香港物種探索
Hong Kong Biodiversity
Agriculture,Fisheries and Conservation Department Newsletter

Issue No. 24 May 2016

www.hkbiodiversity.net

Division Column

A Report on the Butterfly Monitoring Programme of the Hong Kong Wetland Park (2003-2015)

N.M. Cheng and P.T. Yau
Wetland Park Division

香港濕地公園自2003年起定期進行蝴蝶監測，記錄公園內蝴蝶的品種和數量。直至2015年底，監測計劃共記錄到166種蝴蝶，當中包括具保育價值或罕見的品種，顯示香港濕地公園能夠為蝴蝶提供適合的棲息地。本文亦討論了公園內不同生境蝴蝶數據的差別以及監測數據隨時間的變化，有助了解蝴蝶對生境的需求以及制訂適當的管理措施。

Introduction

The Hong Kong Wetland Park (HKWP) is located at the north-west of Hong Kong, adjacent to the Mai Po Inner Deep Bay Ramsar Site. The 60-hectare outdoor wetland reserve of the HKWP comprises diverse habitats, including freshwater marshes, ponds, reedbeds, mangroves, mudflats and woodlands. The habitats are managed for the purposes of demonstrating the diversity of Hong Kong's wetland ecosystem, and providing an education and recreation venue with a theme on the functions and values of wetlands.

Habitat management for wildlife in the HKWP is conducted mainly through planting and creating suitable micro-habitats. With a view to managing the vegetated areas of the HKWP as favourable habitats for butterflies, a flagship invertebrate group with high aesthetic value for effective conservation education, over 60 species of larval food plants and nectar plants have been planted in the HKWP, and a butterfly garden has been developed to provide abundant natural food sources for butterflies.

A systematic monitoring programme of butterflies has been undertaken in the HKWP since 2003. The main purpose of the butterfly monitoring is to record the species diversity of butterflies in different habitats of the HKWP, and to record the presence of species of conservation concern and their habitat associations. The monitoring results have been used to evaluate and enhance the habitat management plans of the HKWP.

Contents

Subscribing to Hong Kong Biodiversity

If you would like to have a copy, or if you know anyone who is interested in receiving a copy of this newsletter, please send the name, organisation, email and postal address (hard copy only) to the Article Editor.

Chief Editor : Jackie Y. Yip
(yyip@afcd.gov.hk)

Article Editor : Y.M. Tsang
(yuman_tsang@afcd.gov.hk)

Methods

Butterfly monitoring was conducted once every month from March to October from 2003 to 2006 and from March to November from 2007 to 2015.

A transect method, modified from Pollard (1977), was employed for butterfly monitoring in the HKWP. Monitoring data were collected according to the HKWP ecological monitoring manual, which identifies four transects (Fig. 1 to Fig. 5). During the monitoring, surveyors followed the designated path at a steady pace and recorded all butterfly adults observed within five metres on either side of each transect on a fine day. The abundance of butterfly adults was recorded with the aid of binoculars. Individuals which were difficult to identify in flight were caught using a hand net and released right after identification. Weather information, including air temperature and relative humidity, was also recorded.

Fig. 1. Map showing the survey transects.

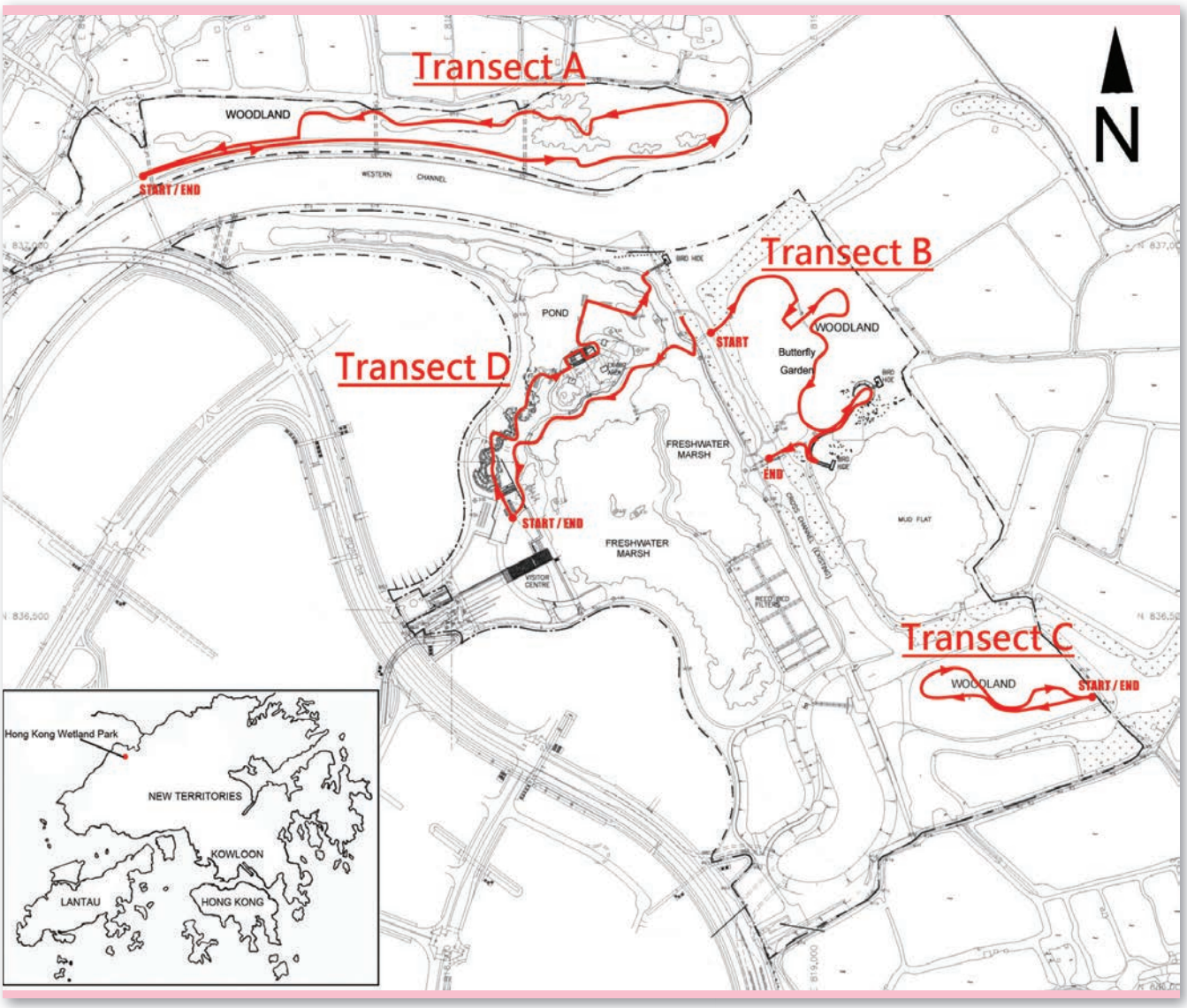


Fig. 2. Transect A.

Fig. 3. Transect B.

Fig. 4. Transect C.

Fig. 5. Transect D.

Results and Discussion

A total of 166 species of butterfly were recorded in the HKWP from 2003 to 2015 during the regular butterfly monitoring programme and other occasional observations. This accounts for about 70% of the butterfly species in Hong Kong. Of these, 24 butterfly species were 'rare' and 23 were 'very rare' (Table 1), while 16 of them were considered to be of conservation concern (Chan et al. 2011). Except for the subfamily Miletinae, with two members either rare or very rare in Hong Kong, members of all the butterfly subfamilies recorded in Hong Kong were found in the HKWP. The monitoring found that the families Lycaenidae and Pieridae were the least represented butterfly families (Table 2). Species in these families are usually less apparent to observers because many of them are swift-flying canopy species. The checklist of butterfly species recorded in the HKWP from 2003 to 2015 is in Annex 1.

Table 1. Number of butterfly species recorded in the HKWP categorized by local restrictedness.

Local Restrictedness	No. of species in the HKWP
Very Common (VC)	18
Common (C)	58
Uncommon (UC)	40
Rare (R)	24
Very rare (VR)	23
Unevaluated#	3*
Total	**166#**

* Three species (*Colias erate, Notocrypta paralysos* and *Libythea myrrha*) are not on the active checklist of Hong Kong butterflies (Chan et al. 2011).

Records of the regular monitoring programme and occasional observations in the HKWP.

Table 2. Number of butterfly species recorded in the HKWP categorized by family.

Family	Subfamily	No. of species in HK (Chan et al. 2011)	Species in the HKWP		
			No.	Percentage (Subfamily)	Percentage (Family)
Hesperiidae 弄蝶科 (59 species)	Coeliadinae 竪翅弄蝶亞科	10	5	50%	66%
	Hesperiinae 弄蝶亞科	42	32	76%	
	Pyrginae 花弄蝶亞科	7	2	29%	
Lycaenidae 灰蝶科 (54 species)	Curetinae 銀灰蝶亞科	1	1	100%	63%
	Lycaeninae 灰蝶亞科	2	1	50%	
	Miletinae 雲灰蝶亞科	2	0	0%	
	Polyommatinae 眼灰蝶亞科	26	19	73%	
	Theclinae 線灰蝶亞科	20	10	50%	
	Riodininae 蜆蝶亞科	3	3	100%	
Nymphalidae 蛺蝶科 (80 species)	Acraeinae 珍蝶亞科	1	1	100%	78%
	Amathusiinae 環蝶亞科	2	2	100%	
	Charaxinae 螯蛺蝶亞科	4	3	75%	
	Danainae 斑蝶亞科	12	10	83%	
	Nymphalinae 蛺蝶亞科	45	35	78%	
	Satyrinae 眼蝶亞科	16	11	69%	
Papilionidae 鳳蝶科 (22 species)	Papilioninae 鳳蝶亞科	22	15	68%	68%
Pieridae 粉蝶科 (21 species)	Coliadinae 黃粉蝶亞科	7	4	57%	62%
	Pierinae 粉蝶亞科	14	9	64%	
	Total	**236**	**163***	**69%**	

* Three species (*Colias erate, Libythea myrrha* and *Notocrypta paralysos*) are not included as they are not on the active checklist of Hong Kong butterflies (Chan et al. 2011).

Seasonal Variation

The peaks in the abundance and number of species occurred in June and September/October (Fig. 6 & 7). This is similar to the general trend of seasonal variation in butterfly diversity and abundance in the territory (Law 1998; Chan 2004).

Temporal Variation from 2003 to 2015

Compared with the monitoring results conducted during the construction stage of the HKWP before 2006, a general increase in diversity of butterfly species was observed soon after its opening in 2006 (Fig. 8). It is likely that habitat restoration, habitat enhancement and reduced disturbance contributed to the increase in diversity of butterflies after its habitat establishment in the HKWP. However, there was a drop in the diversity of butterflies after 2007, an exceptionally good year, and it fluctuated at around 100 species in the subsequent years between 2011 and 2015. It is suspected that some recorded butterfly species were attracted from nearby areas, and have not established a sustainable population in the HKWP. Natural fluctuation of butterfly populations caused by weather and vegetation succession in the HKWP could also be possible reasons.

