'Chongheang Rivers.

11. *Prodasineura coerulescens* (Fraser, 1932) (Figs. 13 & 14)

Recorded at three locations and common (≥ 20 individuals) during all three visits to the O'Chongheang River. Also common at the O'Khampa river on the Sekong River side of the road bridge. Unusually, only one female was observed at the confluence of the O'Khampa River and the Sekong River on 16 November, although the species was probably overlooked due to difficulty accessing the site away from the boat.

12. *Pseudocopera ciliata* (Selys, 1863) (Fig. 15)

Four males and two females were seen and photographed at Beoung Nava on 17 November. These were found in a shaded marshy area at the western end of the site. This was the only location where this species was found.

Coenagrionidae

13. *Aciagrion borneense* Ris, 1911 (Fig. 16)

Recorded in three locations. Numbers at Trapeang Lumtea ranged from common (≥ 20 individuals) on the second visit and less (ten individuals) on the last visit. Usually seen in more open channels of water with intermittent vegetation. Males were mainly seen although some pairs in copulation were also noted. Up to three males were recorded at Beoung Nava and Beoung Khampa.

14. *Aciagrion pallidum* Selys, 1891

Recorded in three locations. A single male was photographed at the O'Anchan Stream on 15 November. Another male was recorded at Beoung Nava on 17 November and up to six males were seen in forest near the O'Chongheang River on 23 November. The latter observations were in the same habitat as *Vestalis grcalis*.

15. *Aciagrion paludense* Fraser, 1922 (Figs. 17–19)

Only recorded at Trapeang Lumtea. A single male with the black basal-pointing "chess pawn" variant marking on segment 8 was photographed on 12 November and single male was photographed on 26 November. The latter was initially identified as *A. occidentale* based on Laidlaw (1924), as it had the diagnostic black triangle on segment 8 with the apex pointing towards segment 7. The former was initially overlooked among photographs of the similar *A. borneense*. However, following review and consultations with O. Kosterin, the initial identifi-

cations were revised (a justification for this revision is provided in the Discussion). These are the first records of this species in Cambodia.

16. *Agriocnemis minima* Selys, 1877

Recorded at five sites and the most commonly recorded species in the genus. Common (≥ 20 individuals) on all four visits to Trapeang Lumtea, especially around its muddy margins. Individuals seen were mainly males with smaller numbers of females and orange teneral females. The species was also common at Trapeang Trau, Beoung Nava and Beoung Khampa, but was not recorded in riverine habitats.

17. *Agriocnemis nana* (Laidlaw, 1914)

Individuals were recorded at three locations. One female was photographed at the unnamed and overgrown trapeang on the track leading to Beoung Khampa on 12 November. Single males were also recorded at Trapeang Trau and the O'Chongheang River.

18. *Ceriagrion cerinorubellum* (Brauer, 1865)

Only recorded at Beoung Nava, where two males were recorded on 12 and 17 November.

19. *Ceriagrion indochinese* Asahina, 1967 (Fig. 20)

Only recorded at Trapeang Lumtea, but noted on all four visits. The maximum count was of six males and a single female was noted on the 26 November.

20. *Ceriagrion malaisei* Schmidt, 1964 (Fig. 21)

Recorded in two locations and seen on all four visits to Trapeang Lumtea. A single male was recorded at Beoung Nava on 12 November.

21. *Ceriagrion olivaceum* Laidlaw, 1914 (Fig. 22)

A single male was photographed at Trapeang Lumtea on 10 November. This was the only record during the study.

22. *Ischnura senegalensis* (Rambur, 1842)

This otherwise widespread and ubiquitous species was only recorded in two locations. These comprised a single male at Trapeang Lumpon on 10 November and two males at Beoung Khampa on 12 November.

23. *Paracercion calamorum* (Ris, 1916) (Fig. 23)

The only record during the survey was of a single male photographed at Beoung Khampa on 12 November.

24. *Pseudagrion australasiae* Selys, 1876

Recorded in three locations and on all four visits to Trapeang Lumtea with a maximum count of ten males. The species was common on both visits at Beoung Nava and Beoung Khampa. A maximum count of 20 was made at Beoung Nava on 12 November.



