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What can be found from the observation records of Hong Kong Odonata over the past decade? (Part 3)

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ABSTRACT

The author's observation records of Hong Kong Odonata adults between 2011 and 2020 are reviewed. Temporal and spatial distribution of local Epiprocta is discussed, with brief accounts on several widely or restrictedly distributed species. A framework for citizen Odonata survey is proposed for a better understanding of local fauna and promulgation of knowledge and interest to the public.

Key words: Odonata, Epiprocta, Citizen Science, Hong Kong

INTRODUCTION

Part 2 of this article reviewed the author's observation records of Odonata species in Hong Kong between 2011 and 2020, assessed the conservation importance of sites and discussed the distribution of adult damselfly species. In Part 3, the author's observation records of adult dragonfly species of the suborder Epiprocta are discussed, particularly on their spatial and temporal distribution, with brief accounts on certain species of interest. Suggestions on citizen survey are given at the end of this article.

MATERIALS & METHODS

Refer to Part 2 of this article.

RESULTS

Refer to Part 2 of this article.

DISCUSSION

Temporal and spatial distribution of Epiprocta species in Hong Kong

Tam et al. (2011) listed 79 species of Anisoptera (formerly considered as a suborder of Odonata, now a clade under suborder Epiprocta) that occur in Hong Kong. None of them were regarded as historical records. Yet two species, namely *Gynacantha saltatrix* and *Orthetrum melania* (Fig. 1), have not been reported in the territory for some time before 2011, nor was there any sighting in the past decade (Mahler Ka, pers. comm.). For the latter, only photos from Guangdong and Taiwan are illustrated in Tam et al. (2011). In Wilson (1995) and Wilson (2003) these two species were considered uncommon but were still recorded in several sites spreading throughout Hong Kong. The protection

status of some sites have not been changed since these publications. These species may have become locally extinct due to unknown reasons. *G. saltatrix* was recorded in the nearby Huizhou, and *O. melania* still occurred in numbers in northern Guangdong areas.

Two species, *Planaeschna skiaperipola* and *Heliogomphus retroflexus*, were added to the Hong Kong checklist from a single sighting. Their local breeding status is uncertain. The presence of *Sieboldius deflexus* was determined by exuviae and is considered a misidentification (Ka, 2021).

Appendix 1 illustrates the number of Epiprocta species recorded in each month. Unlike Hong Kong Zygoptera which has most of its species starting to emerge in April, many Epiprocta species are not seen on wing until May, June or even July. These are also the months with peak species richness, with 65 species records in June. Towards winter months (December to February) the number of species observed decreases before it rises again in April the following year.

Similar to the classification in Part 2, the Epiprocta species are also roughly divided into lentic species and lotic species. The result is similar to that of Zygoptera, with the highest lotic species richness (26) in June, mainly represented by members of Gomphidae, Macromiidae and Synthemistidae, most of which have short flight periods between spring and mid-summer. Lentic species, on the other hand, reach the peak richness in July (43), and remain active till October. These are represented by most Libellulidae species as well as a few pond species in Aeshnidae and Gomphidae.

Same as the case for Zygoptera, the five most species-



Figure 1. *Orthetrum melania* in northern Guangdong province. This species has not been recorded in Hong Kong for decades. Photo by author.

rich sites for Odonata are also the ones which are the most species-rich for Epiprocta. A variety of habitats are present in these sites, accommodating both riverine environment for lotic species and swamps / ponds for lentic species.

The top five species ranked according to the number of sites recorded are the highly migratory *Pantala flavescens* (62 sites) and four from Hong Kong's most speciose Odonata genus *Orthetrum*, namely *O. glaucum* (49 sites), *O. pruinosum* (41 sites), *O. chrysis* (39 sites) and *O. sabina* (38 sites). These are followed by *Trithemis festiva* (37 sites), *T. aurora* (35 sites) and *Tramea virginia* (31 sites) that are usually seen in urban parks as well, then *Neurothemis fulvia* and *Zygonyx iris* (both 25 sites). The highest ranked non-Libellulidae species is *Ictinogomphus pertinax* (24 sites) (Fig. 2).

