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**Winter aggregation of Danaine Butterflies in Hong Kong (1999 - 2009)
Ten years records and a brief account**

■ 饒戈 Vor YIU

香港昆蟲學會

Hong Kong Entomological Society

🏠 www.hkentsoc.org

✉ contact@hkentsoc.org

編輯 Editors :

保羅艾斯頓 Paul ASTON

饒戈 Vor YIU

設計排版 Design & Page setting :

葉朝霞 Chiu Ha YIP

Chrysomelidae of Hong Kong Part 2

Subfamily Alticinae

■ Paul Aston

Abstract

This is the second part of this study of the Chrysomelidae occurring in Hong Kong. Thirty five species are covered by the keys. Photographs of the larvae and life history information on *Podontia lutea* Olivier 1790 and *Altica cyanea* (Weber) are also given.

The Alticinae, commonly known as the Flea Beetles, due to their extraordinary power of jumping, are generally small in size, though in Hong Kong we have species up to 15.5mm in length. The following characteristics distinguish the Alticinae from other groups of coleoptera (1) Phytophagous in both larval and adult stages; (2) the posterior femora are usually much thickened, and in all cases thicker than the femora in the two pairs of anterior legs; (3) the antennae are always placed between the inner margins of the eye; (4) the anterior coxae are not conically prominent at the apex as they are in the closely related Galericinae.

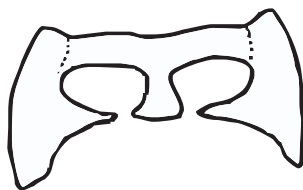
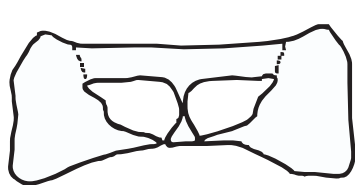
Keys have been built on and modified from Gressitt and Kimoto (1963) and are best used for fresh specimens, though older specimens should pose no problem for more experienced users. Note that colours do generally

become darker in older specimens. It is very likely that many more species will be discovered in Hong Kong, but most or all of our commonly occurring species should be adequately covered in the keys.

In the systematic section, for each species are given the (1) Name (2) References to the type description are given to the right of the species name. (3) Length and description. (4) **Host** information, if known, is generally taken from existing literature on south China, and is only listed if the species of plant is included in the *Agriculture, Fisheries and Conservation Department Bulletin 1* (revised) *Checklist of Hong Kong Plants 2004*. (5) **Imago** - period when adults can be seen in Hong Kong, mostly from personal notes of the author (and in brackets - Literature records of when adults have been seen in south China). Also information on Hong Kong records. (6) World Distribution - indicating edges of range.

Key 1 - Major groups

1. Anterior coxal cavities closed behind see figure below right (Group 1)..... Key 2
- Anterior coxal cavities open behind see figure below left (Group 2)..... Key 5



Prosternum showing pro-coxal cavities.

Right: closed coxal cavities
i.e. The posterior of the coxa are not touching the mesosternum.

Left: open coxal cavities.
i.e. The posterior of the coxa are against the mesosternum.

Key 2 - Group 1 Genera with anterior coxal cavities posteriorly closed

1. Antenna 11 segmented..... 2
- Antenna 9-segmented, terminal segments usually flattened; body ovate (Figure below). *Nonarthra*



Nine segmented antennae
of *Nonarthra* sp.

2. (1) Pronotum and elytra pubescent 3
- Pronotum and elytra not pubescent; Pronotum without a distinct ante-basal impression 4
3. (2) Hind tibia with 1 apical spine; Pronotum with ante-basal, transverse impression shallow, bounded laterally by a small, deep impression *Micrepitrix*
- Hind tibia with 2 apical spines; body elongate, densely covered with adpressed hairs; postantennal tubercles contiguous *Eutrea*