Fig. 13 *Prodasineura autumnalis*, *P. coerulescens* and *Psudagrion rubriceps* ovipositing in tandem pairs, O'Khampa River, 19 November 2022.



Fig. 14 Male *Prodasineura coerulescens*, O'Khampa River, 19 November 2022.



Fig. 15 Male *Pseudocopera ciliata*, Beoung Nava, 17 November 2022.



Fig. 16 Male *Aciagrion borneense*, Trapeang Lumtea, 26 November 2022. Note the broad black bar on segment 8 and thin black line on segment 9.



Fig. 17 *Aciagrion paludense*, Trapeang Lumtea, 26 November 2022. Note the black basal-pointing triangle on segment 8 which differs from *A. borneense* and *A. occidentale*.



Fig. 18 *Aciagrion paludense*, Trapeang Lumtea, 26 November 2022.



Fig. 19 *Aciagrion paludense*, Trapeang Lumtea, 12 November 2022. Note black basal-pointing “chess pawn” marking on segment 8.



Fig. 20 Male *Ceriagrion indochinese*, Trapeang Lumtea, 26 November 2022.



Fig. 21 Male *Ceriagrion malaisei*, Trapeang Lumtea, 11 November 2022.



Fig. 22 Male *Ceriagrion olivaceum*, Trapeang Lumtea, 10 November 2022.



Fig. 23 Male *Paracercion calamorum*, Beoung Khampa, 12 November 2022.



Fig. 24 Male *Pseudagrion williamsoni*, Beoung Khampa, 12 November 2022.

25. *Pseudagrion microcephalum* (Rambur, 1842)

Only recorded at the O'Chongheang River where it completely replaced the similar *P. australasiae* and was common (≥ 20 individuals) on all three days.

26. *Pseudagrion pruinosum* (Burmeister, 1839)

Only recorded at the O'Chongheang River, where one male was observed on 22 November and eight were observed on 23 November.

27. *Pseudagrion rubriceps* Selys, 1876

Recorded in five locations. Observed and photographed in small numbers at all three locations on the O'Khampa River. A tandem pair were photographed ovipositing on the same floating stick as *Prodasineura autumnalis* and *P. coerulea* (Fig. 13). A single male was recorded at Beoung Khampa on 19 November and the species was common (≥ 20 individuals) on all three days spent at the O'Chongheang River.

28. *Pseudagrion williamsoni* Fraser 1922 (Fig. 24)

Only recorded in two locations in semi-evergreen forest north of the O'Khampa River. Two and one individuals were recorded at Beoung Khampa on 12 and 17 November. Recorded on two out of three days at the O'Chongheang River with a maximum count of ten individuals.

Aeshnidae

29. *Anax aurantiacus* Makbun, Wongkamhaeng & Saetung Keetapithchayakul, 2022

Four males were seen patrolling at separate locations on the O'Khampa River at the confluence with the Sekong River on 16 November 2022. These were initially identified as *Anax immaculifrons* Rambur, 1842. The primarily orange-ground colour of the male abdomen is quite different to the colouration of individuals in the western part of its range, although this was previously considered a different colour form of the same species. However, Makbun *et al.* (2022) described individuals with orange abdomens in Cambodia, Laos, China, Hong Kong, Thailand and Vietnam as a new species (*A. aurantiacus*), based on colouration as well as morphological and molecular differences.

Gomphidae

30. *Ictinogomphus decoratus* (Selys, 1854)

Five males were seen (but not photographed) on the O'Khampa River at the confluence with the Sekong River on 16 November.

Libellulidae

31. *Acisoma panorpoides* Rambur, 1842

Recorded in three locations. Seen on three of the four visits to Trapeang Lumtea, with a maximum count of five individuals. Also common (≥ 20 individuals) on both visits to Beoung Nava and Beoung Khampa.

32. *Brachydiplax farinosa* Krüger, 1902 (Fig. 25)

Recorded in two locations. Seen on all four visits to Trapeang Lumtea with a maximum count of 12 males. Only one female was seen. Five males were recorded at Beoung Khampa on 12 November.