Comparison between transects and relationship with habitat types

The diversity of butterflies was generally highest along Transect A and lowest along Transect D (Fig. 8). This is likely due to the length of the transects and the area of vegetation cover within them (Table 3). Transect A is the longest of the four transects and it includes a mixed woodland.

The diversity of butterflies along Transect B peaked in 2013. This might be a result of enhancement planting and the setting up of the Butterfly Garden in 2007, which was expanded in 2010. A drop of butterfly diversity was observed in 2015 which may likely be because of the renovation and replanting work carried out in the Butterfly Garden in early 2015.

Fig. 6. Monthly mean abundance of butterflies recorded in the HKWP from 2003 to 2015 (error bar: +/- 1 SD).

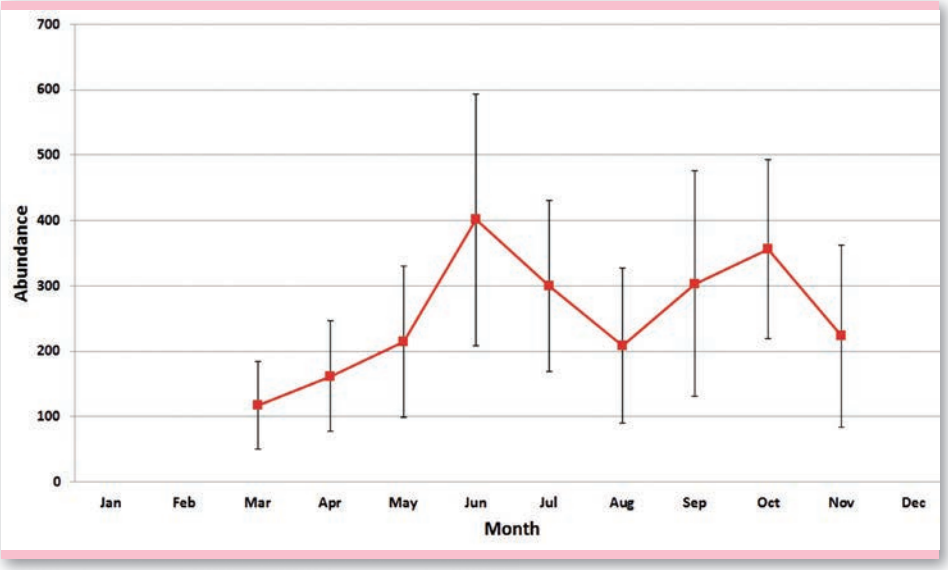


Fig. 7. Monthly mean diversity of butterflies recorded in the HKWP from 2003 to 2015 (error bar: +/- 1 SD).

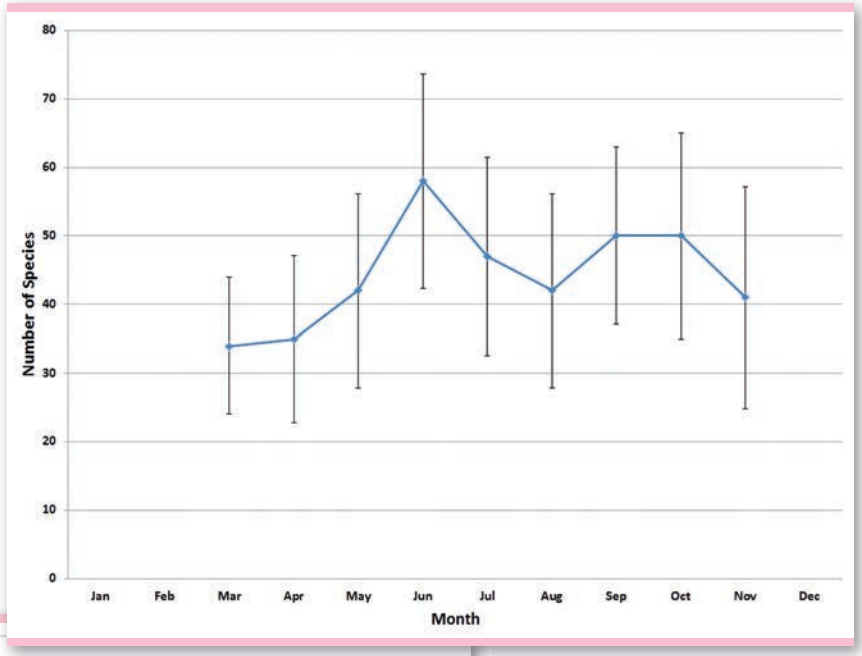
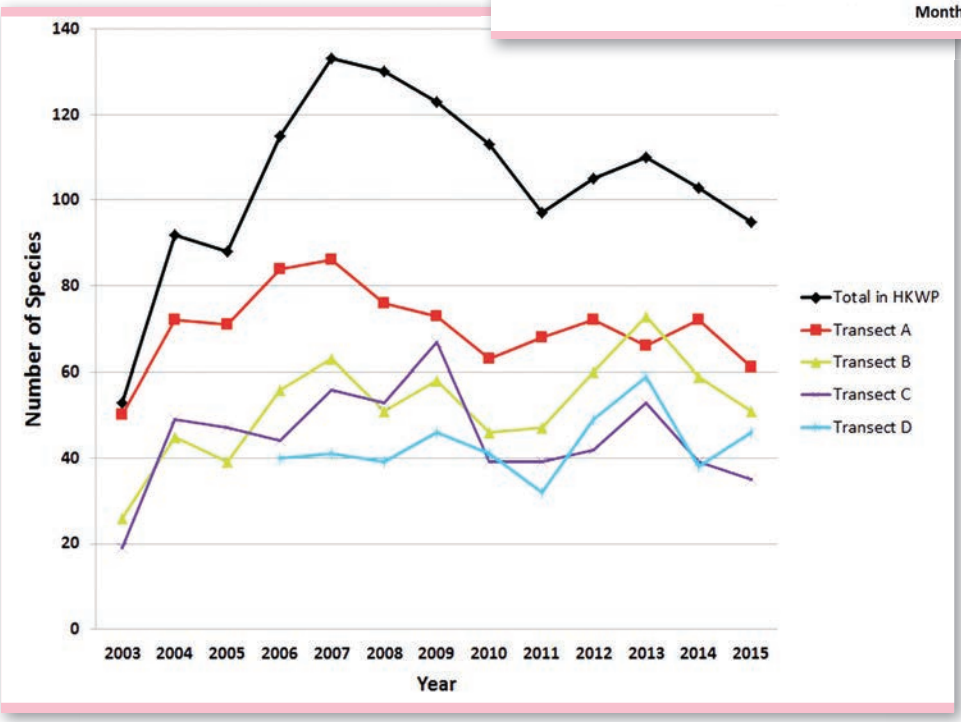


Fig. 8. Diversity of butterflies recorded in the HKWP from 2003 to 2015.



The habitats along Transect D are mainly ponds and streams, with less vegetation cover than the other transects, and as a result, the butterfly diversity was comparatively lower than the other transects.

Of the 166 butterfly species recorded, 60 were found in all four transects. One example is *Remelana jangala* (萊灰蝶; Fig. 9), which is associated with wetlands. The mangrove *Kandelia obovata* (秋茄樹; Fig.10), one of its larval food plants, is abundant in the HKWP. Other examples include *Pelopidas agna* (南亞穀弄蝶) and *Potanthus confucius* (孔子黃室弄蝶), which are 'uncommon' species that feed on plants of the family Gramineae (禾本科), a group of plants that is also abundant in the HKWP.

Fig. 9. *Remelana jangala*.

Fig. 10. *Kandelia obovata*.

Fig. 11. *Catochrysops strabo*.

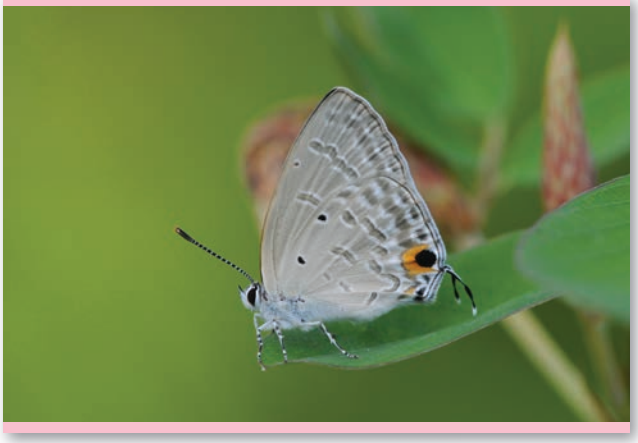


Fig. 12. *Hedychium coronarium*.

Fig. 13. *Jamides alecto*.

Table 3. Number of butterfly species recorded in the survey transects.

Transect	Approximate length (m)	Major habitats	Total number of species recorded from 2003 to 2015
A	1600	Woodland of native species and *Eucalyptus* spp., seasonal ponds, mangroves	125
B	400	Butterfly Garden, reedbed, woodland and mangroves	112
C	400	Woodland of mainly native species	101
D	1200	Ponds and streams	81

Planting larval food plants in the HKWP has also successfully attracted rare butterflies and other species of conservation concern. For example, *Catochrysops strabo* (咖灰蝶; Fig. 11), a 'very rare' species and a species of conservation concern, was recorded in 2012 near its larval food plant, *Desmodium heterocarpon* (假地豆). The species was recorded again in subsequent years, indicating that it might have successfully established a population in the HKWP. Planting Ginger Lily (*Hedychium coronarium*; 薑花; Fig. 12) in various locations successfully attracted the 'very rare' *Jamides alecto* (素雅灰蝶; Fig. 13), which was recorded every year since 2013 along Transects B and D.

After the renovation work of the Butterfly Garden, *Zizula hylax* (長腹灰蝶, Fig. 14), a 'very rare' species of conservation concern, was observed in the Butterfly Garden (Transect B) in November 2015. Further monitoring is required to confirm whether the species has established a population in the HKWP.

The rich butterfly diversity in the HKWP demonstrates that recreated habitats could provide suitable habitats for butterflies through proper management, and that planting of suitable larval food plants would be beneficial to the conservation of rare species or species of conservation concern.

Fig. 14. *Zizula hylax*.

Way Forward

The HKWP will continue its butterfly monitoring and implement appropriate habitat enhancement measures for the conservation of butterflies, in particular species of conservation concern, through regular review of the monitoring findings and habitat management plans.

References

Chan CH. 2004. Hong Kong Butterfly Conservation [postgraduate thesis]. [Hong Kong]: The University of Hong Kong. 117 p.

