

What can be found from the observation records of Hong Kong Odonata over the past decade? (Part 2)

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ABSTRACT

The author's observation records of Hong Kong Odonata adults between 2011 and 2020 are reviewed. Sites and dates of the records of 111 species are summarized. It shows that, in general, the flight periods of most lotic species occur between April and June, while those for the lentic species are more spread out from April to November. Conservation importance of the 109 sites visited are evaluated following the assessment metric in Reels (2020). Sha Lo Tung is the top-ranked site, outscoring the more species-rich sites at Luk Keng, Hok Tau and Sham Tseng. Temporal and spatial distribution of local Zygoptera is discussed, with brief accounts on several restrictedly distributed species.

Key words: Odonata, Zygoptera, Assessment Metric, Hong Kong

INTRODUCTION

Part 1 of this article described the 13 new Hong Kong Odonata species records after 2011. In Part 2, the author's observation records of all adult Odonata species between 2011 and 2020 are discussed, particularly on their spatial and temporal distribution, with brief accounts on local damselfly species (suborder Zygoptera). Discussion on the remaining dragonflies (suborder Epiprocta) will be covered in Part 3, which will also discuss the new Odonata species records since publication of Part 1 and suggestions for citizen Odonata survey.

MATERIALS & METHODS

The author's photographic records of adult Odonata from 2011 to 2020 are summarized. Field observation records between 2017 and 2020 are supplemented to the data set. Only records that can be identified to species level are included, except two Gomphidae species which will be explained in Part 3, while doubtful sightings of closely resembling species are discarded.

Each entry of record contains the date, the site and the scientific name of each species observed. Only a single entry is put into the data set if there are more than one individual of that particular species occur at the same site on the same date. Sightings of the same species at the same site on a different date or that on the same date at a different site are treated as separate records. Details about gender, behaviour (e.g. mating, flying in tandem, oviposition) and (in more recent entries) the approximate number of individuals are remarked for

each record, but these are not analyzed in the present study.

It should be noted that particulars of the visits (e.g. the choice of sites, duration and frequency each year with respect to dry / wet seasons) were not chosen following commonly adopted methods for scientific study. Sampling effort between months or sites is not directly comparable, yet this does not affect the discussion in this article.

RESULTS

A total of 3,444 Hong Kong Odonata observation records from 2011 to 2020 are reviewed. These encompass 111 species, including 32 for Zygoptera and 79 for Epiprocta. Records were taken during 552 visits to 109 sites over the territory. Figure 1 shows the locations of these sites, which are grouped according to their geographical location.

The total number of species recorded by month over the past decade is illustrated in Figure 2. These data show that the flight periods of Odonata adults are highly seasonal. Most species are on the wing from late spring to early autumn. During the winter months (December to February) only few species would still be active as adults. Emergence starts to bloom in April, with the peak numbers of recorded species in June and July.

It should be noted that since the current review is largely based on photographic records, data on visits that yielded no Odonata record are not included. The flight period information here provides an insight rather than a vigorous investigation result.

The ten most species-rich sites and the species recorded are listed in Appendix 1. Species checklist follows Ka (2021), except that *Asiagomphus* spp. records are not distinguished (to be explained in Part 3) and the unidentified *Sympetrum* sp. is discarded. Over 40 species are recorded in five of these sites. It is worth noting that there is no direct relationship between the number of visits and species richness of the sites. Five of the top ten sites are located in New Territories North.

DISCUSSION

Site conservation value assessment

Reels (2020) considered that species richness alone does not fully reflect the conservation importance of an Odonata site, and adopted an assessment metric proposed by Wilson and Reels in an unpublished

proceeding in 1999 for evaluating the conservation values of major sites. Each species is allocated a score based on their distribution, biology, population trend etc. For each site, a total score is given by adding up the scores of each species that is recorded there. Species scores listed in Reels (2019) are adopted in the current study. For newly recorded but regularly seen species (e.g. *Gynacantha ryukyuensis* and *Indothemis carnatica*), a conservative score of 1 is adopted, pending further review of the scoring criteria. A short discussion on the species scores will be included in Part 3.

Scores of the top ten sites are listed in Appendix 2. Sha Lo Tung receives the highest score despite ranking fourth in species richness, mainly due to the numerous Gomphidae species that can be found there. Many of the Hong Kong gomphid species are with more than half of their distribution range inside southeast China according to Reels (2019). The most species-rich site, Hok Tau, ranks second. Their scores well exceed lower ranked sites. This generally aligns with the assessment in Reels (2020), in which the combined Sha Lo Tung / Hok Tau site ranked first, implying the high conservation value under this assessment metric. While Luk Keng ranks second in species richness, its score ranks fourth, partly due to the vast number of common Libellulidae species in lowland area.

Temporal and spatial distribution of Zygoptera species in Hong Kong

Tam et al. (2011) listed 37 species of Zygoptera species that occur in Hong Kong, four of which are said to be historical records, namely *Euphaea opaca*, *Ischnura asiatica*, *Ischnura rufostigma* and *Paracercion hieroglyphicum* and not seen in recent years. While *Lestes praemorsus* (nominate subspecies *L. p. praemorsus*) has not been classified as historical, only photos from Singapore showing another subspecies *L. p. decipiens* were included, and according to enthusiasts this species has not been recorded in the past decade either. The author's record of 32 species over the past decade generally aligns with Tam et al (2011). A single male *Ischnura rufostigma* was collected in New Territories West on 20 March 2020 (AFCD, 2020) (Fig. 10), and whether the population has been re-established in Hong Kong remains unknown.

Appendix 3 illustrates the number of Zygoptera species recorded in each month. Most of the species start to emerge in April, which is also the peak number of species recorded among the months. Species richness decreases from above 20 during summer months to around 15 to 17 during late summer and autumn months from September to November. Very few species are on the wing during winter and there is no record in January.

In Appendix 3, the 32 Zygoptera species are roughly divided into lentic species (slow flowing streams, ponds and swamps, mostly in lowland areas) and lotic species (fast flowing streams or seepages, mostly in upland wooded areas) according to their occurring habitats.