33. *Brachydiplax sbrina* (Rambur, 1842) (Fig. 26)

Only recorded at Trapeang Lumtea, where single males were seen on 14 and 26 November. This species is very similar to *Brachydiplax farinosa*, but has seven antenodal cross veins, whereas the latter has eight.

34. *Brachythemis contaminata* (Fabricius, 1793) (Fig. 27)

Recorded in eight locations. As many as ten individuals were recorded on Koh Dat Tum Island within the Sekong River. Recorded at all locations visited on the O'Khampa and O'Chongheang Rivers and also in the dry dipterocarp forest areas of Trapeang K'Dung and around the tented camp.

35. *Crocothemis servilia* (Drury, 1773)

Somewhat unusually, this widespread Asian species was only recorded in low numbers in four locations. Maximum counts of two males were registered on each visit to Beoung Nava, single males were observed at Beoung Khampa and the new bridge side of the O'Khampa River, and an immature male was observed at Trapeang K'Dung.

36. *Diplacodes nebulosa* (Fabricius, 1793)

Recorded in five locations. Common (≥ 20 individuals) on each visit to Trapeang Lumtea, Trapeang K'Dung, Beoung Nava and Beoung Khampa. Two individuals were recorded at Trapeang Buon Ch'run on 13 November.

37. *Diplacodes trivialis* (Rambur, 1842)

Recorded in eleven locations. Commonly encountered but not formally recorded at numerous locations within dry dipterocarp forest. Common (≥ 20 individuals) at Trapeang Thymea where it was the only species recorded. Common on all four visits to Trapeang Lumtea, as well as Trapeang K'Dung and Trapeang Trau. Also common at the tented camp, Beoung Nava, Beoung Khampa and Koh Dat Tum. Smaller numbers were recorded on the

O'Anchan Stream, O'Chongheang River and at the new bridge side of the O'Khampa River.

38. *Hydrobasileus croceus* (Brauer, 1867)

The only record during the survey was of a single male which was observed hawking over the water at Beoung Khampa on 12 November.

39. *Indothemis limbata* (Selys, 1891)

Recorded in four locations and males mainly seen on all four visits to Trapeang Lumtea. A maximum count of ≈12 males was made on 11 November. The only female recorded was in copulation with a male and seen at the same location on 26 November. Common (≥20 individuals) on both visits to Beoung Khampa and common at Beoung Nava on 17 November, although only two were recorded there on 12 November. Two males were also observed at Trapeang Trau on 13 November.

40. *Lathrecista asiatica* (Fabricius, 1798)

The only records were of two immature males which were recorded on the O'Chongheang River on the 22 November.

41. *Neurothemis fulvia* (Drury, 1773)

Recorded in six locations and seen on all three visits to the O'Chongheang River, with a maximum count of ten individuals on 22 November. As many as six males were recorded at Beoung Khampa on 17 November. Three males were recorded at Trapeang Buon Ch'runng on 13 November and one female was observed at Trapeang Trau on the same day. Single males were also observed at the tented camp and O'Anchan Stream.

42. *Neurothemis intermedia* (Rambur, 1842) (Fig. 28)

Recorded in two locations. Six males were seen at Beoung Khampa on 12 November. An immature male was seen at Beoung Nava on 17 November.

43. *Neurothemis tullia* (Drury 1773)

Recorded in four locations and common (≥20 individuals) on all visits to Beoung Nava and Beoung Khampa. Two males were seen at Trapeang Lumtea on 14 and 26 November, whereas single males were recorded on the O'Chongheang River on 21 and 22 November.

44. *Orthetrum chrysis* (Selys, 1891)

Recorded in three locations. Recorded on each visit to the O'Chongheang River with a maximum count of four males on 22 November. A single male was seen on the O'Anchan Stream on 15 November. One male was recorded on the confluence of the O'Khampa and Sekong rivers and a female was noted further upstream on the new bridge side of the river.

45. *Orthetrum pruinosum* (Burmeister, 1839)

Recorded in three locations. As many as two were recorded daily at the O'Chongheang River from 21 to 23 November. One male was photographed at the stream near Beoung Nava on 17 November and two males were observed to the west of the new bridge on the O'Khampa River on 19 November.