Chan A, Cheung J, Sze P, Wong A, Wong E, Yau E. 2011. A Review of the Local Restrictedness of Hong Kong Butterflies. Hong Kong Biodiversity. 21: 1-12.

Law JWY. 1998. The use of butterflies for conservation evaluation in Hong Kong [postgraduate thesis]. [Hong Kong]: The University of Hong Kong. 74 p.

Pollard E. 1977. A method for assessing changes in the abundance of butterflies. Biological Conservation. 12: 115-134.

Annex 1. Checklist of the butterflies recorded in the Hong Kong Wetland Park from 2003 to 2015.

No.	Family	Subfamily	Scientific Name	Chinese Common Name	Local Restrictedness (Chan et al. 2011)	Species of conservation concern (Chan et al. 2011)	Location of records (transect)			
							A	B	C	D
1	Hesperiidae 弄蝶科	Coeliadinae 竪翅弄蝶亞科	*Badamia exclamationis*	尖翅弄蝶	VR	*	*			
2	Hesperiidae 弄蝶科	Coeliadinae 竪翅弄蝶亞科	*Bibasis gomata*	白傘弄蝶	UC		*			
3	Hesperiidae 弄蝶科	Coeliadinae 竪翅弄蝶亞科	*Hasora badra*	三斑趾弄蝶	VR		*	*	*	
4	Hesperiidae 弄蝶科	Coeliadinae 竪翅弄蝶亞科	*Hasora chromus*	雙斑趾弄蝶	R					*
5	Hesperiidae 弄蝶科	Coeliadinae 竪翅弄蝶亞科	*Hasora taminatus*	銀針趾弄蝶	VR	*	*		*	
6	Hesperiidae 弄蝶科	Hesperiinae 弄蝶亞科	*Aeromachus jhora*	寬鍔弄蝶	R					*
7	Hesperiidae 弄蝶科	Hesperiinae 弄蝶亞科	*Aeromachus pygmaeus*	侏儒鍔弄蝶	VR				-[1]	
8	Hesperiidae 弄蝶科	Hesperiinae 弄蝶亞科	*Ampittia dioscorides*	黃斑弄蝶	UC		*	*	*	*
9	Hesperiidae 弄蝶科	Hesperiinae 弄蝶亞科	*Astictopterus jama*	腌翅弄蝶	C		*	*	*	
10	Hesperiidae 弄蝶科	Hesperiinae 弄蝶亞科	*Borbo cinnara*	秈弄蝶	C		*	*	*	*
11	Hesperiidae 弄蝶科	Hesperiinae 弄蝶亞科	*Caltoris bromus*	無斑珂弄蝶	VR		*	*	*	
12	Hesperiidae 弄蝶科	Hesperiinae 弄蝶亞科	*Erionota torus*	黃斑蕉弄蝶	UC			*		
13	Hesperiidae 弄蝶科	Hesperiinae 弄蝶亞科	*Halpe porus*	雙子酣弄蝶	VR	*	*		*	
14	Hesperiidae 弄蝶科	Hesperiinae 弄蝶亞科	*Hyarotis adrastus*	希弄蝶	UC				-[1]	
15	Hesperiidae 弄蝶科	Hesperiinae 弄蝶亞科	*Iambrix salsala*	雅弄蝶	UC		*		*	

No.	Family	Subfamily	Scientific Name	Chinese Common Name	Local Restrictedness (Chan et al. 2011)	Species of conservation concern (Chan et al. 2011)	Location of records (transect)			
							A	B	C	D
16	Hesperiidae 弄蝶科	Hesperiinae 弄蝶亞科	*Matapa aria*	瑪弄蝶	UC		*	*	*	
17	Hesperiidae 弄蝶科	Hesperiinae 弄蝶亞科	*Notocrypta curvifascia*	曲紋袖弄蝶	UC		*	*		
18	Hesperiidae 弄蝶科	Hesperiinae 弄蝶亞科	*Notocrypta paralysos*	窄紋袖弄蝶	-[2]					*
19	Hesperiidae 弄蝶科	Hesperiinae 弄蝶亞科	*Parnara bada*	么紋稻弄蝶	R			*		
20	Hesperiidae 弄蝶科	Hesperiinae 弄蝶亞科	*Parnara ganga*	曲紋稻弄蝶	UC		*	*	*	
21	Hesperiidae 弄蝶科	Hesperiinae 弄蝶亞科	*Parnara guttata*	直紋稻弄蝶	C		*	*	*	*
22	Hesperiidae 弄蝶科	Hesperiinae 弄蝶亞科	*Pelopidas agna*	南亞穀弄蝶	UC		*	*	*	*
23	Hesperiidae 弄蝶科	Hesperiinae 弄蝶亞科	*Pelopidas assamensis*	印度穀弄蝶	R				-[1]	
24	Hesperiidae 弄蝶科	Hesperiinae 弄蝶亞科	*Pelopidas conjunctus*	古銅穀弄蝶	R				*	
25	Hesperiidae 弄蝶科	Hesperiinae 弄蝶亞科	*Pelopidas mathias*	隱紋穀弄蝶	UC		*	*		
26	Hesperiidae 弄蝶科	Hesperiinae 弄蝶亞科	*Pelopidas subochraceus*	近赭穀弄蝶	VR	*	*			
27	Hesperiidae 弄蝶科	Hesperiinae 弄蝶亞科	*Polytremis lubricans*	黃紋孔弄蝶	C		*	*	*	*
28	Hesperiidae 弄蝶科	Hesperiinae 弄蝶亞科	*Potanthus confucius*	孔子黃室弄蝶	UC		*	*	*	*
29	Hesperiidae 弄蝶科	Hesperiinae 弄蝶亞科	*Potanthus pava*	寬紋黃室弄蝶	VR	*	*			
30	Hesperiidae 弄蝶科	Hesperiinae 弄蝶亞科	*Potanthus pseudomaesa*	木黃室弄蝶	R		*	*	*	
31	Hesperiidae 弄蝶科	Hesperiinae 弄蝶亞科	*Potanthus trachala*	斷紋黃室弄蝶	R		*	*	*	
32	Hesperiidae 弄蝶科	Hesperiinae 弄蝶亞科	*Suastus gremius*	素弄蝶	UC		*	*	*	*
33	Hesperiidae 弄蝶科	Hesperiinae 弄蝶亞科	*Taractrocera ceramas*	草黃弄蝶	R		*			
34	Hesperiidae 弄蝶科	Hesperiinae 弄蝶亞科	*Telicota ancilla*	紅翅長標弄蝶	UC		*		*	
35	Hesperiidae 弄蝶科	Hesperiinae 弄蝶亞科	*Telicota colon*	長標弄蝶	R		*	*	*	
36	Hesperiidae 弄蝶科	Hesperiinae 弄蝶亞科	*Telicota ohara*	黃紋長標弄蝶	R			*	*	
37	Hesperiidae 弄蝶科	Hesperiinae 弄蝶亞科	*Udaspes folus*	薑弄蝶	R			*		*
38	Hesperiidae 弄蝶科	Hesperiinae 弄蝶亞科	*Zographetus satwa*	黃裳腫脈弄蝶	R		*			
39	Hesperiidae 弄蝶科	Pyrginae 花弄蝶亞科	*Odontoptilum angulatum*	角翅弄蝶	C			*		
40	Hesperiidae 弄蝶科	Pyrginae 花弄蝶亞科	*Tagiades litigiosus*	沾邊裙弄蝶	C		*		*	
41	Lycaenidae 灰蝶科	Curetinae 銀灰蝶亞科	*Curetis dentata*	尖翅銀灰蝶	UC				*	
42	Lycaenidae 灰蝶科	Lycaeninae 灰蝶亞科	*Heliophorus epicles*	斜斑彩灰蝶	C		*	*		*
43	Lycaenidae 灰蝶科	Polyommatinae 眼灰蝶亞科	*Acytolepis puspa*	鈕灰蝶	C		*	*	*	*
44	Lycaenidae 灰蝶科	Polyommatinae 眼灰蝶亞科	*Catochrysops strabo*	咖灰蝶	VR	*		*		
45	Lycaenidae 灰蝶科	Polyommatinae 眼灰蝶亞科	*Chilades lajus*	紫灰蝶	C		*	*		
46	Lycaenidae 灰蝶科	Polyommatinae 眼灰蝶亞科	*Chilades pandava*	曲紋紫灰蝶	UC		*	*	*	*
47	Lycaenidae 灰蝶科	Polyommatinae 眼灰蝶亞科	*Euchrysops cnejus*	棕灰蝶	UC		*	*		*
48	Lycaenidae 灰蝶科	Polyommatinae 眼灰蝶亞科	*Everes lacturnus*	長尾藍灰蝶	C		*	*	*	*
49	Lycaenidae 灰蝶科	Polyommatinae 眼灰蝶亞科	*Famegana alsulus*	琺灰蝶	UC		*			
50	Lycaenidae 灰蝶科	Polyommatinae 眼灰蝶亞科	*Jamides alecto*	素雅灰蝶	VR			*		*
51	Lycaenidae 灰蝶科	Polyommatinae 眼灰蝶亞科	*Jamides bochus*	雅灰蝶	C		*	*	*	*
52	Lycaenidae 灰蝶科	Polyommatinae 眼灰蝶亞科	*Lampides boeticus*	亮灰蝶	C		*	*	*	*
53	Lycaenidae 灰蝶科	Polyommatinae 眼灰蝶亞科	*Megisba malaya*	美姬灰蝶	VR	*			-[1]	
54	Lycaenidae 灰蝶科	Polyommatinae 眼灰蝶亞科	*Nacaduba kurava*	古樓娜灰蝶	C		*	*	*	*
55	Lycaenidae 灰蝶科	Polyommatinae 眼灰蝶亞科	*Neopithecops zalmora*	一點灰蝶	UC				*	
56	Lycaenidae 灰蝶科	Polyommatinae 眼灰蝶亞科	*Pseudozizeeria maha*	酢漿灰碟	VC		*	*	*	*
57	Lycaenidae 灰蝶科	Polyommatinae 眼灰蝶亞科	*Udara albocaerulea*	白斑嫵灰蝶	VR		*			
58	Lycaenidae 灰蝶科	Polyommatinae 眼灰蝶亞科	*Udara dilecta*	珍貴嫵灰蝶	VR	*			-[1]	
59	Lycaenidae 灰蝶科	Polyommatinae 眼灰蝶亞科	*Zizeeria karsandra*	吉灰蝶	UC		*			
60	Lycaenidae 灰蝶科	Polyommatinae 眼灰蝶亞科	*Zizina otis*	毛眼灰蝶	C		*	*	*	*
61	Lycaenidae 灰蝶科	Polyommatinae 眼灰蝶亞科	*Zizula hylax*	長腹灰蝶	VR	*		*		
62	Lycaenidae 灰蝶科	Theclinae 線灰蝶亞科	*Arhopala bazalus*	百嬈灰蝶	R		*			
63	Lycaenidae 灰蝶科	Theclinae 線灰蝶亞科	*Artipe eryx*	綠灰蝶	UC		*	*	*	
64	Lycaenidae 灰蝶科	Theclinae 線灰蝶亞科	*Deudorix epijarbas*	玳灰蝶	R		*	*	*	
65	Lycaenidae 灰蝶科	Theclinae 線灰蝶亞科	*Horaga onyx*	斑灰蝶	R		*	*	*	*
66	Lycaenidae 灰蝶科	Theclinae 線灰蝶亞科	*Iraota timoleon*	鐵木萊異灰蝶	UC		*	*	*	*
67	Lycaenidae 灰蝶科	Theclinae 線灰蝶亞科	*Rapala manea*	燕灰蝶	C		*	*	*	*