Twelve species were recorded at two or less sites (status defined as "Rare" following Tam et al., 2011), including *Polycanthagyna erythromelas*, *Euthygomphus koxingai*, *Fukienogomphus choifongae*, *Lamelligomphus hainanensis*, *Sinictinogomphus clavatus*, *Stylogomphus* sp., *Idionyx claudia*, *Diplacodes nebulosa*, *Onychothemis tonkinensis*, *Tramea transmarina* and *Trithemis pallidinervis*. More details are included in the brief accounts of each respective family below.

The recent sighting of *Chlorogomphus papilio* in Ng Tung Chai (AFCD, 2021) is outside of the study period and thus not included in the current article.

Aeshnidae

Species richness of Aeshnidae as a whole is fairly consistent from April to October (four to six species recorded per month, except July with eight species). Adults of the two speciose genera *Anax* and *Gynacantha* are found active from March to December.

Despite their larger sizes, they are more difficult to observe than other families, since many species are crepuscular and rest in woodland areas during daytime, while the diurnal species seldom rest during active hours. Even they are found at rest hanging on tree branches, they often fly away for good without returning to the resting position if disturbed.

Some interesting observations are noted below:

Anaciaeschna jaspidea: the author recorded the species at four locations, two of which were unlikely their habitats. Two mature males were found resting at Scatter Fall, Ng Tung Chai (about 500m above sea level) at dusk on 13 July 2013. Another dying, mature male was found on the staircase of a building at Sheung Wan on 7 August 2019. It is not sure whether these individuals were from migratory flocks (Fig. 3).

Cephalaeschna klostae: there was no confirmed sighting of this very elusive species by the author. Occasional reports from enthusiasts were known (Mahler Ka, pers. comm.), all from Ng Tung Chai in July (Fig. 4).



Figure 2. The top five most frequently recorded species of Epiprocta by author. From left to right in descending order of record frequencies: *Pantala flavescens*, *Orthetrum glaucum*, *O. pruinosum*, *O. chrysis* and *O. sabina*. Photos by author.



Figure 3. A mature male *Anaciaeschna jaspidea* with bright blue eyes found at Ng Tung Chai, which is not a typical habitat for this species. Photo by author.



Figure 4. A male *Cephalaeschna klostae* recorded at Ng Tung Chai, the only known locality of this species in Hong Kong. Photo by Rainbow Li.

Polycanthagyna erythomelas: although this species was recorded by the author at only two locations, it has also been reported in a number of sites from Wu Kau Tang in the northeast to Keung Shan in the southwest of Hong Kong (Cheung Che-Man, pers. comm.). The larvae can be found in many stagnant water pools near streams throughout the territory (Fig. 5).

Gomphidae

Emergence of lotic Gomphidae species in Hong Kong seems to follow specific patterns every year. Based on previous observations by others (Mahler Ka, pers. comm.) and subsequent records by the author, below is the earliest months of emergence observed:

March: *Asiagomphus* spp.

April: *Euthygomphus koxingai*, *Fukienogomphus choifongae*, *Heliogomphus scorio*, *Sieboldius alexanderi*, *Stylogomphus chunliuae*

May: *Burmagomphus vermicularis*, *Gomphidia kelloggi*, *Lamelligomphus hainanensis*, *Leptogomphus hongkongensis*, *Megalogomphus sommeri*, *Ophiogomphus sinicus*

June: *Melligomphus guangdongensis*, *Paragomphus capricornis*

July: *Labrogomphus torvus*

Emergence time may vary, for example a teneral *B. vermicularis* was once observed in July. But in general the flight periods of many Gomphidae species are brief. Adults begin to disappear around late June to July. A few species are on the wing towards the end of summer.

The two lentic species *Ictinogomphus pertinax* and *Sinictinogomphus clavatus* have longer flight periods that are well extended into autumn.

Asiagomphus spp.: most articles and publications listed



Figure 5. Adults of *Polycanthagyna erythomelas* are not commonly seen, but larvae (inset) usually occur in vast amount in small pools near hilly streams. Photos by author.