4. (2) Mid and hind tibiae excavated apically; each side of excavation with a marginal row of stiff bristles *Chaetocnema*
 - Mid and hind tibiae not as above 5
5. (4) Rows of elytral punctures easily counted; disc of elytron with 9 complete rows; inter-antennal space usually broad 6
 - Rows of elytral punctures indistinct or confusedly punctate; claws appendiculate. 8
6. (5) Body massive, length 8-17mm; pronotum with fossettes ; claws bifid 7
 - Length 3 - 4 mm; Body sub-quadrate; each tibia armed with 1 apical spine *Podagricomela*
7. (6) Prosternum triangularly excavated to fit mesosternum; hind femur angularly dilated on inner edge *Podontia*
 - Prosternum truncate along posterior margin; hind femur not angularly dilated. *Ophrida*
8. (5) Vertex evenly convex, disc not elevated, sides not deeply excavated above eye. 9
 - Vertex with disc longitudinally elevated; sides deeply excavated above eye (see figure right) *Neorthaea*
9. (8) Sides of pronotum with opposing, short, longitudinal impressions situated on anterior and posterior margins, though the latter only visible under high magnification. *Nisotra*
 - Pronotum not as above Abdominal sternite 1 distinctly longer than 2 ; apical segments of maxillary palp forming a spherical globule; terminal segment of antenna flattened. *Acrocrypta*



Shaded area showing longitudinally elevated disc of vertex in *Neorthaea* species.

1. *Nonarthra variabilis*

Baly, 1862, Jour. Ent. 1: 456



Length The 9-segmented antenna with the flattened terminal segments is diagnostic of this genus, the only other members likely to occur in Hong Kong have blue elytra. This species is extremely variable in colour. The head may be completely black; or when it is yellow-brown there are usually two round black spots on the vertex. The prothorax may be light yellow, red brown or black. The scutellum is generally black, sometimes red brown or lighter. The elytra may be entirely yellow, red-brown, or black; otherwise they has two variable transverse black bands.

Host: *Zea mays*; *Lagerstroemis indica*; *Castanea mollissima*.

Imago: HK : April – August (March – November).

Distribution: Northern India, Myanmar, North Vietnam, China (Sichuan, Hubei, Jiangxi, Fujian, Guangdong, Hainan and Taiwan).

2. *Micrepitrix coomani*

Laboissiere, 1933, Mus. Paris, Bull. 1933: 206

Length 1.1-1.4 mm. Shining blackish brown, dorsal surface darker; antenna pale brown with apical segments slightly darker; legs pale brown, posterior femora slightly darker; Pronotum transverse, almost as broad as base of elytra, with deep ante-basal, transverse impression attaining lateral margin; Hind tibia with 1 apical spine.

Imago: Kimoto 1967 lists 2 specimens from Tai Po Kau in April 1965, surprisingly he listed it under the subfamily galericinae.

Distribution: Vietnam and Hainan.

3. *Eutrea bowringii*

Baly, 1875, Ent. Soc. Lond., Trans. 1875: 25

Pronotum and elytra pubescent; Hind tibia with 2 apical spines; body elongate, densely covered with adpressed hairs; postantennal tubercles contiguous.

Distribution: This species was described from Hong Kong and is the type or the genus. There appears to be no records since the original description in 1875.

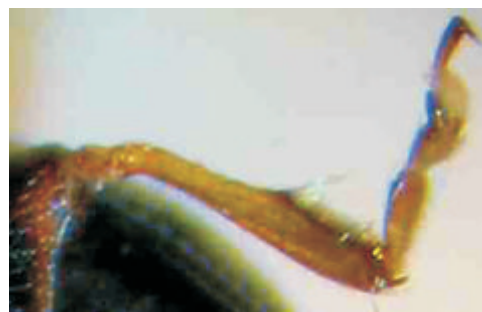
Key 3 - species of *Chaetocnema*.

Even though the species in this genus are particularly small (0.9 to 2 mm long locally) they have a characteristic build, making them easy to identify (see photos and drawings below). The important distinguishing character of this genus is the mid and hind tibiae possess a long excavation on the outer edge, extending from its apex. This excavation is fringed by a row of bristly hairs, some of which are developed into spines. The first segment of the tarsi is long. Almost always the first five or six segments of the antennae, the front and middle legs and the posterior tibiae and tarsi are brown.