No.	Family	Subfamily	Scientific Name	Chinese Common Name	Local Restrictedness (Chan et al. 2011)	Species of conservation concern (Chan et al. 2011)	Location of records (transect)			
							A	B	C	D
68	Lycaenidae 灰蝶科	Theclinae 線灰蝶亞科	*Remelana jangala*	萊灰蝶	C		*	*	*	*
69	Lycaenidae 灰蝶科	Theclinae 線灰蝶亞科	*Sinthusa chandrana*	生灰蝶	R			*		*
70	Lycaenidae 灰蝶科	Theclinae 線灰蝶亞科	*Spindasis lohita*	銀線灰蝶	C		*	*	*	*
71	Lycaenidae 灰蝶科	Theclinae 線灰蝶亞科	*Tajuria maculata*	豹斑雙尾灰蝶	VR			*		
72	Lycaenidae 灰蝶科	Riodininae 蜆蝶亞科	*Abisara echerius*	蛇目褐蜆蝶	VC		*		*	*
73	Lycaenidae 灰蝶科	Riodininae 蜆蝶亞科	*Dodona egeon*	大斑尾蜆蝶	R					*
74	Lycaenidae 灰蝶科	Riodininae 蜆蝶亞科	*Zemeros flegyas*	波蜆蝶	C		*	*	*	*
75	Nymphalidae 蛺蝶科	Acraeinae 珍蝶亞科	*Acraea issoria*	苧麻珍蝶	R			*		
76	Nymphalidae 蛺蝶科	Amathusiinae 環蝶亞科	*Discophora sondaica*	鳳眼方環蝶	UC		*		*	
77	Nymphalidae 蛺蝶科	Amathusiinae 環蝶亞科	*Faunis eumeus*	串珠環蝶	C		*	*	*	
78	Nymphalidae 蛺蝶科	Charaxinae 螯蛺蝶亞科	*Charaxes bernardus*	白帶螯蛺蝶	C		*	*	*	*
79	Nymphalidae 蛺蝶科	Charaxinae 螯蛺蝶亞科	*Polyura athamas*	窄斑鳳尾蛺蝶	UC		*	*		
80	Nymphalidae 蛺蝶科	Charaxinae 螯蛺蝶亞科	*Polyura nepenthes*	忘憂尾蛺蝶	UC		*		*	
81	Nymphalidae 蛺蝶科	Danainae 斑蝶亞科	*Danaus chrysippus*	金斑蝶	UC		*	*	*	*
82	Nymphalidae 蛺蝶科	Danainae 斑蝶亞科	*Danaus genutia*	虎斑蝶	C		*	*	*	*
83	Nymphalidae 蛺蝶科	Danainae 斑蝶亞科	*Euploea core*	幻紫斑蝶	C		*	*	*	*
84	Nymphalidae 蛺蝶科	Danainae 斑蝶亞科	*Euploea midamus*	藍點紫斑蝶	VC		*	*	*	*
85	Nymphalidae 蛺蝶科	Danainae 斑蝶亞科	*Euploea mulciber*	異型紫斑蝶	UC		*	*	*	
86	Nymphalidae 蛺蝶科	Danainae 斑蝶亞科	*Ideopsis similis*	擬旖斑蝶	VC		*	*	*	
87	Nymphalidae 蛺蝶科	Danainae 斑蝶亞科	*Parantica aglea*	絹斑蝶	C		*	*	*	
88	Nymphalidae 蛺蝶科	Danainae 斑蝶亞科	*Parantica swinhoei*	史氏絹斑蝶	VR	*		*		
89	Nymphalidae 蛺蝶科	Danainae 斑蝶亞科	*Tirumala limniace*	青斑蝶	C		*	*	*	
90	Nymphalidae 蛺蝶科	Danainae 斑蝶亞科	*Tirumala septentrionis*	斋青斑蝶	VR	*				*
91	Nymphalidae 蛺蝶科	Libytheinae 喙蝶亞科	*Libythea myrrha*	棒紋喙蝶	- [3]					*
92	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Argyreus hyperbius*	斐豹蛺蝶	C			*	*	*
93	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Ariadne ariadne*	波蛺蝶	C		*	*	*	*
94	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Athyma nefte*	相思帶蛺蝶	C		*		*	
95	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Athyma perius*	玄珠帶蛺蝶	UC		*		*	
96	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Athyma selenophora*	新月帶蛺蝶	C		*	*		
97	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Cethosia biblis*	紅鋸蛺蝶	UC		*	*	*	
98	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Cupha erymanthis*	黃襟蛺蝶	VC		*	*		*
99	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Cyrestis thyodamas*	網絲蛺蝶	C		*	*	*	*
100	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Euripus nyctelius*	芒蛺蝶	VR		*			
101	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Euthalia lubentina*	紅斑翠蛺蝶	UC			*		
102	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Euthalia phemius*	尖翅翠蛺蝶	C		*	*	*	
103	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Hestina assimilis*	黑脈蛺蝶	C		*	*	*	*
104	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Hypolimnas bolina*	幻紫斑蛺蝶	C		*	*	*	*
105	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Hypolimnas misippus*	金斑蛺蝶	UC		*	*	*	*
106	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Junonia almana*	美眼蛺蝶	C		*	*		*
107	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Junonia atlites*	波紋眼蛺蝶	C		*	*		
108	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Junonia hierta*	黃裳眼蛺蝶	R		*			
109	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Junonia iphita*	鉤翅眼蛺蝶	C				- [1]	
110	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Junonia lemonias*	蛇眼蛺蝶	C		*	*	*	*
111	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Junonia orithya*	翠藍眼蛺蝶	UC		*	*	*	*
112	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Kaniska canace*	琉璃蛺蝶	C		*	*	*	*
113	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Moduza procris*	穆蛺蝶	VR	*		*		
114	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Neptis clinia*	珂環蛺蝶	C			*		
115	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Neptis hylas*	中環蛺蝶	VC		*	*	*	*
116	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Pantoporia hordonia*	金蟬蛺蝶	UC				- [1]	
117	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Parasarpa dudu*	丫紋俳蛺蝶	C		*			
118	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Parathyma sulpitia*	殘鍔線蛺蝶	C		*	*	*	*
119	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Phaedyma columella*	柱菲蛺蝶	C		*	*	*	*

No.	Family	Subfamily	Scientific Name	Chinese Common Name	Local Restrictedness (Chan et al. 2011)	Species of conservation concern (Chan et al. 2011)	Location of records (transect)			
							A	B	C	D
120	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Phalanta phalantha*	珐蛺蝶	VR		*			*
121	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Polygonia c-aureum*	黃鉤蛺蝶	VR	*		-(1)		
122	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Rohana parisatis*	羅蛺蝶	C		*	*		
123	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Symbrenthia lilaea*	散紋盛蛺蝶	C			-(1)		
124	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Vagrans egista*	彩蛺蝶	VR	*	*			
125	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Vanessa cardui*	小紅蛺蝶	R			-(1)		
126	Nymphalidae 蛺蝶科	Nymphalinae 蛺蝶亞科	*Vanessa indica*	大紅蛺蝶	UC		*		*	*
127	Nymphalidae 蛺蝶科	Satyrinae 眼蝶亞科	*Elymnias hypermnestra*	翠袖鋸眼蝶	C		*	*	*	*
128	Nymphalidae 蛺蝶科	Satyrinae 眼蝶亞科	*Lethe confusa*	白帶黛眼蝶	C		*			
129	Nymphalidae 蛺蝶科	Satyrinae 眼蝶亞科	*Lethe europa*	長紋黛眼蝶	UC		*		*	
130	Nymphalidae 蛺蝶科	Satyrinae 眼蝶亞科	*Lethe rohria*	波紋黛眼蝶	UC			*	*	
131	Nymphalidae 蛺蝶科	Satyrinae 眼蝶亞科	*Melanitis leda*	暮眼蝶	C		*	*	*	
132	Nymphalidae 蛺蝶科	Satyrinae 眼蝶亞科	*Melanitis phedima*	睇暮眼蝶	UC		*	*	*	
133	Nymphalidae 蛺蝶科	Satyrinae 眼蝶亞科	*Mycalesis mineus*	小眉眼蝶	VC		*	*	*	*
134	Nymphalidae 蛺蝶科	Satyrinae 眼蝶亞科	*Mycalesis zonata*	平頂眉眼蝶	C		*	*	*	
135	Nymphalidae 蛺蝶科	Satyrinae 眼蝶亞科	*Neope muirheadii*	蒙鏈陰眼蝶	UC		*			
136	Nymphalidae 蛺蝶科	Satyrinae 眼蝶亞科	*Ypthima baldus*	矍眼蝶	VC		*	*	*	*
137	Nymphalidae 蛺蝶科	Satyrinae 眼蝶亞科	*Ypthima lisandra*	黎桑矍眼蝶	C		*	*	*	
138	Papilionidae 鳳蝶科	Papilioninae 鳳蝶亞科	*Chilasa clytia*	斑鳳蝶	C		*	*	*	*
139	Papilionidae 鳳蝶科	Papilioninae 鳳蝶亞科	*Graphium agamemnon*	統帥青鳳蝶	C		*	*	*	*
140	Papilionidae 鳳蝶科	Papilioninae 鳳蝶亞科	*Graphium doson*	木蘭青鳳蝶	C		*	*	*	*
141	Papilionidae 鳳蝶科	Papilioninae 鳳蝶亞科	*Graphium sarpedon*	青鳳蝶	VC		*	*	*	*
142	Papilionidae 鳳蝶科	Papilioninae 鳳蝶亞科	*Pachliopta aristolochiae*	紅珠鳳蝶	R		*			*
143	Papilionidae 鳳蝶科	Papilioninae 鳳蝶亞科	*Papilio bianor*	碧鳳蝶	C		*	*	*	*
144	Papilionidae 鳳蝶科	Papilioninae 鳳蝶亞科	*Papilio demoleus*	達摩鳳蝶	C		*	*	*	*
145	Papilionidae 鳳蝶科	Papilioninae 鳳蝶亞科	*Papilio helenus*	玉斑鳳蝶	VC		*	*	*	*
146	Papilionidae 鳳蝶科	Papilioninae 鳳蝶亞科	*Papilio memnon*	美鳳蝶	VC		*	*	*	*
147	Papilionidae 鳳蝶科	Papilioninae 鳳蝶亞科	*Papilio paris*	巴黎翠鳳蝶	VC		*	*	*	*
148	Papilionidae 鳳蝶科	Papilioninae 鳳蝶亞科	*Papilio polytes*	玉帶鳳蝶	VC		*	*	*	*
149	Papilionidae 鳳蝶科	Papilioninae 鳳蝶亞科	*Papilio protenor*	藍鳳蝶	VC		*	*	*	*
150	Papilionidae 鳳蝶科	Papilioninae 鳳蝶亞科	*Papilio xuthus*	柑橘鳳蝶	R		*	*		*
151	Papilionidae 鳳蝶科	Papilioninae 鳳蝶亞科	*Pathysa antiphates*	綠鳳蝶	C		*	*	*	*
152	Papilionidae 鳳蝶科	Papilioninae 鳳蝶亞科	*Troides helena*	裳鳳蝶	UC	*		*		
153	Pieridae 粉蝶科	Coliadinae 黃粉蝶亞科	*Catopsilia pomona*	遷粉蝶	C		*	*	*	*
154	Pieridae 粉蝶科	Coliadinae 黃粉蝶亞科	*Catopsilia pyranthe*	梨花遷粉蝶	VC		*	*	*	*
155	Pieridae 粉蝶科	Coliadinae 黃粉蝶亞科	*Colias erate*	斑緣豆粉蝶	-(4)			-(1)		
156	Pieridae 粉蝶科	Coliadinae 黃粉蝶亞科	*Eurema blanda*	檗黃粉蝶	C		*	*	*	*
157	Pieridae 粉蝶科	Coliadinae 黃粉蝶亞科	*Eurema hecabe*	寬邊黃粉蝶	VC		*	*	*	*
158	Pieridae 粉蝶科	Pierinae 粉蝶亞科	*Appias lyncida*	靈奇尖粉蝶	VR	*				*
159	Pieridae 粉蝶科	Pierinae 粉蝶亞科	*Cepora nerissa*	黑脈園粉蝶	C		*		*	
160	Pieridae 粉蝶科	Pierinae 粉蝶亞科	*Delias acalis*	紅腋斑粉蝶	R			-(1)		
161	Pieridae 粉蝶科	Pierinae 粉蝶亞科	*Delias hyparete*	優越斑粉蝶	UC		*		*	*
162	Pieridae 粉蝶科	Pierinae 粉蝶亞科	*Delias pasithoe*	報喜斑粉蝶	VC		*	*	*	*
163	Pieridae 粉蝶科	Pierinae 粉蝶亞科	*Hebomoia glaucippe*	鶴頂粉蝶	C		*	*	*	*
164	Pieridae 粉蝶科	Pierinae 粉蝶亞科	*Ixias pyrene*	橙粉蝶	UC			*		
165	Pieridae 粉蝶科	Pierinae 粉蝶亞科	*Pieris canidia*	東方菜粉蝶	VC		*	*	*	*
166	Pieridae 粉蝶科	Pierinae 粉蝶亞科	*Pieris rapae*	菜粉蝶	R		*	*	*	*