Asiagomphus hainanensis as the only species of this genus occurring in Hong Kong, e.g. Wilson (1995), Wilson (2003), Tam et al. (2011), Reels (2019). Zhao (1990) and Ka (2021) mentioned the occurrence of both *A. hainanensis* and *A. septimus* in Hong Kong. Zhao (1990) states that the subgenital plate in the female of *A. septimus* is nearly at right angle to the abdomen, while it is never so for *A. hainanensis*. Tsou (2021) mentioned that the difference in the length of antehumeral stripe, among other features, distinguishes the species, but Zhao (1990) illustrates both patterns under *A. hainanensis*, with the shorter band variety sketch modified from Asahina (1965, 1966) based on Hong Kong specimens. Other distinguishing features mentioned in Zhao (1990) and Tsou (2021) include female occiput shape, yellow spots on pronotum etc. These features cannot always be clearly identified in the field or from photos. For these reasons the observation records are treated as *Asiagomphus* spp. (Fig. 6).

Fukienogomphus choifongae: since its discovery in 2004, this species has only been recorded in Wu Kau Tang. Teneral and sub-adult individuals were seen from early to mid-April. Mature individuals with emerald eyes were very occasionally encountered in the same locality around late April / early May. A female was observed ovipositing near a stream on the other side of the watershed above Wu Kau Tang on 11 June 2020. Hu et al. (2021) opined that this may indeed be *F. prometheus* based on similarity in body pattern and the fact that the genitalia of immature male (used as evidence to separate the species in Wilson and Tam 2006) is prone



Figure 6. (Top left and right) The length of the antehumeral stripe is said to be a feature that helps distinguish between *Asiagomphus hainanensis* and *A. septimus*. This feature varies among *Asiagomphus* individuals in Hong Kong. (Bottom) The subgenital plates of the female *Asiagomphus* sp. observed in Hong Kong are usually at right angle to the abdomen in lateral view. Photos by author.

to deformation, yet this would be subject to further study on mature male specimen (Fig. 7).

Lamelligomphus hainanensis: there is a stable community at Sham Tseng, the only site recorded by the author. It is also known to occur at other sites particularly in the northeast New Territories (Fig. 8).

Stylogomphus spp.: Ka (2021) reported that *Stylogomphus* individuals found at Lantau Island is morphologically different from those found in mainland New Territories, which have been identified as *S. chunliuae*. Differences in occiput shape, thoracic stripes and appendages are noted. AFCD's Biodiversity Database (AFCD 2022) has adopted this distinction (Fig. 9).

Macromiidae

The three lotic *Macromia* spp., namely *M. berlandi*, *M. katae* and *M. urania*, start to emerge in early summer. The flight period for the former two is relatively short,

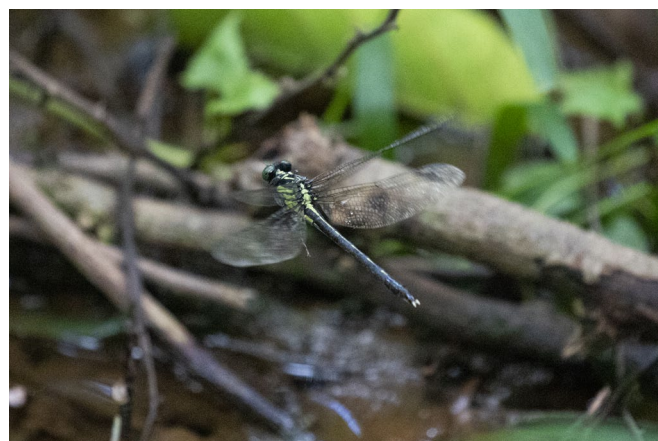


Figure 7. An ovipositing *Fukienogomphus choifongae*. Photo by author.

with no record after July, while *M. urania* can be seen on wing till autumn, albeit in much fewer number of sightings after summer. *M. katae* (Fig. 10) is more commonly observed in New Territories North while the other two are more widespread. The even more widespread *Epophthalmia elegans* are seen on wing from April to November, cruising above lentic habitats like fish ponds and man-made reservoirs.

Synthemistidae

Similar to the lotic Macromiidae species, the four Hong Kong Synthemistidae species are mainly seen as adults in summer months. *Macromidia ellenae* (Fig. 11) are only recorded in New Territories North with a brief flight period between April and June, while the only other congeneric species in Hong Kong, *M. rapida*, are as widespread as *Idionyx victor* with similar flight period from May to September. The elusive *Idionyx claudia* has only been recorded by the author in July in Ng Tung Chai.