There is no strict definition for and boundary between each grouping, and some species may occur in both types of habitats.

Following this classification, it can be seen from Appendix 3 that lotic species richness peaks in April and May, and drops rapidly after June. This is particularly the case for the two species of Rhipidolestidae and four species of Platystictidae (Fig. 3) which are only recorded from late spring to middle summer. Their short flight period may also account for their late discovery compared with other Hong Kong species: five of these six species were first described from Hong Kong specimens in 1987 (*Prosticta taipokauensis*) and between 1996 and 1997 (*Rhipidolestes janetae*, *Drepanosticta hongkongensis*, *Prosticta beaumonti* and *Sinosticta ogatai*). Lentic species richness, on the other hand, remains above 10 from April to November and generally increases towards late summer.

The five most species-rich sites for Odonata are also the ones which are most species-rich for Zygoptera. Tan Shan River, ranked 8th for overall Odonata species richness, tied with Sha Lo Tung and Wu Kau Tang at the 4th place in terms of Zygoptera richness. It is a lowland, gentle gradient stream, a habitat which has been disappearing in Hong Kong over the past two to three decades due to urban development and flood prevention works.

The top five species ranked according to the number of sites recorded are *Euphaea decorata* (31 sites), *Ceriagrion auranticum* (31 sites), *Heliocypha perforata* (23 sites), *Prodasineura autumnalis* (23 sites) and *Copera marginipes* (19 sites). Although the two top ranked species, *E. decorata* and *C. auranticum* (Fig. 3), are recorded at the same number of sites, there is difference in the distribution of records by month, with most records of *E. decorata* concentrate between May and August, while those for *C. auranticum* spread out evenly between May and October.

Six species are recorded at two or less sites (status defined in Tam et al. (2011) as "Rare"). Those recorded in two sites are *Lestes nodalis*, *Aciagrion approximans* and *Mortonagrion hirosei*. Other than *L. nodalis*, there are other known sites for the other two species by various observers over the past decade. Three species are recorded at only one site, namely *Agriocnemis lacteola*, *Pseudagrion spencei* and *Prosticta beaumonti*. Brief accounts on the observation records of these six species are given below.

Lestes nodalis (Fig. 5): This is the only remaining Lestidae species regularly seen in Hong Kong in the past decade, usually recorded in Pat Sin Leng and Ha Miu Tin in early spring (February to April in the current data set. Sightings in May in former years). They inhabit seasonal marshes which may become dry during spring time. Females oviposit by piercing the stems of nearby vegetation.

Aciagrion approximans (Fig. 6): Formerly referred to as *Aciagrion tillyardi* in Hong Kong Odonata literatures. This name is now considered as a synonym of *A. approximans* following a review by Kosterin, Constant and Wilson (2014). Tam et al. (2011) mentioned its occurrence at a single location (Pat Sin Leng) with a flight period from May to October, and classified its status as “rare” locally. Enthusiasts found that established communities exist at various streams in the Castle Peak area (pers. comm.). A female was sighted by the author at Cheung Sheung on 12.X.2013. Its distribution at the extreme west and east sides of the New Territories implies that the species may be more common than previously thought, but adults’ life may be cryptic and they readily escape when disturbed according to Tam et al. (2011).

Mortonagrion hirosei (Fig. 7): The author recorded this species in April, August, October and November at two sites in New Territories North, a longer flight period than that stated in Tam et al. (2011). It is known to occur regularly in many other mangrove sites in, for example, Mai Po, Ma On Shan and Lantau Island. Being classified as a vulnerable species by IUCN, this species is found in few places outside Hong Kong, including Guangdong (Zhang, 2018), Taiwan and Japan.

Agriocnemis lacteola (Fig. 8): Over the past decade, this species is only recorded at Cheung Sheung. It was observed to occur in abundance in late summer / early autumn in abandoned paddies, which are also inhabited by vast amount of leeches. It was known from indigenous residents that no pesticide was applied to these paddies, which may further explain the thriving of the species’ remaining community in Hong Kong.

Pseudagrion spencei (Fig. 9): There was only a single sighting of a male in November 2011 at Tan Shan River in the past ten years. Earlier on there were occasional records by others in 2008 and 2009 in Sai Kung and Wu Kau Tang respectively (M Y Lai and Vivi Chan, pers comm.). It is unknown whether this species has become locally extinct, or overlooked due to its small size or close resemblance to *Pseudagrion microcephalum* or *Paracercion melanotum*.

Protosticta beaumonti: It was only recorded in Tei Tong Tsai by the author, but is known to consistently occur at other sites on Hong Kong Island and Lantau Island. Up to now there is no record from the New Territories mainland.

Some species, although recorded at a number of sites, appear to have only restricted distribution in the New Territories. For example, both *Rhipidolestes janetae* and *Calicnemia sinensis* are only recorded at New Territories Central sites but not others, while they can be found on the two biggest islands to the south (Lantau Island for both species and Hong Kong Island for *C. sinensis*). The reason behind so requires further investigation.

The current set of data only records the occurrence of

a particular species at a particular site on a particular date. Abundance of each species during each observation event has not been taken into account. Although restrictedly distributed species occur at only a few localities (e.g. *Aciagrion approximans*, *Agriocnemis lacteola*), vast number of individuals can be found at particular periods of time every year. On the other hand, some other widespread and large species, e.g. *Philaganga vestusta* and *Pseudagrion pruinosum*, are never seen to have more than three or four individuals in a locality at the same time. It is not sure whether it is related to their higher ability of dispersal owing to their size.