(1) Recorded outside the survey transects by occasional observations.
(2) New butterfly species to Hong Kong firstly reported in 2014.
(3) New butterfly species to Hong Kong recorded in the HKWP in 2011. This species is likely to have been introduced (Chan et al. 2011).
(4) New butterfly species to Hong Kong firstly recorded in 2008. Further monitoring is required to confirm the establishment of a local population (Chan et al. 2011).

Working Group Column

A Pilot Study of Macaque Movements using a Global Positioning System Collar

Wing W.C. Tsui and C.T. Shek
Mammal Working Group

為進一步了解本地陸上哺乳動物的生態情況，漁農自然護理署哺乳動物工作小組於2012年開始，使用配備有全球定位系統(GPS)的頸圈追蹤大型哺乳動物在野外放歸後的行蹤。本文旨在介紹香港首個於獼猴身上套上全球定位系統頸圈的試點研究，結果發現此頸圈裝置能有效記錄獼猴的活動範圍及移動模式。是次研究亦為將來就其他本土哺乳動物進行相關研究提供了寶貴的經驗。

Introduction

Global Positioning System (GPS) technology has been widely used to monitor and map wildlife movements over the past decade (Cagnacci et al. 2010). This relatively new technology can allow positional snapshots to be taken of the tagged animals to investigate their movement ecology, such as home range, habitat use and activity pattern. Movement studies using GPS collars are often restricted to medium-to-large mammals, as the maximum weight of the GPS collar should ideally be less than 5% of the animal's body weight (American Society of Mammalogists Animal Care and Use Committee 1998).

In 2012, the Mammal Working Group of the Agriculture, Fisheries and Conservation Department (AFCD) conducted a trial study of animal movements, which involved the use of GPS collars to track the spatial movements of local mammals, such as macaques, wild pigs and leopard cats. This article presents the preliminary results of a pilot study on an adult male macaque.

Methods

Before actual deployment, the GPS collar (GPS PLUS Mini, VECTRONIC Aerospace GmbH, http://www.vectronic-aerospace.com/) was tested for sensitivity and accuracy under different local field conditions. Generally, the GPS collar performance was similar to that of commonly used handheld GPS devices (Garmin GPSMAP 60CSx) in terms of location accuracy.

The macaque that was studied was a hybrid of the Rhesus Macaque (*Macaca mulatta*, 獼猴) and Longtailed Macaque (*M. fascicularis*, 長尾獼猴) (Fig. 15). It was captured at Hin Keng Estate, Sha Tin on 15 June 2012 and fitted with a GPS collar weighing about 260 g, which was less than 3% of the macaque's body weight. The macaque was then transferred to the Animal Management Centre for observation for two weeks and released in Kam Shan Country Park on 28 June 2012. It was monitored for two months, until it was recaptured in Lion Rock Country Park on 28 August 2012. The GPS collar was removed and the macaque was examined for any possible adverse effects from wearing the collar, such as weight loss, hair loss or abrasion.

The GPS collar was programmed to provide a geographical position record every hour and all data were stored as on-board memory. The expected battery life of the collar was about 120 days. The Global System for Mobile Communication (GSM) unit installed on the collar allowed us to receive position records as standard Short Messaging Service (SMS) text messages at the ground station through the local GSM mobile phone network. Every position record included the following information: date, time, latitude, longitude, height, Position Dilution of Precision (PDOP), type of position (i.e. 2D/3D), number of tracked satellites and battery voltage. Positions were recorded mainly in 3D mode (i.e. latitude, longitude and height above sea level) when tracked and generated by at least four satellites. The 2D mode (i.e. latitude and longitude only) was switched on when only three satellites were tracking the macaque. PDOP indicates the precision level of the geometry acquired by satellites: a lower PDOP value represents better satellite geometry, which gives a more accurate position estimate, and vice versa. In our study, only 3D fixes with a PDOP value less than or equal to 4.0 were considered highly accurate (with ±5 m precision), and were used for home range and habitat use analysis (Crown Registry and Geographic Base Branch 2008).

Selected positions were mapped via the software package ArcMap10 (ESRI, Redlands, CA). Home range, defined by Burt (1943) as the area traversed by the individual for foraging, mating and caring for young, was estimated by using the widely-used Fixed Kernel method (with scaled-reference bandwidth = 131). Home range and activity centres were defined as 95% and 50% fixed kernel area estimates respectively, and were constructed using the Home Range Tools extension for ArcGIS. The potential habitat use of the collared macaque was calculated by overlaying the area estimates with a habitat map (Environmental Resource Management 2010), and was determined by measuring the proportion of each habitat type within the estimated home range and activity centres.

The activity pattern of the macaque was recorded using an activity sensor installed in the collar at a sampling interval of five minutes. The data was processed and displayed using the Activity Pattern software (VECTRONIC Aerospace GmbH, http://www.vectronic-aerospace.com/).

Fig. 15. An adult male macaque fitted with a GPS Plus Mini collar from VECTRONIC Aerospace GmbH, Germany.

Results

Field observation indicated that during the tagging period, the collared macaque was repeatedly found in the forested area at the Fitness Trail of Lion Rock Country Park and remained solitary (Fig. 16). Despite the collar's relatively large size, we did not observe any adverse impact on the collared macaque, either physically or behaviourally. Upon recapture, we observed only minor hair loss on the neck, but no bare or abraded skin. In fact, the macaque increased its weight around 5% during the two-month tagging period.

Overall, 98.8% of 1,057 positioning attempts obtained by the GPS collar were successful. Of these, 92.0% and 6.8% were 3D and 2D positions, respectively. Of all positions logged, 729 (69.8%) were considered to be valid (3D positions with PDOP ≤ 4.0).

Analysis for Home Range and Habitat Use

During the tagging period, the macaque stayed primarily in areas within and close to Lion Rock Country Park, and avoided densely populated residential areas, such as Hin Keng Estate. Its home range and activity centres were estimated using valid GPS data points (3D positions with PDOP ≤ 4.0) from 30 June 2012, which was two days after the macaque had been released for observation and was believed to have reached its normal activity range, to the day when the collar was removed (28 August 2012; n=705). The estimated home range was 1.95 km^2, with two activity centres defined: 'Activity Centre 1', the woodland around the Fitness Trail, and 'Activity Centre 2', the vegetated area behind the Sha Tin Sewage Treatment Works (Fig. 16). The first capture site was located close to the boundary of its home range.

Figure 16 shows valid positions logged (n=729) from the GPS collar worn by the adult solitary male macaque within and close to Kam Shan and Lion Rock Country Parks, and the estimated home range (in blue) and activity centres (in pink), based on valid positions from 30 June to 28 August 2012 only (n=705). The red arrow shows the capture site at Hin Keng Estate, the yellow arrow indicates the release site in Kam Shan Country Park, and the green arrow indicates the recapture site along the Fitness Trail of Lion Rock Country Park.

Fig. 16. Valid positions logged from the macaque's GPS collar.