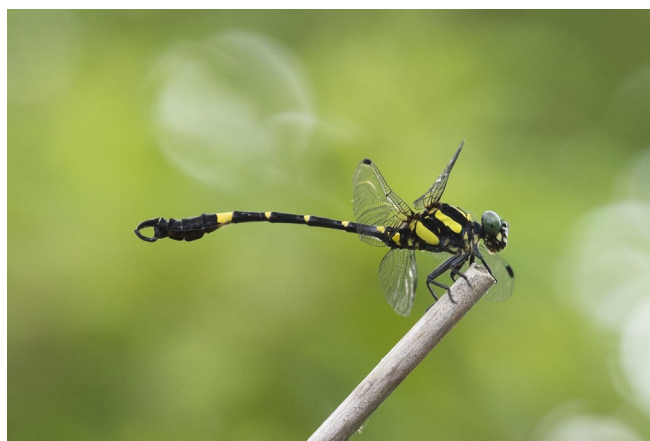


Figure 8. A male *Lamelligomphus hainanensis* found in the northeast New Territories. Photo by author.



Figure 9. Males of *Stylogomphus* spp. found in Yuen Long (left) and on Lantau Island (right). Photos by author.

Libellulidae

Majority of the Libellulidae species have a flight period of six months or longer. Other than those that are separately described below, species with a shorter flight period as per the author's records include *Nannophya pygmaea* (May to August), *Nannophyopsis clara* (May to September), *Orthetrum poecilops* (May to August), *Rhyothemis triangularis* (April to August) and *Zygonyx asahinai* (May to July). All these adults are most abundant in summer months, similar to most other Libellulidae species. *Diplacodes trivialis* and the highly migratory *Pantala flavescens* are more frequently recorded in autumn.

Diplacodes nebulosa: the abundance of this species in Hong Kong has been dropped significantly compared to the situation a few decades ago that was described in Wilson (1995). It has only occasionally been recorded as if it is a vagrant species, with only one or two individuals at a time. The author recorded male individuals in Luk Keng on 19 October 2013 and 22 November 2014 and a female in Wu Kau Tang on 18 June 2016. Apart from these and the locations quoted in Tam et al. (2011), this species was also recorded in Lung Kwu Tan (Eric Tse, pers. comm.) and Tin Shui Wai. It is not sure whether

there is still a breeding colony in Hong Kong (Fig. 12).

Onychothemis tonkinensis: an uncommon species mostly seen in New Territories North sites. Recorded by the author from June to August. It favours gentle gradient streams, many of which were converted into concrete channels for flood prevention in the last decades of the twentieth century. Since the millennium, ecological values of lowland streams have been taken into account in river training projects, and deployed elements such as grasscreting, gabions, retention of meanders etc. to preserve the habitats for freshwater life (DSD, 2022). One of the communities for *O. tonkinensis* was found in one channelized stream in Fanling (Fig. 13).

Tamea transmarina: described as occasional visitors in Tam et al. (2011). The author has recorded the subspecies *T. t. euryale* at Sha Lo Tung and Kowloon Walled City Park. A male individual of another subspecies, *T. t. propinqua* with larger colour patch in the hindwings, was recorded in Yuen Tun Ha, identification courtesy of Mahler Ka. Local photographic records are occasionally seen on the internet, and most are not related to typhoon as described in Wilson (2003), yet its breeding status in Hong Kong is still uncertain (Fig. 14).



Figure 10. The Macromiidae species *Macromia katae* was first described from Hong Kong specimens. Photo by author.



Figure 11. The Synthemistidae species *Macromia ellenae* was first described from Hong Kong specimens. Photo by author.



Figure 12. *Diplacodes nebulosa* male. Photo by author.



Figure 13. A male *Onychothemis tonkinensis* found on riparian vegetation of a channelized river in Fanling. Photo by author.

Trithemis pallidinervis: this was only recorded once by the author in Hong Kong. A mature male was seen at Wo Sang Wai on 13 September 2011. Occasional records were known at Ninepin Islands (Cheung Che-man, pers. comm.) and other anonymous locations (Fig. 15).

Public Odonata survey

Although the Hong Kong Odonata fauna is better known than many other local insect orders, there is still much to learn about their distribution and ecology (Reels, 2014). Owing to limited resources, surveys for research projects or for Environmental Impact Assessments usually cover only a certain period of time in a year around specific sites in concern (e.g. Reels, 2019), with gaps in both specific months in a year or geographic locations within the territory. Moreover, certain sites formerly considered to be valuable for Odonata have been degraded due to natural succession or nearby development (Reels, 2020). Collaborative effort of territory-wide observation and / or monitoring by citizens can at least fill the knowledge shortfall and provide baseline information as evidence for further conservation actions.