1. Interantennal space flat and strongly punctured; vertex distinctly and rather regularly punctured (subgenus *Chaetocnema*) *concinnipennis*
- Interantennal space carinate or swollen medially, not punctured; vertex impunctate or with few punctures (subgenus *Tlanoma*) 2
2. Posterior angles of pronotum distinctly exceeding breadth of elytra at humeral angles *hainanensis*
- Posterior angles of pronotum narrower or equaling breadth of elytra at humeral angles *discreta*

4. *Chaetocnema (Chaetocnema) concinnipennis*

Baly, 1877, Ent. Soc. Lond., Trans. 170



Length 2 mm. Colour shining brassy-greenish or bluish. Antennae and legs tawny, with posterior femora sometimes darker or pitchy. Elytral punctures closely arranged in 15 rows. Elytral epipleura with rows of punctures. Frequently attracted to village lights at night.

Imago: May – November. All records Lantau Island on a wide range of shrubs.

Distribution: India, Sri Lanka, N. Vietnam (Tonkin), Hainan. This species has not been recorded previously in Hong Kong.

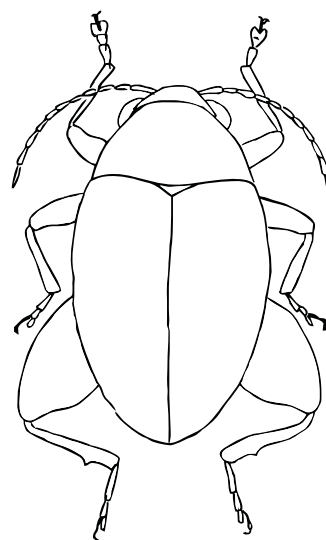
5. *Chaetocnema (Tlanoma) hainanensis* Chen, 1933, Sinensia 3 : 228

Length 0.9 - 1 mm. Posterior angles of pronotum distinctly exceeding breadth of elytra at humeral angles. Elytron without a transverse depression.

Imago: (April – July). Recorded in Hong Kong by Chen (1934). No modern records known.

Distribution: China (Hainan, Guangdong, Jiangsu and Fujian.)

Sketch right: outline of *Chaetocnema (Tlanoma) hainanensis* after Gressitt (1963)

**6. *Chaetocnema (Tlanoma) discreta discreta***

Plectroscelis discreta Baly, 1876, Ent. Soc. Lond., Trans. 1876: 596

Length 1.8 - 2mm. Cupreous above; Pronotum fully 2/3 times as long as broad, lateral margin feebly convex; vertex with 3 or 4 large punctures near inner margin of eye.

Host: *Duchesnea indica*; *Solanum melongena* L. var. *esculentum*; *Alternanthera sessilis*.

Imago: July (April – August.). Recorded by Gressitt (1963) in the Lam Tsuen Valley July 1962.

Distribution: China (Jiangsu, Fujian, Guangdong, Hunan, Hubei, Guizhou), North Vietnam and Japan.

7. *Podagricomela nigricollis*

Chen, 1934, Peking Nat. Hist. Bull. 8: 58

Length 3.0-3.5mm. Head, pronotum and elytral humerus usually black, but sometimes varying from brown to pitchy black; elytron brown or red brown with interstices slightly raised.

Host: *Citrus* spp. Occasionally is attracted to village lights at night. . Lee and Winney (1981) lists *Citrus sinensis*, *C. paradisi* and *C. reticulata*.

Imago: February – May (March – June). Lee and Winney (1981) recorded this species for the first time in Hong Kong.

Distribution: China (Guangdong, Zhejiang and Sichuan).

**8. *Podontia lutea***

Olivier 1790, Encycl. Meth. 5 : 692

Length 13 - 15.5 mm. Elytra not distinctly marked; body flavous to reddish testaceous above. Tibiae, tarsi and the seven apical segments of the antennae black.