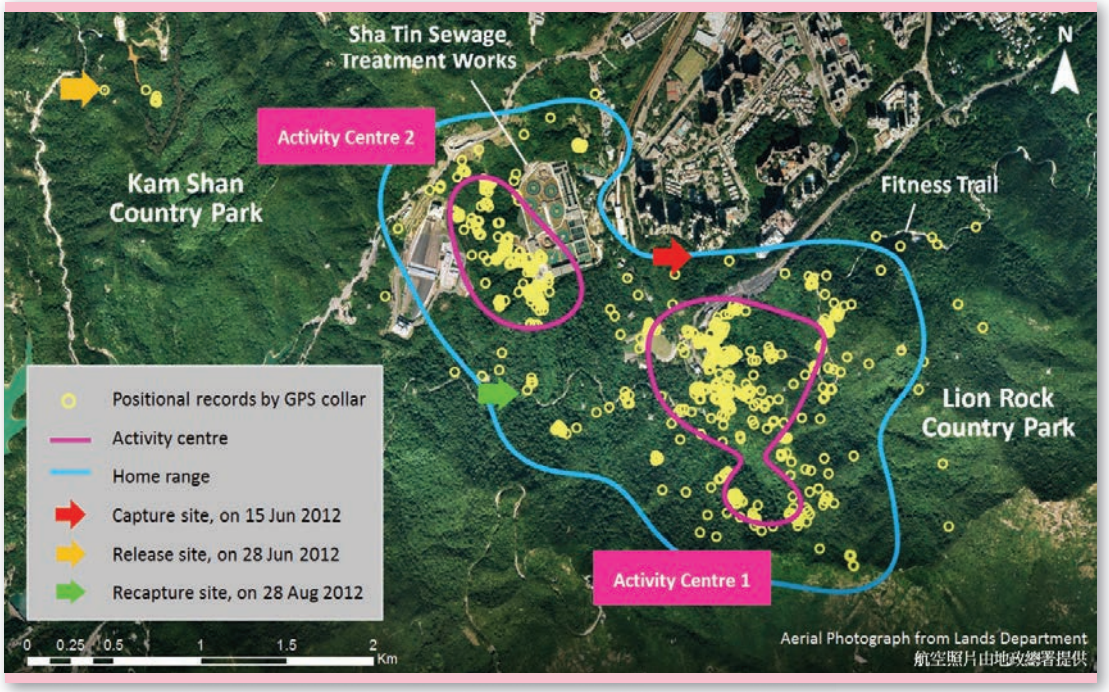


Table 4. Potential habitat use of the collared macaque within the estimated home range during the two-month tagging period, 30 June to 28 August 2012.

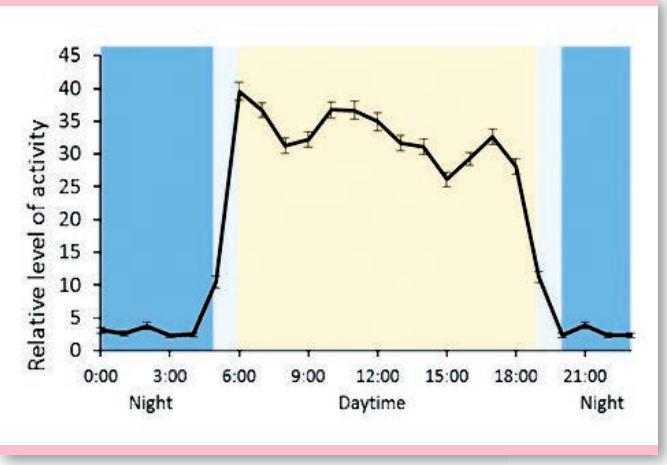
Habitat Types	Home Range (95% fixed kernel)	Activity Centres (50% fixed kernel)
Lowland woodlands	69.8%	67.4%
Scrublands	8.4%	9.0%
Grasslands	13.7%	15.2%
Urban areas	3.2%	4.6%
Others	4.9%	3.8%

The sequence of activities shows that the collared macaque stayed primarily around Activity Centre 1, but shifted its hub to Activity Centre 2 from 6 to 18 August 2012, and then returned to Activity Centre 1. There were a few occasions when the macaque was recorded on concrete roads near the woodland. The potential habitat use analysis suggested that the collared macaque did not uniformly inhabit the area, but preferred the lowland woodland over the other habitats, such as scrublands and grasslands (Table 4). It also ventured into some urban areas, but remained mostly in the non-residential areas. We also found that the macaque did not have a regular sleeping site. It tended to move around and pick different spots to rest.

Analysis of Activity Pattern

The activity pattern of the collared macaque was recorded throughout the whole monitoring period. Its daily activity was plotted against the time of day (Fig. 17). It is apparent that it was more active during the period from 06:00 to 18:00, with minor fluctuations; and was quiet from 20:00 to 05:00.

Fig. 17. Mean hourly activity (±SEM) of the collared macaque during its monitoring period, from 28 June to 28 August 2012.



Discussion

In this pilot study, the GPS collar data showed that the subject solitary male, which was once considered a 'nuisance macaque', spent most of its time in the woodland close to urban region, but not in the densely populated residential areas. The estimated home range of this solitary macaque was 1.95 km^2, which is relatively small compared to that of macaques that live in the wilderness. In China, rhesus macaques living in mountainous areas have home ranges that vary in size from 11 to 22 km^2; while in village areas, they have much smaller ranges, from 0.1 to 0.72 km^2, as 'village macaques' usually depend on humans for their food: offerings from visitors, crop raiding, or opportunistic foraging on food remains in rubbish areas, for example (Southwick et al. 1996). The relatively small home range estimated in our study may indicate that the macaque depended on food sources from humans through food offerings and food remains in rubbish. On top of that, the solitary nature of the individual and the fragmented habitats in the study area might have contributed to the small home range.

Within the home range, two activity centres were identified. An activity centre is an area estimated with the highest kernel density, which in turn represents where the animal being studied spends most of its time during the study period (Seaman and Powell 1996). We speculated that Activity Centre 1 was the primary activity centre, as the macaque returned to this area after spending two weeks in Activity Centre 2. After the tagging period, this animal was spotted at the Fitness Trail during the daily feeding for the macaque contraceptive programme. Further tracking and focal observation is needed to investigate the possible causes of such short-term movement patterns.

The activity pattern of the collared macaque conforms to the diurnal nature of macaques, which become more active after the sun rises (approximately 06:00), and quiet down after sunset (approximately 18:00). The pattern also matches the results of our camera trap survey (Shek et al. 2007).

This pilot study demonstrated that GPS collars equipped with GSM communication units can be an effective means for monitoring macaques under local field conditions. During the two-month tagging period, all 142 SMS messages, containing 1,044 position fixes, were transmitted from the collar to the ground station, and over 66.6% of the positions logged were considered highly accurate, with ±5m precision. Unlike the traditional radio collar technique, GPS collar telemetry allows us to collect a large number of accurate position records in almost real-time, with minimal labour required. To understand the movement ecology of our local macaques, more GPS collar tracking will be conducted on both peripheral males (a spatially distinct subgroup comprised mostly of sub-adult males and adult males) and heterosexual

troops. We hope that through these studies, we can gain greater insight into how macaques interact with the local environment.

We believe that the present study provides useful information for the further study of mammal movement, as well as for reviewing and formulating effective and sound conservation management plans for macaques and other local mammals.

Acknowledgements

We would like to express our sincere gratitude to the Ocean Park Conservation Foundation Hong Kong and the New Territories North Animal Management Centre for their technical support for this study.

References

American Society of Mammalogists Animal Care and Use Committee. 1998. Guidelines for the capture, handling, and care of mammals as approved by the American Society of Mammalogists. Journal of Mammalogy. 79(4): 1416-1431.

Burt WH. 1943. Territoriality and home range concepts as applied to mammals. Journal of Mammalogy. 24: 346-352.

Cagnacci F, Boitani L, Powell RA, Boyce MS. 2010. Animal ecology meets GPS-based radiotelemetry: a perfect storm of opportunities and challenges. Philosophical Transactions of the Royal Society Biological Sciences. 365(1550): 2157-2162.

Crown Registry and Geographic Base Branch. 2008. Province of British Columbia Standards, specifications and guidelines for resource surveys using Global Positioning System (GPS) Technology Release 4.0. Victoria, Canada: Crown Publications, Queen's Printer. 149 p.

Environmental Resource Management. 2010. 2008 update of terrestrial habitat mapping and ranking based on conservation value. Final Report to Sustainable Development Division, Hong Kong Special Administrative Region Government.

Seaman DE, Powell RA. 1996. An evaluation of the accuracy of kernel density estimators for home range analysis. Ecology. 77(7): 2075-2085.

Shek CT, Chan SM, Wan YF. 2007. Camera tray survey of Hong Kong terrestrial mammals. Hong Kong Biodiversity. 15: 1-11.

Southwick CH, Zhang Y, Hiang H, Liu Z, Qu W. 1996. Population ecology of rhesus macaques in tropical and temperate habitats in China. In: Fa JE, Lindburg DG, editors. Evolution and ecology of macaque societies. Cambridge (U.K.): Cambridge University Press. p. 95-105.

What's New

New Dragonfly Species for Hong Kong – *Gynacantha ryukyuensis* Asahina, 1962 (琉球長尾蜓)

Kenneth K.K. Leung[1], W.L. Hui[2] and T.H. Fung[3]
[1]Nature Conservation Division
[2]Country Parks Ranger Services Division
[3]Biodiversity Conservation Division

漁農自然護理署蜻蜓工作小組於2004年在新界東北首次記錄到琉球長尾蜓。其後，工作小組於2013及2014年在不同地方再次發現此蜻蜓品種，並於2014年確認為香港新記錄。本文就琉球長尾蜓的特徵、分布及生態作簡短介紹。

Dragonflies of the Genus *Gynacantha* are one of the most mysterious groups of aeshnids in the world, owing to their crepuscular behaviour and highly similar morphological characters. There are 86 described species of *Gynacantha* in the world, nine of which are known from China (Zhang and Li 2011). Up to 2013, three *Gynacantha* species had been recorded in Hong Kong: *G. japonica* Bartenef, 1909, *G. saltatrix* Martin, 1909 and *G. subinterrupta* Rambur, 1842. There was also a report of a *G. hyalina* record in Hong Kong, but it is regarded as a misidentified record (Wilson and Xu 2008; Zhang and Li 2011).

In addition to the three known species, a *G. ryukyuensis* was found and confirmed to occur in Hong Kong in 2014. *G. ryukyuensis* was first recorded by the AFCD Dragonfly Working Group in Hong Kong's northeast New Territories in 2004, when one male and one female were captured. Two females were then recorded in Tai Lam Country Park and the northeast New Territories in April 2013 and May 2014 respectively (Fig. 18). A male was also captured in Tai Lam Country Park on 6 June 2014 (Fig. 19). All *G. ryukyuensis* recorded in Hong Kong were observed resting in trees during the day in dense woodland with a marsh nearby. In the 2014 record, the female was observed several times chasing prey near a stream with high canopy coverage.

Fig. 18. Female *Gynacantha ryukyuensis*.

Fig. 19. Male *Gynacantha ryukyuensis*.

G. ryukyuensis has been recorded in Japan, Taiwan and Vietnam (Do et al. 2011; misidentified as *G. subinterrupta* in the report, personal communication with W.C. Yeh). Adult *G. ryukyuensis* are known to frequent marshes in woodlands or near woodland margins. They fly in an erratic path at slow speed. Like other *Gynacantha* species, the females lay their eggs in mud (Tsou 2005).