General public participation in biodiversity survey is not new to Hong Kong. Examples include collation of records from public bird watchers (HKBWS, 2022), annual surveys by Butterfly Surveyor Group comprising public members since 2008 (Green Power, 2022), public surveys for terrestrial invertebrates on Lantau Island (OWLHK, 2022) and Hong Kong Firefly Survey Team (Yiu, 2021). Data from these surveys did contribute much to enhancing understanding of the local ecology in their respective study areas.

From the results in Part 1 to Part 3 of this article, it can be seen that Odonata observation records of a few

enthusiasts over a long period of time not only add species to the Hong Kong checklist, but also give clues about their phenology, habitat preference etc. Expanding the number of recorders would certainly provide a much more robust set of data that help in the research of local Odonata ecology and provide rationale for conservation decisions.

A citizen science programme for Hong Kong Odonata survey can facilitate

(1) the provision of persistent survey results for conservation use, and

(2) the popularization of interest in and knowledge of Odonata fauna.

Fraisl et al (2022) outlines implementation and examples of adopting citizen science processes for nature related projects. The programme for Hong Kong Odonata may comprise the following two parts:



Figure 15. A mature male *Trithemis pallidinervis*. Photo by author.



Figure 14. Different subspecies of *Tramea transmarina* were recorded in Hong Kong: (left) *T. t. euryale*; (right) *T. t. propinqua*. Photos by author.

(1) Engagement of public to become Odonata surveyors to carry out systematic monitoring. Training sessions shall be organized to equip the surveyors with sufficient skills for Odonata identification and field survey, similar to the practice in Green Power (2022) and Yiu (2021).

(2) Collation of past observation records by individual enthusiasts and records uploaded to online database such as iNaturalist. At the time of writing (October 2022), for example, there are over 20,000 Hong Kong Odonata records in iNaturalist database. Each record shall be reviewed for correctness in species identification, availability of geographical location etc., before further analysis.

Careful choice of methods and parameters may address concerns about apparent randomness of the above survey data if they are to be used for trend estimation (Issac et al., 2014).

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APPENDIX

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Aeshnidae												
Lotic species												
<i>Anax immaculifrons</i>				✓	✓	✓	✓	✓	✓	✓		
<i>Cephalaeschna klotsi</i>												
<i>Planaeschna skiaperipola</i>												
<i>Tetracanthagyna waterhousei</i>				✓	✓	✓						
Lentic species												
<i>Anaciaeschna jaspidea</i>							✓	✓		✓		
<i>Anax guttatus</i>				✓	✓	✓	✓	✓	✓	✓	✓	
<i>Anax indicus</i>												
<i>Anax nigrofasciatus</i>			✓	✓	✓				✓			
<i>Anax parthenope</i>							✓		✓	✓	✓	✓
<i>Gynacantha japonica</i>							✓	✓	✓	✓	✓	
<i>Gynacantha ryukyuensis</i>					✓	✓	✓					
<i>Gynacantha saltatrix</i>												
<i>Gynacantha subinterrupta</i>						✓	✓	✓	✓	✓	✓	
<i>Polycanthagyna erythromelas</i>					✓	✓	✓	✓				
Cordulegastridae												
Lotic species												
<i>Anotogaster</i> sp.					✓							
Gomphidae												
Lotic species												
<i>Asiagomphus</i> spp.			✓	✓	✓	✓	✓					
<i>Burmagomphus vermicularis</i>					✓	✓	✓	✓				
<i>Euthygomphus koxingai</i>				✓	✓	✓						
<i>Fukienogomphus choifongae</i>				✓		✓						
<i>Gomphidia kelloggi</i>					✓	✓	✓					
<i>Heliogomphus retroflexus</i>												
<i>Heliogomphus scorpio</i>				✓	✓	✓						
<i>Labrogomphus torvus</i>							✓	✓	✓			
<i>Lamelligomphus hainanensis</i>					✓	✓	✓	✓				
<i>Leptogomphus hongkongensis</i>					✓	✓	✓					
<i>Megalogomphus sommeri</i>					✓	✓	✓					
<i>Melligomphus guangdongensis</i>						✓	✓					
<i>Ophiogomphus sinicus</i>					✓	✓	✓					
<i>Paragomphus capricornis</i>						✓	✓	✓	✓			
<i>Sieboldius alexanderi</i>				✓	✓	✓	✓	✓				
<i>Sieboldius deflexus</i>												
<i>Stylogomphus chunliuae</i>				✓		✓						
<i>Stylogomphus</i> sp.						✓						
Lentic species												
<i>Ictinogomphus pertinax</i>				✓	✓	✓	✓	✓	✓	✓		
<i>Sinictinogomphus clavatus</i>					✓	✓	✓	✓	✓			
Macromiidae												
Lotic species												
<i>Macromia berlandi</i>					✓	✓	✓					
<i>Macromia katae</i>					✓	✓	✓					
<i>Macromia urania</i>					✓	✓	✓	✓	✓			
Lentic species												
<i>Epophthalmia elegans</i>				✓	✓	✓	✓	✓	✓		✓	