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REFERENCES

- AFCD, 2020. Rediscovery of *Ischnura rufostigma* (Selys, 1876) in Hong Kong after half a century. Available from <https://www.afcd.gov.hk/english/conservation/hkbiodiversity/news/20200323.html>, accessed on 15 September 2021.
- Ka, M., 2021. *A Checklist of Dragonflies (Odonata) of Hong Kong*. Available from <https://hkdragonflies.blogspot.com>, accessed on 10 October 2021.
- Kosterin, O.E., Constant, J., Wilson, K.D.P., 2014. Neotype of *Pseudagrion approximans* Selys, 1876 designated to resolve a nomenclatorial confusion in the genus *Aciagrion* Selys, 1891 (Odonata: Coenagrionidae). *International Journal of Odonatology* 17(2-3): 161-172.
- Reels, G.T., 2019. An annotated check list of Hong Kong dragonflies and assessment of their local conservation significance. *Journal of the International Dragonfly Fund. Faunistic Studies in South-east Asian and Pacific Island Odonata* 30: 1-49.
- Reels, G.T., 2020. A ranking of key dragonfly sites in Hong Kong using a species conservation value assessment metric. *Journal of the International Dragonfly Fund. Faunistic Studies in South-east Asian and Pacific Island Odonata* 31: 1-50.
- Tam, T.W., Leung, K.K., Kwan, B.S.P., Wu, K.K.Y., Tang, S.S.H., So, I.W.Y., Cheng, J.C.Y., Yuen, E.F.M., Tsang, Y.M. and Hui, W.L., 2011. *The Dragonflies of Hong Kong*. AFCD and Cosmo Books. 368pp.
- Zhang, H.M., 2018. *Dragonflies and Damselflies of China*. Chongqing University Press. 1460pp.

TABLES , FIGURES & APPENDICES

Top 10 sites by species richness		Top 10 sites by assessment metric	
Site	No. of species	Site	Score
Hok Tau	63	Sha Lo Tung	422
Luk Keng	60	Hok Tau	400
Sham Tseng	56	Shing Mun	329
Sha Lo Tung	54	Wu Kau Tang	310
Wu Kau Tang	47	Luk Keng	283
Shing Mun	29	Sham Tseng	275
Tsiu Hang	29	Yuen Tun Ha	226
Tan Shan River	26	Ng Tung Chai	179
Castle Peak	26	Tai Mo Shan	173
Tai Po Kau	24	Tate's Cairn	172

Table 1. Ranking of the top 10 sites based on species richness and conservation value assessment metric.

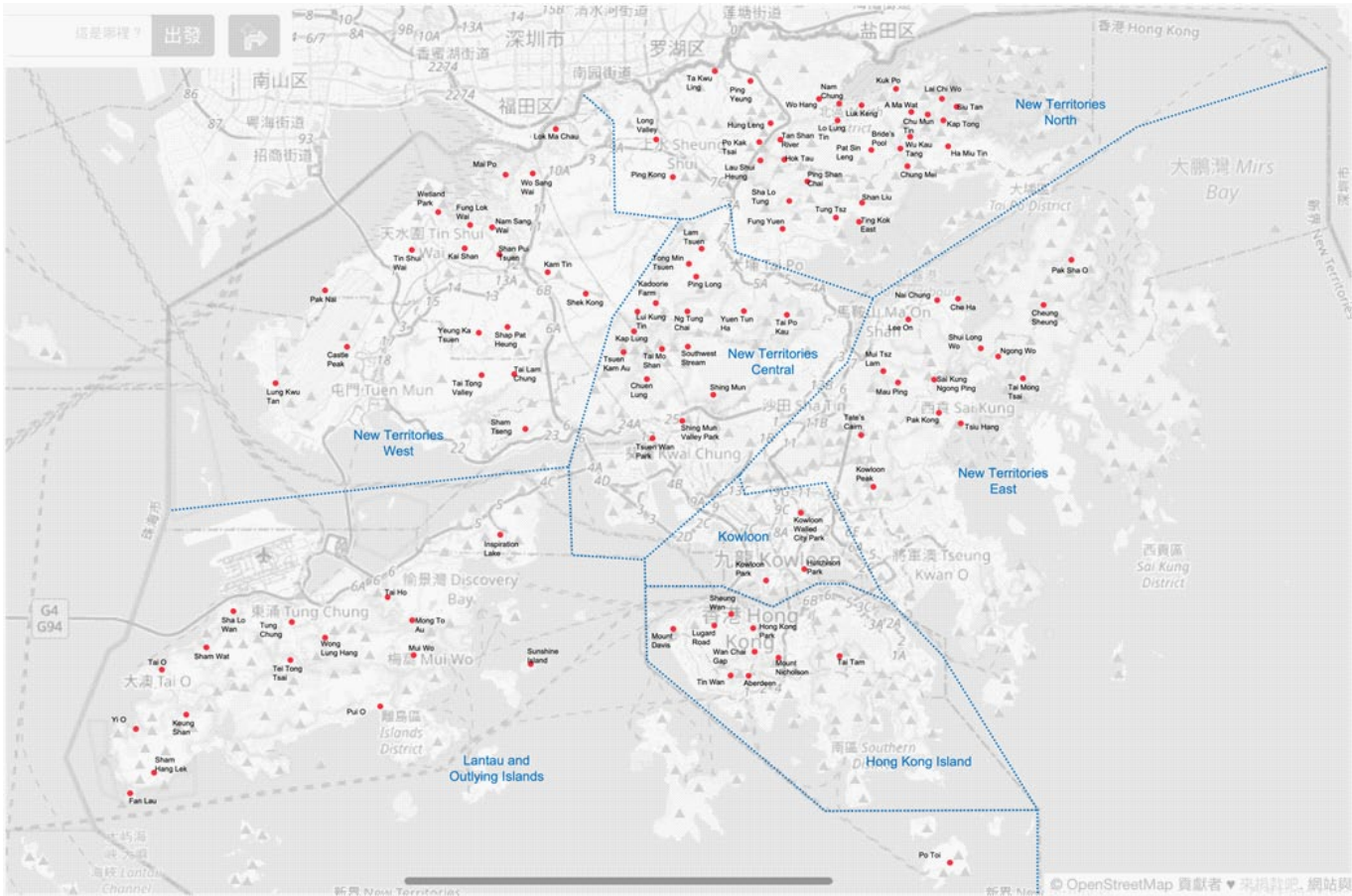


Figure 1. Odonata sites visited by the author between 2011 and 2020. Base map from openstreetmap.org.