The mature *G. ryukyuensis* is a medium-sized aeshnid with distinctive brownish-yellow compound eyes. Its frons is yellow, with a black T-shaped mark. The bulky synthorax is yellowish green with a black vertical stripe on the dorsum. Prominent brown marking is found on the wing base, which is not easy to observe in the field (Tsou 2005). Two blue markings are found on the dorsum of the 2nd abdominal segment (Fig. 20). The side of the abdomen of females has rich yellow markings. Compared with *G. japonica*, the male *G. ryukyuensis* has shorter superior caudal appendages, which are also comparatively narrower (Fig. 21), while the female's cerci are extremely short and narrow (Asahina 1962). In addition, the abdomen of the female *G. ryukyuensis* is much more robust than that of the female *G. japonica*. Morphological measurements of male and female *G. ryukyuensis* are listed in Table 5.

Table 5. Morphological measurements of *Gynacantha ryukyuensis*.

Measurements	Male	Female (cersi detached)
Total length (mm)	66.0-67.4	65.6
Abdomen + anal appendages (mm)	52.9-53.3	50.6
Hind wing (mm)	43.3-44.5	43.8

Fig. 20. Comparison of synthorax of three male *Gynacantha* species recorded in Hong Kong (not to scale).

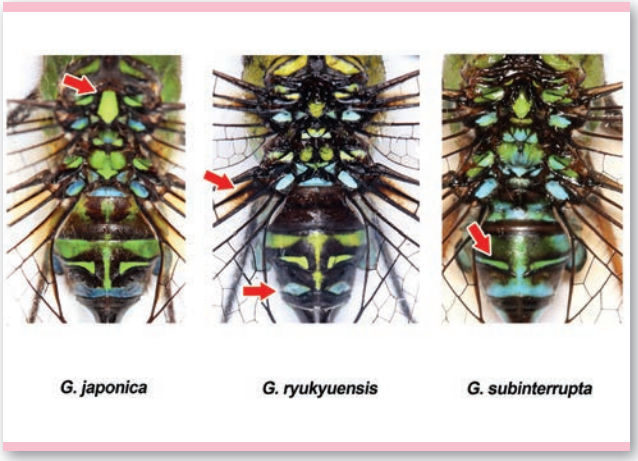
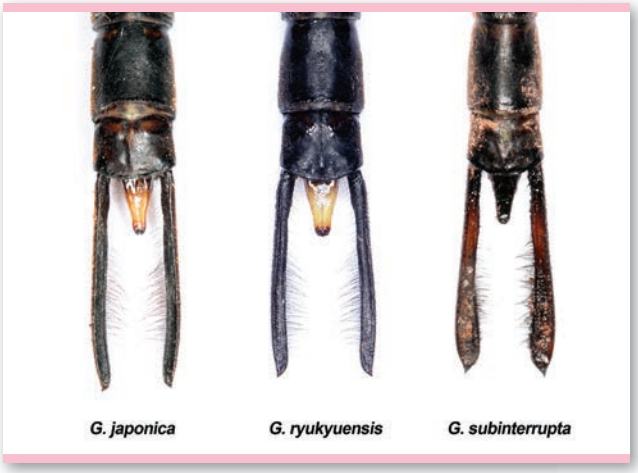


Fig. 21. Comparison of anal appendages of three male *Gynacantha* species recorded in Hong Kong (not to scale).



Acknowledgements

The authors would like to acknowledge Dr. Wang Liang-jong, Mr. Yeh Wen-chi and Dr. Zhang Hao-miao for their help in the identification, and provision of information and relevant references for the study.

References

Asahina S. 1962. Odonata of Ryukyu Archipelago. Part III. The Odonata from the Amami Islands, adult dragonflies. Tombo. 5 (1-4): 4-18.

Do MC, Bui MH, Nguyen TH, Phan QT. 2011. Anisoptera of Cuc Phuong National Park, North Vietnam. International Dragonfly Fund – Report 33. 1-18 p.

Tsou MH. 2005. Dragonflies of Taiwan: 120 species. Taipei: Wild Bird Society of Taipei. 128 p. (In Chinese)

Wilson KDP, Xu ZF. 2008. Aeshnidae of Guangdong and Hongkong (China) with the descriptions of three new *Planaeschna* species (Anisoptera). Odonatologica. 37(4): 329-360.

Zhang HJ, Li XX. 2011. Study on *Gynacantha* Genus (Odonata: Aeshnidae) from China. Journal of Anhui Agricultural Science. 39 (13): 7562-7564, 7566.

Changes/Updates to the Dragonfly Checklist in Hong Kong

Kenneth K.K. Leung[1] and T.W. Tam[2]
[1]Nature Conservation Division
[2]Dragonfly Working Group

A Hong Kong dragonfly checklist was published in "The Dragonflies of Hong Kong" by AFCD in 2011. Since then, new records of dragonfly species have been made by the Dragonfly Working Group of AFCD and reported by other researchers, non-government organisations and amateurs. At present, a total of 123 dragonfly species have been recorded in Hong Kong. Apart from the new dragonfly species records, there were some changes to the names and local status of some dragonfly species. The changes/updates to the dragonfly checklist are summarized in Table 6.

Table 6. Changes/updates to the dragonfly checklist.

Scientific Name	English Common Name	Chinese Common Name	Status	Remarks
Additions				
Anax indicus Lieftinck, 1942	Elephant Emperor	黃斑偉蜓	Vagrant	Recorded by Yam (2012) in 2010.
Anotogaster cf. *klossi* Fraser, 1919	–	圓臀大蜓屬品種	To be confirmed	Recorded by the AFCD Dragonfly Working Group in 2015.
Gynacantha ryukyuensis	Ryukyu Dusk-hawker	琉球長尾蜓	Uncommon	Recorded by the AFCD Dragonfly Working Group in 2004 and its identification was confirmed in 2014.
Matrona basilaris Selys, 1853	–	透頂單脈色蟌	Historical	Specimens of this species collected in Hong Kong between 1878 and 1907 were discovered by Seehausen (2014) in a museum in Denmark.
Rhyothemis fuliginosa Selys, 1883	–	黑麗翅蜻	Vagrant	Recorded by Ng (2014a) in 2014.
Stylurus kreyenbergi Ris, 1928	–	克雷擴腹春蜓	Vagrant	Recorded by So (2008) in 2008 and its status was reviewed and confirmed in 2014.
Sympetrum darwinianum (Selys, 1883)	–	夏赤蜻	Vagrant	Recorded by Ng (2014b) in 2014.

Scientific Name	English Common Name	Chinese Common Name	Status	Remarks
Changes to names				
Acisoma panorpoides Rambur, 1842	Asian Pintail	錐腹蜻	Common	*Acisoma panorpoides panorpoides* is raised to species level and dubbed *Acisoma panorpoides* based on adult male morphology and COI sequence data (Mens et al. 2016).
Cephalaeschna klotsae Asahina, 1982	Yellow-spotted Dusk-hawker	克氏頭蜓	Rare	The scientific name was changed from *Cephalaeschna klotsi* to *Cephalaeschna klotsae*. The species is named after a female biologist Dr. Elsie Broughton Klots (Hämäläinen 2015). A female gendered species name should be used according to the nomenclature rule of naming a species.
Coeliccia cyanomelas Ris, 1912	Blue Forest Damsel	黃紋長腹扇蟌	Abundant	The Chinese name was changed to align with that of the genus *Coeliccia* according to Dr. Zhang Hao-miao (personal communication).
Onychothemis tonkinensis tonkinensis Martin, 1904	Black Riverdarter	北部灣爪蜻	Uncommon	The scientific name was updated as the reference for identification of the species had used an incorrect name (*Onychothemis testacea tonkinensis*) for the species.
Pseudocopera ciliata (Selys, 1863)	Black-kneed Featherlegs	毛狹扇蟌	Common	This species is migrated to a new genus *Pseudocopera* according to Dijkstra et al. (2013) and the original Chinese name (白狹扇蟌) referred to another species according to Dr. Zhang Hao-miao (personal communication).
Changes to status				
Tramea transmarina euryale (Selys, 1878)	Ocean Glider	海神斜痣蜻	Vagrant	Status reviewed and changed from occasional records to vagrant.

References

Dijkstra K-D B, Bechly G, Bybee SM, Dow RA, Dumont HJ, Fleck G, Garrison RW, Hamalainen M, Kalkman VJ, Karube H, May ML, Orr AG, Paulson DR, Rehn AC, Theischinger G, Trueman JWH, VanTol J, Von Ellenrieder N, Ware J. 2013. The classification and diversity of dragonflies and damselflies (Odonata). Zootaxa. 1854: 63-68.

Hämäläinen M. 2015. Catalogue of individuals commemorated in the scientific names of extant dragonflies, including lists of all available eponymous species-group and genus-group names. International Dragonfly Fund – Report. 80: 1-168.

Mens LP, Schütte K, Stokvis FR, Dijkstra K-D B. 2016. Six, not two, species of *Acisoma* pintail dragonfly (Odonata: Libellulidae). Zootaxa. 4109(2): 153-172.

Ng. 2014a. *Rhyothemis fuliginosa* [photo]. Flickr [accessed 2015 July 8]. https://www.flickr.com/photos/m6n66/15589058555/in/photostream/.

Ng. 2014b. *Sympetrum darwinianum* [photo]. Flickr [accessed 2015 July 8]. https://www.flickr.com/photos/m6n66/16023556161/in/photostream/.

Seehausen M. 2014. New to the fauna of Hong Kong: *Matrona basilaris* Selys, 1853 (Odonata: Calopterygidae). International Dragonfly Fund – Report. 65: 3-5.

So. 2008. Hong Kong first record *Stylurus kreyenbergi* [photo]. Flickr [accessed 2015 July 8]. https://www.flickr.com/photos/35761902@N00/sets/72157606708887373?view=sq.

Yam LY. 2012. *Anax indicus* Lieftinck, 1942 (Odinata: Aeshnidae, Anax) – a new record for Hong Kong. Insect News. 4:2-4.

Other Submission

Uncovering the Identity of the Pale Chub (寬鰭鱲) in Hong Kong

Stephen Y.H. Lai

在一份近期發表有關越南及附近區域的馬口鱲(鯉科魚)的分類研究中，香港的寬鰭鱲被鑑定為尖翅馬口鱲[*Opsariichthys acutipinnis* (Bleeker)]。然而，在2013年8月，一條於烏蛟騰採到的雄性寬鰭鱲標本被發現擁有與長鰭馬口鱲 [*O. evolans* (Jordan & Evermann)]十分相近的分類特徵。從現時的資料顯示，這兩個馬口鱲品種均可能在香港出現。

Introduction

The Pale Chub is a small minnow with vertical stripes along its body. It is found in streams and reservoirs in Hong Kong and the scientific name, *Zacco* platypus (Temminck and Schlegel 1846), is widely used to describe the species. This minnow was not initially included in the Hong Kong freshwater fish checklist published by the famous ichthyologist Lin Shu-yen (1949). It was only until 1981 when Man and Hodgkiss (1981) recorded the minnow for the first time in Hong Kong as *Z. platypus*, a species described from Japan. Since then, *Z. platypus* remains the only scientific name employed to describe this minnow, and this name is quoted in all ichthyological accounts whenever a Pale Chub is found in Hong Kong.