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Synthemistidae												
Lotic species												
<i>Idionyx claudia</i>							✓					
<i>Idionyx victor</i>					✓	✓	✓	✓	✓			
<i>Macromidia ellenae</i>				✓	✓	✓						
<i>Macromidia rapida</i>					✓	✓	✓	✓				
Libellulidae												
Lotic species												
<i>Onychothemis tonkinensis</i>						✓	✓	✓				
<i>Zygonyx asahinai</i>					✓	✓	✓					
<i>Zygonyx iris</i>				✓	✓	✓	✓	✓	✓			
Lentic species												
<i>Aethriamanta brevipennis</i>					✓	✓		✓	✓	✓		
<i>Acisoma panorpoides</i>				✓	✓	✓	✓	✓	✓	✓	✓	
<i>Brachydiplax chalybea</i>				✓	✓	✓	✓	✓	✓	✓	✓	
<i>Brachythemis contaminata</i>			✓	✓	✓	✓	✓	✓	✓	✓	✓	
<i>Crocothemis servilia</i>			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>Diplacodes nebulosa</i>						✓				✓	✓	
<i>Diplacodes trivialis</i>		✓				✓	✓	✓	✓	✓	✓	
<i>Hydrobasileus croceus</i>					✓	✓	✓	✓		✓		
<i>Indothemis carnatica</i>							✓					
<i>Lyriothemis elegantissima</i>				✓	✓	✓	✓	✓	✓			
<i>Macrodiplax cora</i>							✓	✓	✓	✓	✓	
<i>Nannophya pygmaea</i>					✓	✓		✓				
<i>Nannophyopsis clara</i>					✓	✓	✓	✓	✓			
<i>Neurothemis fulvia</i>		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>Neurothemis tullia tullia</i>				✓		✓	✓	✓	✓	✓	✓	
<i>Orthetrum albistylum</i>												
<i>Orthetrum chrysis</i>			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>Orthetrum glaucum</i>	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>Orthetrum luzonicum</i>				✓	✓	✓	✓	✓	✓	✓		
<i>Orthetrum melania</i>												
<i>Orthetrum poecilops</i>					✓	✓	✓	✓				
<i>Orthetrum pruinatum</i>			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>Orthetrum sabina</i>					✓	✓	✓	✓	✓	✓	✓	
<i>Orthetrum triangulare</i>				✓	✓	✓	✓	✓	✓	✓		
<i>Palpopleura sexmaculata</i>					✓	✓	✓		✓	✓	✓	
<i>Pantala flavescens</i>			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>Potamarcha congener</i>			✓			✓	✓	✓	✓	✓		
<i>Pseudothemis zonata</i>				✓	✓	✓	✓	✓	✓			
<i>Rhodothemis rufa</i>						✓	✓	✓	✓	✓	✓	
<i>Rhyothemis fuliginosa</i>										✓		
<i>Rhyothemis triangularis</i>				✓		✓	✓	✓				
<i>Rhyothemis variegata</i>				✓	✓	✓	✓	✓	✓	✓	✓	
<i>Sympetrum darwinianum</i>												
<i>Sympetrum fonscolombii</i>											✓	
<i>Tholymis tillarga</i>		✓					✓	✓	✓	✓	✓	✓
<i>Tramea transmarina</i>							✓					
<i>Tramea virginia</i>			✓		✓	✓	✓	✓	✓	✓	✓	✓
<i>Trithemis aurora</i>				✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>Trithemis festiva</i>	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<i>Trithemis pallidinervis</i>									✓			
<i>Urothemis signata</i>					✓	✓	✓	✓	✓	✓	✓	
<i>Zygomma petiolatum</i>					✓	✓	✓	✓	✓	✓		
No. of species in each month	2	5	12	32	54	65	64	51	44	36	28	11

Appendix 1. Observation records of Hong Kong Eiprocta adults by month.