46. *Orthetrum sabina* (Drury 1773)

The most widely recorded species during the survey, being registered at 13 of the 18 survey locations. Seen on three of four visits to Trapeang Lumtea, with a maximum count of approximately ten individuals on 14 November. Recorded as common (≥20 individuals) at Beoung Nava, Beoung Khampa, all three locations on the O'Khampa River, Koh Dat Tum and the O'Chongheang River. Smaller numbers were also recorded at Trapeang Lumpon, Trapeang Trau and Trapeang K'Dung, the tented camp and the O'Anchan Stream.

47. *Pantala flavescens* (Fabricius, 1798)

This highly nomadic and common species was surprisingly only recorded in four locations. As many as ten were observed on Koh Dat Tum island on 16 November. Two were recorded west of the new bridge on the O'Khampa River and singles were observed at Beoung Khampa and the O'Chongheang River.

48. *Potamarcha congener* (Rambur, 1842)

Recorded in two locations. Two males were recorded at Trapeang Buon Ch'runng on 13 November and a single male was recorded at Trapeang Lumpon on 10 November.

49. *Pseudothemis jorina* Förster, 1904

Only recorded at the confluence of the O'Khampa and Sekong rivers, where at least 20 males were observed.

50. *Rhodothemis rufa* (Rambur, 1842)

Only recorded on the Sekong River side of the old bridge on the O'Khampa River. A single immature male was seen but not photographed.

51. *Rhyothemis triangularis* Kirby, 1889

Only recorded at Trapeang Lumtea, where five males were registered on 11 November and two were registered on 26 November.

52. *Rhyothemis variegata* (Linnaeus, 1763)

Recorded in two locations. As many as ten individuals were noted at Beoung Nava on 12 November and a further eight were registered on 17 November. Single



Fig. 25 Male *Brachydiplax farinosa* with eight antennodal crossveins, 26 November 2022.



Fig. 26 Male *Brachydiplax sobrina* with seven antennodal crossveins, 26 November 2022.



Fig. 27 Male *Brachythemis contaminata*, Koh Dat Tum, 16 November 2022.



Fig. 28 Male *Neurothemis intermedia*, Beoung Khampa, 12 November 2022.



Fig. 29 *Trithemis festiva*, O'Chongheang River, 21 November 2022.

females were recorded at Trapeang Lumtea on 11 and 26 November.

53. *Tholymis tillarga* (Fabricius, 1798)

This crepuscular species was recorded at two locations. One male was seen briefly hanging on bamboo at the stream near Beoung Khampa on 17 November. Six and ten individuals were recorded on the O'Chongheang River on 21 and 22 November. The latter sightings were made while camping in the forest whereas the single male was flushed from a perch in the middle of the day. This species may be found to be widespread if suitable areas are searched at dusk or roosting sites are checked.

54. *Trithemis aurora* (Burmeister, 1839)

Recorded in ten locations. This widespread Asian species was common (≥ 20 individuals) on Koh Dat Tum Island

and all locations along the O'khampa River. It was common during all visits to Beoung Nava and Beoung Khampa, as well as on each visit to the O'Chongheang River where *Trithemis festiva* also occurred. So much so, that close inspection of females and subsequent identification were not undertaken as this reduced the time available for searching for other species. As many as four individuals were recorded at the tented camp on 10 November, and singles were recorded at Trapeang Lumpon and the O'Anchan Stream.

55. *Trithemis festiva* (Rambur, 1842) (Fig. 29)

Recorded in two locations. Common (≥ 20 individuals) on all three visits to the O'Chonheang River. Similar to *Trithemis aurora*, close inspection of females and subsequent identification was not undertaken as this reduced the time available for searching for other species. Four males were recorded west of the new bridge on the O'Khampa River on 19 November.

56. *Trithemis pallidinervis* (Kirby, 1889)

Recorded in six locations. Common (≥ 20 individuals) at Beoung Nava and Beoung Khampa on 12 and 17 November, and at the confluence of the O'Chongheang and Sekong rivers on 16 November. Additional counts include six at Koh Dat Tum Island on 16 November, two westwards of the new bridge on the O'Khampa River on 19 November and one male at Trapeang K'Dung on 13 November.