Taxonomy of Pale Chub and Known Distribution Range

In traditional ichthyological literature, the *Zacco* species and its close relative, *Opsariichthys*, are distinguished primarily by the morphological differences in jaw bone structure, with the former having straight jaw bones and the latter having a canine-like projection fitting into the lower jaw (Nichols 1929; Lin 1935a & 1935b). In the Fauna Sinica series, Chen et al. (1998) reported a total of four species under the genus *Zacco* (*Z. platypus*, *Z. chengtui* Kimura, *Z. taiwanenesis* Chen and *Z. pachycephalus* (Günther)), while only one species, *Opsariichthys bidens* Günther, was included under the genus *Opsariichthys*. The scientific names *Z. acutipinnis* (Bleeker) and *Z. evolans* (Jordan & Evermann), with type specimens collected from the Yangtze and Taiwan, respectively, were both treated as synonyms for *Z. platypus*.

However, new information on the classification of these Asian minnows became available in recent years when Taiwanese ichthyologists, Chen, Wu and Hsu (2008) and Chen, Wu and Huang (2009) published reports on the taxonomy of *Opsariichthys*, along with other related genera, including *Parazacco*, *Candidia* and *Zacco*. In their studies, they reviewed the relationships of these minnows, based on morphological and genetic studies, employing mitochondrial sequencing techniques. They demonstrated that the Formosan Pale Chub (*Z. evolans*) and the Yangtze Pale Chub (*Z. acutipinnis*) are in fact unrelated to *Z. platypus*, but closely related to *Opsariichthys*. They deduced that both species should be treated as members of *Opsariichthys*, pointing out that the morphological characters of the zigzag mouth shape (canine-shaped jaw bone) and the anterior notch on the upper jaw do not serve as good diagnostic characters to define all members of *Opsariichthys*. In their studies, they also collected Pale Chub specimens from Mainland China for comparison. Their research findings revealed that *O. evolans* is not endemic to Taiwan, but also occurs in the river systems of southern Zhejiang and Fujian. The survey results also revealed a species closely related to *Z. platypus*, tentatively known as *Z.* cf. *platypus*, found in Liaoning, China. On the other hand, *O. acutipinnis* was recorded in the Yangtze and southern China. Furthermore, Huynh and Chen (2013) identified a new species, *O. duchuunguyeni*, from Vietnam, and collected Pale Chub specimens from Hong Kong for comparison and species confirmation for the first time. In their studies, five juvenile/sub-adult specimens, measuring 51 to 78 mm standard length (SL), collected in Hong Kong (exact location not provided) were subjected to mitogenetic analysis, and the specimens were identified as *O. acutipinnis*.

Identification of Pale Chub collected in Hong Kong

The Pale Chub examined in this study was collected from a stream in a densely forested area in Wu Kau Tang, where it was observed to coexist with other fish species, including *Parazacco spilurus*, *Puntius semifasciolatus*, *Carassius auratus*, *Macropodus hongkongensis* and *Rhinogobius duospilus*. The streams in this area are quite remote and isolated compared with other locations where Pale Chubs have been recorded. Common exotic species such as mosquito fish (*Gambusia* sp.) and tilapia (*Ocerochromis* and *Tilapia* spp.) were not observed.

The identification of the *Zacco* and *Opsariichthys* species is best performed in nuptial males due to the presence of breeding tubercles, modification in fin shape and enhancement of body pigments, which are useful diagnostic features in species determination. In the Huynh and Chen study (2013), the five Hong Kong specimens examined were juveniles or sub-adults, and the only taxonomic accounts provided were a head profile drawing of a male juvenile (55 mm SL), which provided comparatively little reference for morphological examination. In order to obtain more reference materials for identification, the author examined a nuptial male specimen (85 mm SL) collected in Wu Kau Tang in August 2013 (Fig. 22). The specimen was examined with reference to the species descriptions provided by Chen and Chang (2005), Chen, Wu and Huang (2009) and Huynh and Chen (2013) for *Opsariichthys* species. The specimen had the following morphological features:

- body with 12 to 13 blue stripes on the flanks and a greenish-yellow caudal peduncle (Fig. 22);
- pectoral fins extending beyond the origin of the ventral fins (Fig. 22);
- a series of six rounded tubercles under the lower jaw (Fig. 23);
- a series of well separated and rounded tubercles on the cheeks (Fig. 23);
- a blackish purple snout and orange-red lower cheek (Fig. 24);
- eight rows of scales above the lateral line (Fig. 25);
- 15 pectoral fin rays (Fig. 26);
- a maxillary not extending to vertical of anterior margin of orbit; and
- an anal fin extending beyond the caudal fin base.

The above characteristics concur with the diagnostic descriptions provided by the above authors for *O. evolans*. These features can be used to distinguish this species from other congeneric species, including *O. acutipinnis* and *Z. platypus*. According to Huynh and Chen (2013), *O. acutipinnis* can be distinguished from *O. evolans* by the former's pectoral fins not extending to the origin of the ventral fins and the smaller body scales, with nine rows of scales above the lateral line. The specimen illustrated here has pectoral fins that extend far beyond the origin of the ventral fins (Fig. 22), bigger scale size (eight rows above lateral line) (Fig. 25), and 15 pectoral fin rays (Fig. 26), which fall within the range of 13 to 15 recorded for *O. evolans*. Furthermore, the arrangement of facial tubercles (Fig. 23), an important identification feature for *Opsariichthys* spp., matches the descriptions of *O. evolans* provided by Chen, Wu and Huang (2009). The body colouration of the examined specimen, i.e. greenish-yellow caudal peduncle (Fig. 22) and purple snout (Fig. 24), are also known characteristics of *O. evolans*. These features can also be used to distinguish this specimen from *Z. platypus*. According to Chen and Chang (2005), *Z. platypus* can be visually distinguished from *O. evolans*, as the nuptial males of the former have tubercles on their cheeks that are fused to form a ridge, a white snout and pectoral fins that never reach the origin of the ventral fins. The body pattern of *Z. platypus* is also unique, with three to four red stripes above the pectoral fins, and the blue stripes along the flanks fused into three to four large blotches in the posterior half of the body.

Fig. 22. *Opsariichthys* species (Wu Kau Tang, SL 85 mm. 17.iiix 2013).

Fig. 23. Head profile of the *Opsariichthys* species.

Fig. 24. Head profile of the *Opsariichthys* species.

Fig. 25. Scales above the lateral line (preserved specimen).

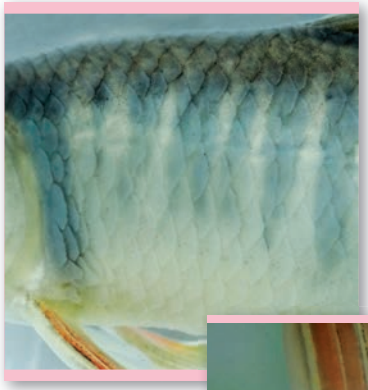


Fig. 26. Pectoral fin (preserved specimen).

Discussion

Given that *O. evolans* has already been recorded in Zhejiang and Fujian in Mainland China, it is possible that this species may also occur in Guangdong. The Pale Chub has been recorded in various streams (Lee et al. 2004) and reservoirs (Lai 2011) in Hong Kong, and it is highly likely that fish populations originating from different sources may occur locally. It is also possible that some populations in Hong Kong may have been accidentally introduced either via water supplies from Mainland China or through imports of other carp fry for aquaculture in the past. However, since *O. evolans* and *O. acutipinnis* are morphologically very similar, further studies on the genetics of the various local Pale Chub populations would be required to confirm the identity of these minnows and whether both species do actually occur in Hong Kong.

Acknowledgements

The author would like to thank Professor Chen I-shiung for the technical papers published on Opsariichthys from Taiwan and the useful information he provided on fish taxonomy. The author is also grateful to Mr. C.F. Ho for providing other relevant published information on the subject.

References

Chen IS, Chang YC. 2005. A photographic guide to the inland-water fishes of Taiwan. Volume 1, Cypriniformes. Keelung: The Sueichan Press. 284 p. (In Chinese)

Chen IS, Wu JH, Hsu CH. 2008. The taxonomy and phylogeny of *Candidia* (Teleostei: Cyprinidae) from Taiwan, with description of a new species and comments on a new genus. The Raffles Bulletin of Zoology. 19 (Supplementary): 203-214.

Chen IS, Wu JH, Huang SP. 2009. The taxonomy and phylogeny of the cyprinid genus *Opsarrichthys* Bleeker (Teleostei: Cyprinidae) from Taiwan, with description of a new species. Environmental Biology of Fishes. 86(1): 165-183.

Chen YY, Chu XL, Chen YL, Kiu YR, He MG. 1998. Fauna Sinica. Osteichthyes. Cypriniformes II. Beijing, China: Science Press. 531 p.

Huynh TQ, Chen IS. 2013. A new species of cyprinid fish of genus *Opsariichthys* from Ky Cung – Bang Giang River Basin, Northern Vietnam with notes on the taxonomic status of the genus from Northern Vietnam and Southern China. Journal of Marine Science and Technology Suppl. 21: 135-145.

Lai SYH. 2011. Reservoir fishes of Hong Kong with remarks on conservation options. Memoirs of the Hong Kong Natural History Society. 27: 63-82.

Lee LF, Lam KS, Ng KY, Chan KT, Young LC. 2004. Field guide to the freshwater fish of Hong Kong. Hong Kong: Friends of the Country Parks, Cosmos Books Ltd. 306 p.

Lin SY. 1935a. Contribution to a study of Cyprinidae of Kwangtung and adjacent provinces. Lingnan Science Journal. 14(3): 403-414.

Lin SY. 1935b. Contribution to a study of Cyprinidae of Kwangtung and adjacent provinces. Lingnan Science Journal. 14(4): 651-663.

Lin SY. 1949. Freshwater fishes of Hong Kong. Journal of the Hong Kong Fisheries Research Station. 2: 75-101.

Man SH, Hodgkiss IJ. 1981. Hong Kong freshwater fishes. Urban Council of Hong Kong. 58 p.

Nichols JT. 1929. A predaceous Chinese Carp and its relationships. Lingnan Science Journal. 8: 169-172.

Temminck GL, Schlegel H. 1846. Pisces in Siebold's Fauna Japonica. Lugduni Batavorum, Leiden.