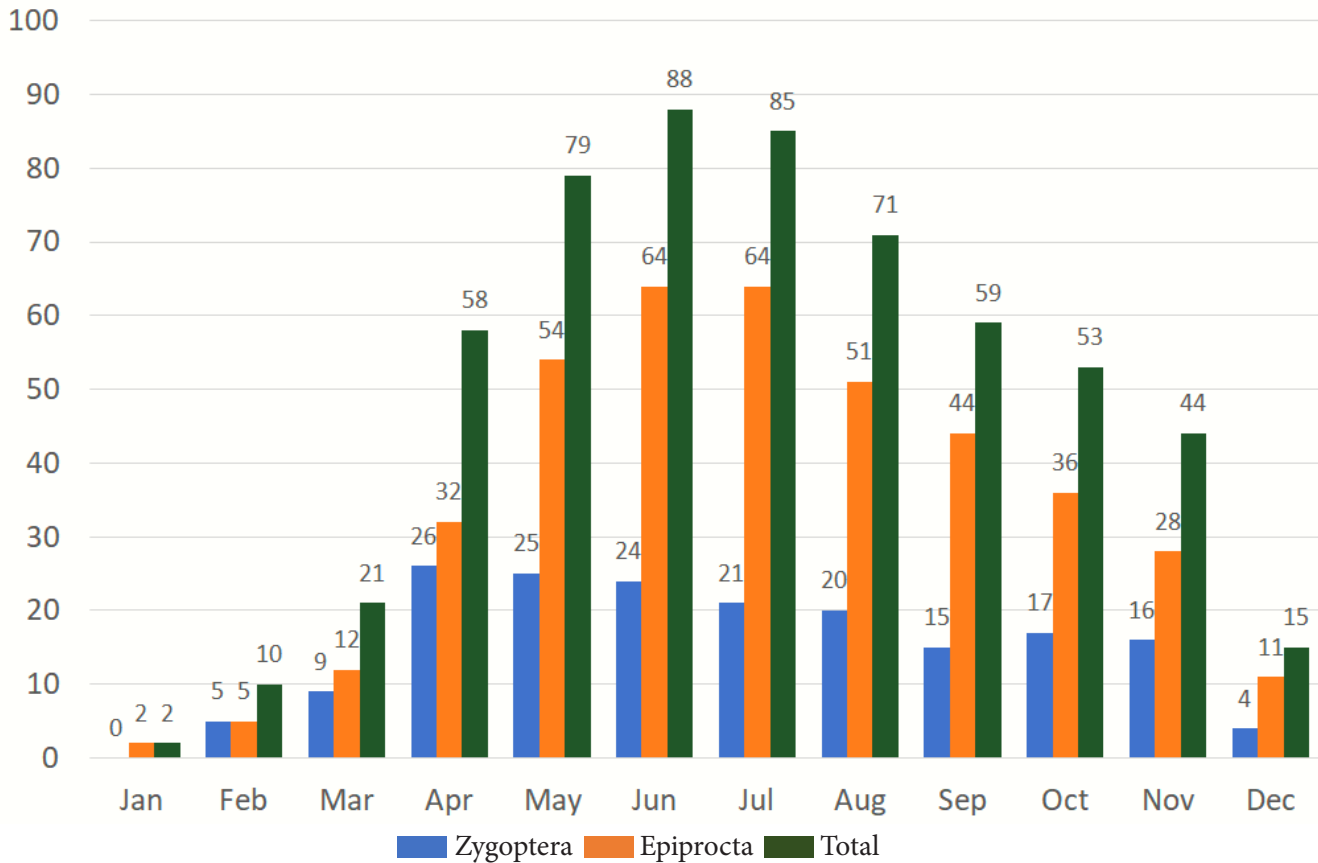


Figure 2. Total number of species recorded in each month from 2011 to 2020.



Figure 3. Adults of the six Hong Kong Rhipidolestidae (top two) and Platystictidae species are only recorded from late spring to middle summer. Apart from *Agriomorpha fusca* (top left), all remaining five species, i.e. *Rhipidoleste janetae* (top right), *Drepanosticta hongkongensis* (middle left), *Protosticta beaumonti* (middle right), *Protosticta taipokauensis* (bottom left) and *Sinosticta ogatai* (bottom right) were first described from Hong Kong specimens. *S. ogatai* is also the type species of its genus. Photos by author.



Figure 4. Two species that are recorded in the most number of sites. (Left) *Euphaea decorata*, a mature female (top) and a teneral male. (Right) A mating pair of *Ceriagrion auranticum*. Photos by author.



Figure 5. Oviposition (in tandem) of two Lestidae species that have been recorded in Hong Kong. (Left) *Lestes nodalis*, occurs regularly at a few seasonal marshes in New Territories North. (Right) *Lestes praemorsus*, considered to have disappeared from Hong Kong. Shown here are individuals of another subspecies *L. p. decipiens* in Singapore. Photos by author.



Figure 6. A mating pair of *Aciagrion approximans*. Photo by author.



Figure 9. The author's only record of *Pseudagrion spencei* in Hong Kong, observed on 13.XI.2011 at Tan Shan River. Photo by author.



Figure 7. *Mortonagrion hirosei* is one of the few Hong Kong Odonata species that can tolerate high salinity habitat. Photo by author.



Figure 10. *Ischnura rufostigma* in northern Guangdong province. The species is thought to be locally extinct before reappearance of a single male in 2020. Photo by author.



Figure 8. *Agriocnemis lacteola* mating. The species can only be found at Cheung Sheung in the past decade. Photo by author.