Host: *Rhus succedanea*.

Imago: April to September (April – October) with last instar larvae recorded in April and September – photo above. Originally found in Hong Kong by Hadden of California Academy of Science in 1933 (Gressitt 1963).

Distribution: Myanmar, China (Shaanxi, Xinjiang, Sichuan, Guizhou, Yunnan, Hubei, Guangxi, Zhejiang, Fujian and Guangdong), Taiwan, and SE Asia.

9. *Ophrida scaphoides*

Podontia scaphoides Baly, 1865, Ent. Soc. Lond., Trans, ser. 3, 2 : 430

Length 7.5 - 9.0mm. Large size and markings make this species quite distinctive. Antenna less than 1/2 body length; interstices of elytron not distinctly raised.

Host: *Rhus vernicifera*. Occasionally is attracted to village lights at night.

Imago: April – September (June – October). Originally recorded by Kimoto (1963) in Lam Tsuen valley May 1956.

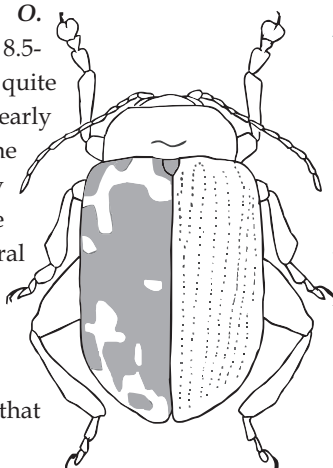
Distribution: China (Zhejiang, Jiangxi, Jiangsu, Fujian, Hubei, Guizhou, Sichuan, Yunnan, Xikang and Taiwan).

Another species of *Ophrida* is listed by Hua (2000) *O. spectabilis* Baly, 1862, but need confirmation. Length 8.5-11.0mm. Large size and markings make this species quite distinctive. Antenna with segments 1-4 testaceous, 5-11 nearly piceous. The spotting similar to *O. scaphoides*, but the spots darker and more confluent, forming irregularly shaped lines along the anterior margin, 1/3 of the anterior lateral margins, 1/3 of the posterior lateral margins, and two spots in the centre of the elytra, each side of the suture.

Host: *Rhus chinensis*.

Imago: (May – September). in Hong Kong. Confirmation that this species does occur in Hong Kong is needed.

Distribution: China (Zhejiang, Jiangxi, Jiangsu, Fujian, Hubei, Gweizhou, Sichuan, Yunnan and Sikang) and Taiwan..



Above: *Ophrida scaphoides*
Left: sketch of *Ophrida spectabilis* after Gressitt 1963. Right hand elytra showing punctures. Grey area on left hand elytra showing the extent of the brown, though this is quite variable.

Key 4 - species of *Neorthaea*

1. Posterior edge of pronotum distinctly bisinuate both sides. Colour dark reddish brown usually with a greenish or brassy / bronze tinge. *Neorthaea micans*
- Posterior edge of pronotum mildly sinuate both sides. Colour blackish c.f. *Neorthaea gressitti* (Chûjô)

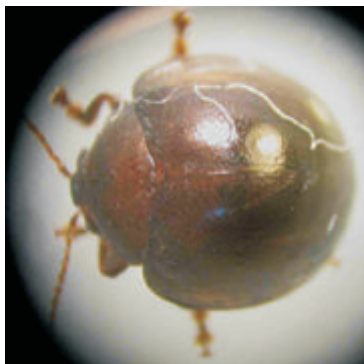
10. *Neorthaea micans*

Baly, 1875, Ent. Soc. Lond., Trans. 28

Length 5–7mm. Fairly evenly Reddish testaceous to dark brown above, usually with a brassy or dull greenish lustre. Posterior edge of pronotum distinctly bisinuate both sides.

Imago: The above individual Mui Wo Lantau, June 08, this is the first record for this species in Hong Kong.