57. *Zyxomma petiolatum* Rambur, 1842

This crepuscular/nocturnal species was only recorded at the O'Chongheang River, with eight individuals registered at dusk on 21 November and two on 22 November. As with *Tholymis tillarga*, these observations were made as we camped in the forest. This species will likely be found to occur more widely if suitable habitats are searched at dusk.

Discussion

Fifty-seven dragonfly species were recorded during the survey. This figure is comparable to the Prey Long Wildlife Sanctuary (Kosterin, 2020) where 60 species were recorded over two visits (June 2018 & December 2019), although Siem Pang Wildlife Sanctuary was only visited in November. An additional visit in May/June during the wet season would likely increase the number of species recorded. It is also notable that the only gomphid species recorded was *Ictinogomphus decoratus*, which is predominantly a lentic species. As most gomphids are lotic species inhabiting fast flowing water, they are more prevalent during the wet season.

It is not possible to draw any conclusions about the importance of trapeangs within the wildlife sanctuary for dragonflies other than they generally held common wetland species in low numbers during the survey period. With 27 species registered, the O'Chongheang River supported the most species, whereas among the trapeangs, the most visited site (Trapeang Lumtea) supported the highest number of species with 17 taxa. Beoung Khampa and Beoung Nava both supported more species than Trapeang Lumtea, with 23 and 18 species respectively, and were visited only twice (as opposed to the latter which was visited four times). I suspect more visits to Beoung Nava and Beoung Khampa would have yielded more species. I also received unpublished information from Jeremy Holden that he observed *Rhyothemis plutonia* (Selys, 1883) (photographic evidence) and *R. phyllis* (Sulzer, 1776) earlier in 2022 at Beoung Nava. The report of *R. plutonia* suggested there were up to 12 individuals flying low above the reeds at 10:00 hrs but they had all gone by midday. Given that my earliest arrival at Beoung Nava was at 11:20 hrs, the species was either missed or not present in November.

Over the course of the survey, 50 dragonfly species were recorded north of and including the O'Khampa River whereas 32 species were registered in the area south of the O'Khampa River. The former was likely due to the wider diversity of habitats in the north of the sanctuary. Most of the species recorded were expected dragonflies which are ubiquitous in open wetland habitats in the region. However, there were notable exceptions including the second country record for *Copera chantaburri* Asahina, 1984 (Figs. 11 & 12). The most significant records were arguably those for *Aciagrion paludense* (Fraser, 1922) (Figs. 17–19) at Trapeang Lumtea on 12 and 26 November which was initially identified as *A. occidentale* (Laidlaw, 1924). This incorrect identification and subsequent re-identification is considered below due to the complexity of taxonomic issues regarding this species and indeed the wider *Aciagrion* genus. Other interesting records include *Euphaea inouei* Asahina, 1997 (Fig. 7) which was observed on the O'Chongheang River from 21 to 23 November, a species whose taxonomic status also varies in the literature. Its taxonomy is therefore also considered below.

Aciagrion occidentale (Laidlaw, 1924) & *Aciagrion paludense* (Fraser, 1922).

Aciagrion occidentale was originally described as *Aciagrion hisopa* (Selys)? race *occidentalis* from three specimens (two males & one female) collected in India in October 1916 (Laidlaw 1919). In his description Laidlaw stated "The two males that I have seen are, however, characterized

by having a black triangle on the dorsum of the eighth abdominal segment, with its apex directed towards the hinder end of the segment". However, referring to specimens from Cochin (now Kochi) and Ceylon (now Sri Lanka) in his later review of the genus, he stated "My description states that the black mark on segment eight of the abdomen has its apex directed toward the hinder end of segment. This should read "directed towards the base of the segment". This was supported by a drawing showing the apex pointing towards the base (Laidlaw, 1924). Laidlaw's correction appeared to close issues related to segment 8, but further complications later arose when an individual matching his original description was found.