Species	Hok Tau	Luk Keng	Sham Tseng	Sha Lo Tung	Wu Kau Tang	Shing Mun	Tsiu Hang	Tan Shan River	Castle Peak	Tai Po Kau	Species rating
ZYGOPTERA											
Calopterygidae											
<i>Matrona basilaris</i>											0
<i>Mnais mneme</i>	✓	✓	✓	✓	✓	✓					10
<i>Neurobasis chinensis</i>	✓	✓	✓	✓	✓			✓			1
Chlorocyphidae											
<i>Heliocypha perforata</i>	✓	✓	✓	✓	✓	✓		✓	✓	✓	1
Devadattidae											
<i>Devadatta argyroides</i>											0
Euphaeidae											
<i>Euphaea decorata</i>	✓	✓	✓	✓	✓	✓			✓	✓	10
<i>Euphaea opaca</i>											0
Philogangidae											
<i>Philaganga vestusta</i>	✓	✓	✓	✓	✓	✓					25
Philosinidae											
<i>Philosina alba</i>											0
Rhipidolestidae											
<i>Agriomorpha fusca</i>	✓		✓	✓		✓				✓	13
<i>Rhipidolestes janetae</i>						✓					55
Lestidae											
<i>Lestes concinnus</i>											0
<i>Lestes nodalis</i>											15
<i>Lestes praemorsus</i>											0
<i>Sympecma paedisca</i>											0
Platystictidae											
<i>Drepanosticta hongkongensis</i>											20
<i>Protosticta beaumonti</i>											20
<i>Protosticta taipokauensis</i>			✓	✓	✓	✓					15
<i>Sinosticta ogatai</i>											45
Coenagrionidae											
<i>Aciagrion approximans</i>									✓		25
<i>Agriocnemis femina</i>		✓					✓	✓			3
<i>Agriocnemis lacteola</i>											25
<i>Agriocnemis pygmaea</i>		✓			✓			✓			5
<i>Paracercion calamorum</i>	✓		✓					✓			5
<i>Paracercion hieroglyphicum</i>											0
<i>Paracercion melanotum</i>		✓					✓				1
<i>Ceriagrion auranticum</i>	✓	✓	✓	✓	✓		✓	✓	✓	✓	1
<i>Ischnura asiatica</i>											0
<i>Ischnura senegalensis</i>		✓	✓				✓	✓			3
<i>Ischnura rufostigma</i>											0
<i>Mortonagrion hirosei</i>		✓									20
<i>Pseudagrion microcephalum</i>		✓	✓					✓			1
<i>Pseudagrion pruinsum</i>	✓							✓			1
<i>Pseudagrion rubriceps</i>	✓		✓					✓			1
<i>Pseudagrion spencei</i>								✓			0

Species	Hok Tau	Luk Keng	Sham Tseng	Sha Lo Tung	Wu Kau Tang	Shing Mun	Tsiu Hang	Tan Shan River	Castle Peak	Tai Po Kau	Species rating
Platycnemididae											
<i>Calicnemia sinensis</i>						✓					25
<i>Coelliccia cyanomelas</i>				✓	✓	✓				✓	10
<i>Copera marginipes</i>	✓	✓	✓	✓	✓			✓	✓	✓	1
<i>Onychargia atrocyana</i>	✓	✓		✓							15
<i>Prodasineura autumnalis</i>	✓	✓	✓	✓	✓		✓	✓	✓	✓	1
<i>Prodasineura croconota</i>	✓	✓		✓	✓						10
<i>Pseudocopera ciliata</i>	✓	✓	✓		✓		✓			✓	1
EPIPROCTA											
Aeshnidae											
<i>Anaciaeschna jaspidea</i>		✓									5
<i>Anax guttatus</i>	✓	✓	✓	✓		✓	✓			✓	3
<i>Anax immaculifrons</i>			✓						✓		5
<i>Anax indicus</i>											0
<i>Anax nigrofasciatus</i>			✓								1
<i>Anax parthenope</i>		✓	✓								1
<i>Cephalaeschna klotsae</i>											40
<i>Gynacantha japonica</i>		✓		✓	✓						5
<i>Gynacantha ryukyuensis</i>		✓		✓	✓						1
<i>Gynacantha saltatrix</i>											1
<i>Gynacantha subinterrupta</i>		✓									1
<i>Planaeschna skiaperipola</i>											45
<i>Polycanthagyna erythromelas</i>			✓				✓				1
<i>Polycanthagyna ornithocephala</i>											0
<i>Tetracanthagyna waterhousei</i>	✓			✓	✓	✓					1
Chlorogomphidae											
<i>Chlorogomphus papilio</i>											0
Cordulegastridae											
<i>Anotogaster</i> sp.						✓					25
Gomphidae											
<i>Asiagomphus</i> sp.	✓	✓	✓	✓	✓	✓				✓	20
<i>Burmagomphus vermicularis</i>	✓		✓	✓				✓			10
<i>Euthygomphus koxingai</i>	✓										10
<i>Fukienogomphus choifongae</i>					✓						55
<i>Gomphidia kelloggi</i>	✓			✓							55
<i>Heliogomphus retroflexus</i>											10
<i>Heliogomphus scorpio</i>	✓	✓	✓	✓	✓	✓					10
<i>Ictinogomphus pertinax</i>	✓	✓	✓				✓	✓			1
<i>Labrogomphus torvus</i>	✓		✓								10
<i>Lamelligomphus hainanensis</i>			✓								20
<i>Leptogomphus hongkongensis</i>			✓	✓	✓	✓					30
<i>Megalogomphus sommeri</i>	✓		✓	✓							10
<i>Melligomphus guangdongensis</i>											25
<i>Ophiogomphus sinicus</i>	✓			✓		✓					30
<i>Paragomphus capricornis</i>	✓		✓								1
<i>Sieboldius alexanderi</i>	✓		✓	✓	✓	✓					15
<i>Sinictinogomphus clavatus</i>											1