Hong Kong firefly survey report 2021-2022

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ABSTRACT

11 members of the Hong Kong Firefly Survey Team 2021-2022 were recruited. After intensive lecture and field trainings, members did the surveys in three different modes - clarifying the range of *Oculogryphus chenghoiyanae*, monitoring population trend of *O. chenghoiyanae* and *Rhagophthalmus hiemalis*. Totally, 53 surveys were done from 2021 December to 2022 June. *O. chenghoiyanae* has not been found out of its current distribution range. Continue decline of population of *O. chenghoiyanae* and *R. hiemalis* is shown. It is the first time larva of *Vesta* is discovered locally.

Key words: Lampyridae, firefly surveys, Hong Kong

INTRODUCTION

Following the success of Firefly Survey Team 2020-2021. Open recruitment for the Firefly Survey Team 2021-2022 was done from 3 June to 23 June 2021. Target was to recruit 5-10 members. 16 applications was received and 11 members were recruited (Fig. 1). Selection criteria were the same as the previous recruitment (Yiu, 2021). Opening ceremony and the first training was held on the World Firefly Day - 3 July 2021.

100% attendance to training lectures was required. Members were also required to pass an examination. Attendance requirement for practical trainings in the wild was four out of the six taken place from August to December. Content of training lectures and places for practical trainings were generally the same as previous year (Yiu, 2021). The main difference is all the trainings were done face-to-face this year.

MATERIALS & METHODS

Trained members of the Hong Kong Firefly Survey Team were arranged to do surveys in small groups of two to three persons. For every survey site, the route map, requirements, methods, location of observation points and a short video showing the site and route were provided to the members beforehand. Each survey should last for 60 minutes or more. After each survey, members were required to fill in an online Firefly Survey Record Form. The form contains name(s) of surveyor, date, start time, end time of survey; moon phase, temperature, wind speed, cloud coverage, precipitation, fog/mist, number and location of the target firefly species found.

There are three different modes of survey done from

December 2021 to June 2022:

Survey mode 2b - Clarifying the range of a restricted species - *Oculogryphus chenghoiyanae*. Three different routes with similar land features and vegetation as the sites with records of the species were selected, namely Tei Tong Tsai Country Trail, Wong Lung Hang Country Trail, Nei Lak Shan Country Trail. Members were required to walk along more or less a distance of two km along the designated route in slow pace within the active time of the female adult displaying light – 19:30 to 21:00, and check for the occurrence of light display female adults. Surveys were done within the flight period – May to early June.

Survey mode 3a - Monitoring population trend of a restricted species - *O. chenghoiyanae*. Surveys were done along a foot path in Tei Tong Tsai. Members were required to walk along designated routes in a slow pace – not faster than 2 km/h, within the active time of the female adult displaying light – 18:00 to 19:00, check every encountered light spots and count the number of light displaying females found along the two sides of the routes – transect count. The routes is about 2 km long. Surveys were done within the flight period – May to early June. Same counting was done along the same routes in previous years.

Survey mode 3b - Monitoring population trend of a restricted species - *Rhagophthalmus hiemalis*. Surveys were done along a road in Lin Fa Shan (MacLehose Trail Section 9), from late December to late February. Members were required to walk along a designated routes in a slow pace – not faster than 2 km/h, within the active time of the female adult displaying light – 18:00 to 19:00, check every encountered light spots and count the number of light displaying females found along the two sides of the routes – transect count. The routes is about 2 km long. Same counting was done along the same routes in previous years.

RESULTS

Survey mode 2b - Clarifying the range of a restricted species - *O. chenghoiyanae*

11 members participated and 18 surveys were done, three surveys along Wong Lung Hang Country Trail, 11 along Tei Tong Tsai Country Trail and four along Nei Lak Shan Country Trail. The target species was not found in all surveys.