Joshi & Kunte (2014) stated "In Intanki NP on 24 May 2013 SJ recorded an *Aciagrion* male with S7 having a black triangle directed to the end of the segment (Image 5), as in the original description of *occidentale* by Laidlaw (1919). This fact made us suppose that this description was correct and the later correction by Laidlaw [sic] (1924) was based on other specimens, with the opposite direction of the triangle.". A photo of this individual is shown on p. 6468 of Joshi & Kunte (2014) which matches the original species described by Laidlaw (1919). This should now be considered the true description of *A. occidentale*.

It should be noted that *A. occidentale* was reported from Cambodia by Asahina (1967). However, Kosterin (2010) stated "There is a problematic species reported by Asahina (1967), *A. occidentale*, which is rare in Indochina, while the very similar *Aciagrion borneense* Ris, 1911 is common in dry season. In those early years, Asahina could still confuse them. Noteworthy that in his later paper (Asahina, 1982) devoted to Coenagrionidae of Thailand, most specimens of *A. borneense* were collected from November to January, the scarce *A. occidentale* in July and August. The specimens reported in Asahina (1967) were collected, at Phnom Penh and Bokor, on 15 XI and 2 XII, respectively. (Meanwhile, the conspecificity of Indochinese specimens referred to as *A. occidentale* and the true Indian *A. occidentale* was doubted by Hamalainen, 2001). Therefore, among the Cambodian Odonata we should list *A. occidentale* with caution.". However, Oleg Kosterin has since shared photographs taken by Stephane De Greef in Siem Reap Province (Fig. 30) of an individual *Aciagrion* which shows the segment 8 pattern of the "true Indian *A. occidentale*" of Laidlaw's (1919) original description. This proves that genuine *A. occidentale* does occur in Cambodia.

In discussing Laidlaw's (1924) revised description of *A. occidentale*, Joshi & Kunte (2014) suggested that "The

pattern of S7 and S10 corresponds to *Aciagrion paludense* Fraser, 1922, considered by a junior synonym of *A. occidentale* (Laidlaw, 1924; Fraser, 1933)". This required further exploration as Fraser (1922) actually stated "Segment 8 all blue save with a black mark shaped like a chess pawn with its apex pointing basal.". The black mark on segment 8 of the individual in Fig. 17 and Fig. 18 appears to be triangular and not "chess pawn" shaped, but closer examination shows the edges do not form a neat triangle. However, the individual in Fig. 19 has a marking on segment 8 which is intermediate between the triangle of the individual in Fig. 17 and Fig. 18 and the classic *Aciagrion borneense* in Fig. 16. In fact, the marking on segment 8 of the *A. paludense* in Fig. 19 is more like the "Chess pawn with apex pointing basal" originally described by Fraser (1922) as *A. paludensis* (*paludense*).

Fraser (1933) later changed his description of segment 8 of *A. occidentale* (which he assumed was a senior synonym of *paludense*) to "segment 8 with a narrow dorsal triangle of black, the base of the triangle on apical border of the segment, its point extending variably nearly quite up to base of segment.". This description better matches the segment 8 pattern of the *A. paludense* in Fig. 17 and Fig. 18.

Photographs of the original lectotype and paralectotype of Fraser's (1922) description of male *A. paludense* (Figs. 31–34) were obtained from the Natural History Museum, London. The lectotype (Fig. 31) clearly shows the basal-pointing "chess pawn" marking on segment 8 which correlates with the *A. paludense* photographed by the present study on 12 November 2022 (Fig. 19). The photograph of the paralectotype (Fig. 34) is inconclusive, as this is not so well preserved. The two individual males of *A. paludense* photographed in this study show variation of the marking on segment 8 with the individual recorded on the 26 November 2022 (Figs. 17 & 18) having a more triangular black marking. From this point of view, both of Fraser's descriptions (1922, 1933) are correct and the pattern on segment 8 is clearly variable. The photographs of the head and thorax of the lectotype (Fig. 32) appear identical to the individuals from Siem Pang Wildlife Sanctuary.