Species	Hok Tau	Luk Keng	Sham Tseng	Sha Lo Tung	Wu Kau Tang	Shing Mun	Tsiu Hang	Tan Shan River	Castle Peak	Tai Po Kau	Species rating
<i>Stylogomphus chunliuae</i>											15
<i>Stylogomphus</i> sp.											1
<i>Stylurus annulatus</i>											0
<i>Stylurus clathratus</i>											0
Macromiidae											
<i>Epophthalmia elegans</i>	✓	✓	✓								1
<i>Macromia berlandi</i>	✓			✓	✓						10
<i>Macromia katae</i>	✓	✓		✓							30
<i>Macromia urania</i>	✓		✓	✓	✓						10
Synthemistidae											
<i>Idionyx claudia</i>											35
<i>Idionyx victor</i>	✓		✓	✓	✓	✓	✓		✓		10
<i>Macromidia ellenae</i>	✓	✓		✓	✓						20
<i>Macromidia rapida</i>	✓		✓	✓	✓	✓					1
Libellulidae											
<i>Acisoma panorpoides</i>	✓	✓			✓		✓				1
<i>Aethriamanta brevipennis</i>	✓	✓									1
<i>Brachydiplax chalybea</i>	✓	✓		✓			✓	✓		✓	1
<i>Brachythemis contaminata</i>	✓	✓	✓	✓	✓			✓			3
<i>Crocothemis servilia</i>	✓	✓	✓	✓	✓		✓		✓		3
<i>Diplacodes nebulosa</i>		✓			✓						1
<i>Diplacodes trivialis</i>		✓		✓	✓				✓		5
<i>Hydrobasileus croceus</i>	✓	✓	✓	✓	✓		✓		✓		1
<i>Indothemis carnatica</i>							✓				1
<i>Lyrithemis elegantissima</i>	✓	✓	✓	✓	✓	✓	✓			✓	1
<i>Macrodiplax cora</i>		✓									1
<i>Nannophya pygmaea</i>		✓									5
<i>Nannophyopsis clara</i>	✓	✓	✓								1
<i>Neurothemis fulvia</i>	✓	✓	✓	✓	✓		✓		✓	✓	1
<i>Neurothemis tullia</i>		✓	✓		✓						1
<i>Onychothemis tonkinensis</i>	✓										15
<i>Orthetrum albistylum</i>											0
<i>Orthetrum chrysis</i>	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	1
<i>Orthetrum glaucum</i>	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	1
<i>Orthetrum luzonicum</i>	✓	✓		✓	✓		✓		✓	✓	1
<i>Orthetrum melania</i>											0
<i>Orthetrum poecilops</i>		✓									35
<i>Orthetrum pruinosum</i>	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	1
<i>Orthetrum sabina sabina</i>	✓	✓	✓	✓	✓		✓	✓	✓		1
<i>Orthetrum triangulare</i>	✓			✓	✓	✓	✓		✓	✓	1
<i>Palpopleura sexmaculata</i>					✓				✓		5
<i>Pantala flavescens</i>	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	1
<i>Potamarcha congener</i>	✓			✓					✓		1
<i>Pseudothemis zonata</i>	✓	✓	✓	✓		✓	✓				1
<i>Rhodothemis rufa</i>	✓	✓	✓								1
<i>Rhyothemis fuliginosa</i>		✓									0
<i>Rhyothemis triangularis</i>	✓	✓	✓	✓						✓	1

Species	Hok Tau	Luk Keng	Sham Tseng	Sha Lo Tung	Wu Kau Tang	Shing Mun	Tsiu Hang	Tan Shan River	Castle Peak	Tai Po Kau	Species rating
<i>Rhyothemis variegata</i>	✓	✓	✓	✓	✓		✓	✓			1
<i>Sympetrum eroticum</i>											0
<i>Sympetrum darwinianum</i>											0
<i>Sympetrum fonscolombii</i>											0
<i>Tholymis tillarga</i>		✓	✓						✓		1
<i>Tramea transmarina</i>											0
<i>Tramea virginia</i>	✓	✓	✓	✓	✓		✓		✓	✓	1
<i>Trithemis aurora</i>	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	1
<i>Trithemis festiva</i>	✓		✓	✓	✓	✓	✓	✓	✓	✓	1
<i>Trithemis pallidinervis</i>											1
<i>Urothemis signata</i>	✓	✓	✓					✓			1
<i>Zygonyx asahinai</i>				✓		✓					10
<i>Zygonyx iris</i>	✓		✓	✓	✓	✓			✓		1
<i>Zyxomma petiolatum</i>	✓	✓		✓						✓	1
No. of species at each site	63	60	56	54	47	29	29	26	26	24	
No. of visits at each site	47	41	29	35	65	20	12	12	13	16	
Site rating	400	283	275	422	310	274	46	48	82	75	

Appendix 1. Species records at the top 10 sites ranked by species richness.

Species	Sha Lo Tung	Hok Tau	Shing Mun	Wu Kau Tang	Luk Keng	Sham Tseng	Yuen Tun Ha	Ng Tung Chai	Tai Mo Shan	Tate's Cairn	Species rating
ZYGOPTERA											
Calopterygidae											
<i>Matrona basilaris</i>											0
<i>Mnais mnome</i>	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	10
<i>Neurobasis chinensis</i>	✓	✓		✓	✓	✓					1
Chlorocyphidae											
<i>Heliocypha perforata</i>	✓	✓	✓	✓	✓	✓				✓	1
Devadattidae											
<i>Devadatta argyroides</i>											0
Euphaeidae											
<i>Euphaea decorata</i>	✓	✓	✓	✓	✓	✓		✓	✓	✓	10
<i>Euphaea opaca</i>											0
Philogangidae											
<i>Philaganga vestusta</i>	✓	✓	✓	✓	✓	✓	✓		✓		25
Philosinidae											
<i>Philosina alba</i>											0
Rhipidolestidae											
<i>Agriomorpha fusca</i>	✓	✓	✓			✓	✓		✓		13
<i>Rhipidolestes janetae</i>			✓				✓				55
Lestidae											
<i>Lestes concinnus</i>											0
<i>Lestes nodalis</i>											15
<i>Lestes praemorsus</i>											0
<i>Sympecma paedisca</i>											0
Platystictidae											
<i>Drepanosticta hongkongensis</i>							✓		✓	✓	20
<i>Protosticta beaumonti</i>											20
<i>Protosticta taipokauensis</i>	✓		✓	✓		✓	✓	✓	✓	✓	15
<i>Sinosticta ogatai</i>							✓			✓	45
Coenagrionidae											
<i>Aciagrion approximans</i>											25
<i>Agriocnemis femina</i>					✓						3
<i>Agriocnemis lacteola</i>											25
<i>Agriocnemis pygmaea</i>				✓	✓						5
<i>Paracercion calamorum</i>		✓				✓					5
<i>Paracercion hieroglyphicum</i>											0
<i>Paracercion melanotum</i>					✓						1
<i>Ceriagrion auranticum</i>	✓	✓		✓	✓	✓	✓				1
<i>Ischnura asiatica</i>											0
<i>Ischnura senegalensis</i>					✓	✓					3
<i>Ischnura rufostigma</i>											0
<i>Mortonagrion hirosei</i>					✓						20
<i>Pseudagrion microcephalum</i>					✓	✓					1
<i>Pseudagrion pruinsum</i>		✓									1
<i>Pseudagrion rubriceps</i>		✓				✓					1
<i>Pseudagrion spencei</i>											0