Survey mode 3a - Monitoring population trend of a restricted species - *O. chenghoiyanae*

11 members and the team leader had participated, 20 surveys were done. Out of the 20 surveys, nine surveys had no record of the target, six surveys had one record of *O. chenghoiyanae* female adult in each; two surveys have two records in each; one survey has three records; one survey has four records; Inputting the data of 2022 and the previous data since 2014 into the IUCN Criteria A example worksheet (IUCN, 2012, 2013), the past reduction over 10 years (longer than three generations) is -65.2% for the population of this species under the assumption that the reduction of number has been constant over time.

Survey mode 3b - Monitoring population trend of a restricted species - *R. hiemalis*

11 members had participated, 11 surveys were done. Out of the 15 surveys, 12 surveys have no record of the target species, three surveys have one record of *R. hiemalis* female adult in each. In the survey done in Dec 2020 to Feb 2021, out of the 31 surveys, three surveys have two records of *R. hiemalis* female adult in each; and 11 surveys have one record of *R. hiemalis* female adult in each. Continue decline is shown (Yiu, 2022).

Other findings

1. Discovery of a larva of *Vesta* (Fig. 2), most probably *Vesta sinuata* which is the only known *Vesta* in Hong Kong.
2. First record of whole-body fluorescence (except the head) of female *Stenocladus bicoloripes* under UV light (Fig. 3)
3. Discovery of diving ability of *Lamprigera taimoshana* larvae under water
4. Two new location records of *Lamprigera taimoshana* (larva) on Tai Mo Shan
5. New location records of *Rhagophthalmus motschulskyi* in Ma On Shan, Mui Wo and Mount Parker Road.
6. New location record of *Aquatica leii* in Sha Lo Tung
7. New location record of *Luciola curtithorax* in Mui Wo
8. New location record of Species inquirenda 1 in Nei Lak Shan
9. New location record of *Luciola* nr. *nicollieri* in Mount Parker and Mount Butler.

DISCUSSION

O. chenghoiyanae is only known along the path near its type locality, but nowhere else. Intensive efforts had been

made to look for the occurrence of *O. chenghoiyanae* in similar habitats in Lantau for two consecutive years, it is not found. It is likely that this species only survive within the current known, very narrow geographic range, much smaller than the threshold of 100km² of Extent of Occurrence and 10km² of Area of Occupancy, and it will fall into the Critically Endangered Category of Criteria B of the IUCN Red List Categories and Criteria (IUCN, 2012). Since the erection of the strong street lamps along the path of its type locality, the population has dropped sharply, -65.2% reduction over 10 years (longer than three generations), and it falls into the Endangered Category of Criteria A. In addition to the strong street lamps, the threats of increasing light pollution from the rapidly expanding Tung Chung city and the airport is also a major concern. There is a high probability of extinction of this species in the near future. A full Red List Assessment report has been submitted to the IUCN Red List Unit.

R. hiemalis is only known from Hong Kong, in Tai Mo Shan, Tsuen Kam Au, Mui Tsz Lam (Shatin) and Shatin Pass. It is no longer found in Mui Tsz Lam site and Tai Mo Shan site after repeated searching in recent years. Repeated quantitative surveys done along the same belt transect along the MacLehose Trail Section 9 finds that the past reduction over 10 years (longer than three generations) is -87.0% for the population of *R. hiemalis* under the assumption that the reduction of number has been constant over time (Yiu, 2022). Applying Criterion A2 of the IUCN Red List Assessment, the species could be listed in the category of Critically Endangered (IUCN, 2012). The main threats to the species is increasing light pollution and habitat degradation intensified by biking activities outside the designated tracks. There is a high probability of extinction of this species in the near future. A full Red List Assessment report has been submitted to the IUCN Red List Unit.

The survey team members has also contributed a lot of new and interesting discoveries about Hong Kong Fireflies.

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FIGURES



Figure 1. The Hong Kong Firefly survey Team 2021-2022. Photo by author.



Figure 2. Larva of *Vesta*. Photo by Fung Chun-Sang.



Figure 3. Whole-body fluorescence (except the head) of female *Stenocladus bicoloripes* under UV light. Photo by Fung Chun-Sang.