It should be noted that Joshi & Kunte (2014) referred to Fraser's original name *A. paludense*, correcting both his 1922 and 1933 publications where he referred to it as *A. paludensis*. Although not stated by Joshi & Kunte (2014), they fulfilled the change of spelling needed to correspond with the neutral gender of the generic name, as required by article 34.2 of the International Commission of Zoological Nomenclature.



Fig. 30 *Aciagrion occidentale* (Laidlaw, 1919), Siem Reap, 2022 (© S. De Greef).



Fig. 32 Dorso-lateral views of the head and thorax of *Aciagrion paludense*, lectotype (male).



Fig. 31 Dorsal and lateral views of the abdomen of *Aciagrion paludense*, lectotype (male).

Given these issues, I conclude that two species exist within the *A. occidentale* conundrum proposed by Joshi & Kunte (2014), namely the genuine *A. occidentale* (Laidlaw, 1919) (as shown in Fig. 30) and *A. paludense* (Fraser, 1922 & 1933) (as shown in Figs. 17–19). As a consequence, I propose that *A. paludense* be recognised as a species in its own right, rather than as a junior synonym of *A. occidentale*. An individual identical to the specimen in Fig. 17 & 18 has been photographed in Vietnam (Kompier, 2022). While this was identified by the author as *A. occidentale*, it should be regarded as *A. paludense*. The two records of *A. paludense* at Trapeang Lumtea on 12 and 26 November (Figs. 17–19) constitute the first records for Cambodia.

Given the foregoing, it is not surprising that Hämäläinen (2001) opined “It is hoped that someone will undertake a review of the whole genus, which is undoubtedly one of the most difficult and poorest known among the oriental damselflies.”



Fig. 33 Wings of *Aciagrion paludense*, lectotype (male).



Fig. 34 Dorsal view of *Aciagrion paludense*, paralectotype (male).

Euphaea inouei Asahina, 1997

The record of *Euphaea inouei* (Fig. 7) along the O'Chongheang River requires further discussion. Species within the genus *Euphaea* are challenging to identify due to the number of similar species. The individuals observed during the survey were initially identified as *E. masoni*, but following discussion with Oleg Kosterin, reassigned to *E. inouei* on the basis of having largely dark wings with coppery iridescence when opened. The specific status of *E. inouei* is not without controversy. Kosterin (2016) treated *inouei* as a subspecies of *E. masoni* and detailed how *masoni* and *inouei* were considered subspecies of *E. guerini* by Rambur (1842) and Asahina (1977), although Kosterin also stated "this did not hold much water (van Tol & Rosendaal, 1995; Hämäläinen & Karube, 2001)". Conversely, Phan *et al.* (2018) discussed how some early authorities, notably Selys Longchamps (1879) and Martin (1904), treated *E. guerini* and *E. masoni* as distinct species. Further, Asahina (1977) and others failed to identify structural differences between *E. guerini* and *E. masoni*. These include the lack of a ventral tuft of bristles on segment 9, with the upperside of the hindwing of *E. guerini* also possessing a green lustre (Phan *et al.*, 2018).

Phan *et al.* (2018) did not attempt to separate specimens from Vietnam into the taxa *masoni* and *inouei*, but listed all of them as *masoni*. They did state "However, the wing upperside of males from Vietnam (and eastern Cambodia) show a strong iridescent coppery-red flash in sunshine and the HW underside, except for its distal part, shows a slight deep-blue flash. At the same time males from Thailand and south-western Cambodia of the typical *Euphaea masoni*, described from the border between Myanmar and Thailand, show only a very slight purple shine on the wing upperside and no flash on the wing underside (Kosterin, 2014, 2016). These differences indicate the possibility that the Vietnamese populations concern a different taxon from *Euphaea masoni sensu stricto*". Phan *et al.* (2018) also state "The genital ligula and anal appendages of *inouei* are identical to those of *masoni*. It should be noted here that recently Hämäläinen (2016: 25, Note 39) listed *Euphaea inouei* as a good species based on morphological and unpublished molecular evidence.". Additionally, Paulson *et al.* (2023) also listed *E. inouei* as a full species. As a consequence of these points, the individuals recorded along the O'Chongheang River are attributed to *E. inouei*.

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