Species	Sha Lo Tung	Hok Tau	Shing Mun	Wu Kau Tang	Luk Keng	Sham Tseng	Yuen Tun Ha	Ng Tung Chai	Tai Mo Shan	Tate's Cairn	Species rating
Platycnemididae											
<i>Calicnemia sinensis</i>			✓					✓	✓		25
<i>Coeliccica cyanomelas</i>	✓		✓	✓			✓	✓	✓	✓	10
<i>Copera marginipes</i>	✓	✓		✓	✓	✓					1
<i>Onychargia atrocyana</i>	✓	✓			✓						15
<i>Prodasineura autumnalis</i>	✓	✓		✓	✓	✓					1
<i>Prodasineura croconota</i>	✓	✓		✓	✓						10
<i>Pseudocopera ciliata</i>		✓		✓	✓	✓					1
EPIPROCTA											
Aeshnidae											
<i>Anaciaeschna jaspidea</i>					✓			✓			5
<i>Anax guttatus</i>	✓	✓	✓		✓	✓	✓				3
<i>Anax immaculifrons</i>						✓					5
<i>Anax indicus</i>											0
<i>Anax nigrofasciatus</i>						✓	✓			✓	1
<i>Anax parthenope</i>					✓	✓					1
<i>Cephalaeschna klotsae</i>											40
<i>Gynacantha japonica</i>	✓			✓	✓						5
<i>Gynacantha ryukyuensis</i>	✓			✓	✓						1
<i>Gynacantha saltatrix</i>											1
<i>Gynacantha subinterrupta</i>					✓						1
<i>Planaeschna skiaperipola</i>											45
<i>Polycanthagyna erythromelas</i>						✓					1
<i>Polycanthagyna ornithocephala</i>											0
<i>Tetracanthagyna waterhousei</i>	✓	✓	✓	✓							1
Chlorogomphidae											
<i>Chlorogomphus papilio</i>											0
Cordulegastridae											
<i>Anotogaster</i> sp.			✓								25
Gomphidae											
<i>Asiagomphus</i> sp.	✓	✓	✓	✓	✓	✓				✓	20
<i>Burmagomphus vermicularis</i>	✓	✓				✓					10
<i>Euthygomphus koxingai</i>		✓									10
<i>Fukienogomphus choifongae</i>				✓							55
<i>Gomphidia kelloggi</i>	✓	✓									55
<i>Heliogomphus retroflexus</i>											10
<i>Heliogomphus scorpio</i>	✓	✓	✓	✓	✓	✓					10
<i>Ictinogomphus pertinax</i>		✓			✓	✓					1
<i>Labrogomphus torvus</i>		✓				✓					10
<i>Lamelligomphus hainanensis</i>						✓					20
<i>Leptogomphus hongkongensis</i>	✓		✓	✓		✓					30
<i>Megalogomphus sommeri</i>	✓	✓				✓					10
<i>Melligomphus guangdongensis</i>											25
<i>Ophiogomphus sinicus</i>	✓	✓	✓					✓	✓		30
<i>Paragomphus capricornis</i>		✓				✓					1
<i>Sieboldius alexanderi</i>	✓	✓	✓	✓		✓				✓	15
<i>Sinictinogomphus clavatus</i>											1

Species	Sha Lo Tung	Hok Tau	Shing Mun	Wu Kau Tang	Luk Keng	Sham Tseng	Yuen Tun Ha	Ng Tung Chai	Tai Mo Shan	Tate's Cairn	Species rating
<i>Stylogomphus chunliuae</i>							✓	✓			15
<i>Stylogomphus</i> sp.											1
<i>Stylurus annulatus</i>											0
<i>Stylurus clathratus</i>											0
Macromiidae											
<i>Epophthalmia elegans</i>		✓			✓	✓					1
<i>Macromia berlandi</i>	✓	✓		✓							10
<i>Macromia katae</i>	✓	✓			✓						30
<i>Macromia urania</i>	✓	✓		✓		✓					10
Synthemistidae											
<i>Idionyx claudia</i>								✓			35
<i>Idionyx victor</i>	✓	✓	✓	✓		✓		✓		✓	10
<i>Macromidia ellenae</i>	✓	✓		✓	✓						20
<i>Macromidia rapida</i>	✓	✓	✓	✓		✓		✓			1
Libellulidae											
<i>Acisoma panorpoides</i>		✓		✓	✓						1
<i>Aethriamanta brevipennis</i>		✓			✓						1
<i>Brachydiplax chalybea</i>	✓	✓			✓						1
<i>Brachythemis contaminata</i>		✓			✓	✓					3
<i>Crocothemis servilia</i>	✓	✓		✓	✓	✓					3
<i>Diplacodes nebulosa</i>				✓	✓						1
<i>Diplacodes trivialis</i>	✓			✓	✓		✓				5
<i>Hydrobasileus croceus</i>	✓	✓		✓	✓	✓					1
<i>Indothemis carnatica</i>											1
<i>Lyriothemis elegantissima</i>	✓	✓	✓	✓	✓	✓					1
<i>Macrodiplax cora</i>					✓						1
<i>Nannophya pygmaea</i>					✓						5
<i>Nannophyopsis clara</i>		✓			✓	✓					1
<i>Neurothemis fulvia</i>	✓	✓		✓	✓	✓					1
<i>Neurothemis tullia</i>				✓	✓	✓					1
<i>Onychothemis tonkinensis</i>		✓									15
<i>Orthetrum albistylum</i>											0
<i>Orthetrum chrysis</i>	✓	✓	✓	✓	✓	✓	✓			✓	1
<i>Orthetrum glaucum</i>	✓	✓	✓	✓	✓	✓	✓		✓	✓	1
<i>Orthetrum luzonicum</i>	✓	✓		✓	✓		✓	✓		✓	1
<i>Orthetrum melania</i>											0
<i>Orthetrum poecilops</i>					✓						35
<i>Orthetrum pruinosum</i>	✓	✓	✓	✓	✓	✓					1
<i>Orthetrum sabina sabina</i>	✓	✓		✓	✓	✓					1
<i>Orthetrum triangulare</i>	✓	✓	✓	✓			✓		✓	✓	1
<i>Palpopleura sexmaculata</i>				✓							5
<i>Pantala flavescens</i>	✓	✓	✓	✓	✓	✓		✓	✓	✓	1
<i>Potamarcha congener</i>	✓	✓									1
<i>Pseudothemis zonata</i>	✓	✓	✓		✓	✓					1
<i>Rhodothemis rufa</i>		✓			✓	✓					1
<i>Rhyothemis fuliginosa</i>					✓						0
<i>Rhyothemis triangularis</i>	✓	✓			✓	✓					1

Species	Sha Lo Tung	Hok Tau	Shing Mun	Wu Kau Tang	Luk Keng	Sham Tseng	Yuen Tun Ha	Ng Tung Chai	Tai Mo Shan	Tate's Cairn	Species rating
<i>Rhyothemis variegata</i>	✓	✓			✓	✓					1
<i>Sympetrum eroticum</i>	✓	✓		✓	✓	✓					0
<i>Sympetrum darwinianum</i>											0
<i>Sympetrum fonscolombii</i>											0
<i>Tholymis tillarga</i>					✓	✓					1
<i>Tramea transmarina</i>											0
<i>Tramea virginia</i>	✓	✓		✓	✓	✓	✓				1
<i>Trithemis aurora</i>	✓	✓	✓	✓	✓	✓	✓				1
<i>Trithemis festiva</i>	✓	✓	✓	✓		✓	✓		✓		1
<i>Trithemis pallidinervis</i>											1
<i>Urothemis signata</i>		✓			✓	✓					1
<i>Zygonyx asahinai</i>	✓		✓					✓	✓		10
<i>Zygonyx iris</i>	✓	✓	✓	✓		✓	✓	✓	✓		1
<i>Zyxomma petiolatum</i>	✓	✓		✓							1
No. of species at each site	54	63	30	47	60	56	21	15	15	17	
No. of visits at each site	35	47	20	65	41	29	12	8	5	1	
Site rating	422	400	329	310	283	275	226	179	173	172	

Appendix 2. Species records at the top 10 sites ranked by the scores obtained from conservation value assessment metric, following Reels (2020).

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lotic species												
<i>Mnais mneme</i>			✓	✓	✓	✓						
<i>Neurobasis chinensis</i>		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
<i>Heliocypha perforata</i>			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>Euphaea decorata</i>				✓	✓	✓	✓	✓	✓	✓		
<i>Philaganga vestusta</i>				✓	✓	✓	✓					
<i>Agriomorpha fusca</i>				✓	✓	✓	✓					
<i>Rhipidolestes janetae</i>				✓	✓							
<i>Drepanosticta hongkongensis</i>				✓	✓							
<i>Protosticta beaumonti</i>				✓	✓	✓						
<i>Protosticta taipokauensis</i>				✓	✓	✓						
<i>Sinosticta ogatai</i>				✓	✓	✓						
<i>Calicnemia sinensis</i>				✓	✓		✓					
<i>Coeliccia cyanomelas</i>				✓	✓	✓	✓	✓				
<i>Prodasineura autumnalis</i>				✓	✓	✓	✓	✓	✓	✓	✓	
<i>Prodasineura croconota</i>				✓	✓	✓	✓	✓	✓	✓		
Lentic species												
<i>Lestes nodalis</i>		✓	✓	✓								
<i>Aciagrion approximans</i>					✓	✓				✓	✓	
<i>Agriocnemis femina</i>		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
<i>Agriocnemis lacteola</i>								✓	✓	✓		
<i>Agriocnemis pygmaea</i>			✓	✓		✓	✓	✓	✓	✓	✓	
<i>Paracercion calamorum</i>						✓	✓	✓		✓	✓	
<i>Paracercion melanotum</i>							✓	✓	✓	✓	✓	
<i>Ceriagrion auranticum</i>		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>Ischnura senegalensis</i>			✓	✓	✓	✓	✓	✓	✓	✓	✓	
<i>Mortonagrion hirosei</i>				✓				✓		✓	✓	
<i>Pseudagrion microcephalum</i>					✓	✓	✓	✓	✓	✓	✓	
<i>Pseudagrion pruinsum</i>				✓	✓	✓	✓	✓			✓	✓
<i>Pseudagrion rubriceps</i>				✓	✓	✓	✓	✓			✓	
<i>Pseudagrion spencei</i>											✓	
<i>Copera marginipes</i>		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>Onychargia atrocyana</i>				✓	✓	✓	✓	✓	✓			
<i>Pseudocopera ciliata</i>				✓	✓	✓	✓	✓	✓	✓		
No. of species in each month	0	5	9	26	25	24	21	20	15	17	16	4

Appendix 3. Observation records of Hong Kong Zygoptera adults by month.