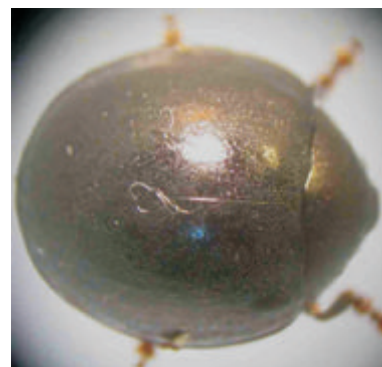
Distribution: Indonesia, Malaysia, N. Vietnam (Tonkin), China (Guizhou, Hubei, Guangxi, Guangdong), Myanmar and India.

**11. c.f. *Neorthaea gressitti* (Chûjô)**

Length 4.8 – 5.5 mm. Punctures on pronotum much lighter than *N. micans*. Colour darker, almost black brown. Posterior edge of pronotum mildly sinuate both sides.

Imago: May to October, Mui Wo, Lantau.

Note: Kimoto 1967 recorded *Neorthaea gressitti* Chûjô on 30 May 1965 from the Lam Tsuen Valley. No information on this species was available and it has therefore been excluded from the above key, it could well be that the above unidentified species is indeed this species.

**12. *Nisotra gemella***

Haltica gemella Erichson, 1834, Nov. Acta Acad. Leop. Carol. 16 (Suppl. 1): 275

syn. *Nisotra orbiculata* = *Sphaeroderma orbiculata* Mots., 1866, Soc. Nat. Mosa, Bull. 39, 1 (2): 421

Length 3.5 - 4 mm. Blue or blue green of varying shades; underside, scutellum and seven apical segments of the antennae piceous; legs, prothorax, and head light brown to dark brown (darker in older specimens). Eyes black. The type of *Nisotra bowringi* Baly, 1876, a synonym of this species was taken in Hong Kong.

Host: This common species is found on many species of plant, but is especially common on *Hibiscus* species.

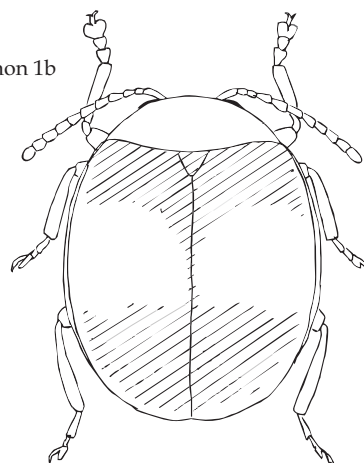
Imago: March – October

Distribution : India, Myanmar, Indonesia, China (Sichuan, Guangxi, Kiangsi, Fukien, Jiangxi, Guangdong, Hainan and Taiwan), Vietnam and Thailand.



13. *Acrocrypta convexa**Colpodes convexa* Gressitt and Kimoto 1963-Chrysomelidae of China & Korea - Pac Ins mon 1b

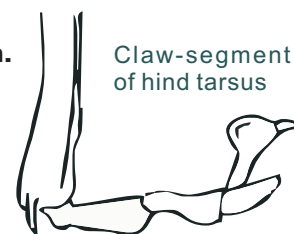
Length 3.0 mm. Ochraceous and reddish brown above; head and pronotum ochraceous; scutellum brown; elytron reddish brown with 2 broad ochraceous bands; 1st area in 2nd 1/4, rounded and not quite reaching suture, but broader than dark areas, 2nd in apical 1/4, laterally rounded and not touching external margin or apex, reaching to suture, which is slightly pigmented; antenna with scape, pedicel and segment 3 pale ochraceous, 4-5 becoming slightly darker, 6-11 reddish brown; ventral surfaces largely ochraceous; legs pale testaceous with femora slightly duller apically. Glabrous above, except for scattered hairs on anterior portion of head.

Host: *Zantedeschia aethiopica*.**Imago:** (April and July) Hua in List of Chinese Insects 2 lists this species as occurring in Hong Kong.**Distribution :** Hainan.

Sketch of *Acrocrypta convexa* (after Gressitt 1963) – shaded area shows the extend of the reddish brown colour of the elytra.

Key 5 - Group 2 Genera with anterior coxal cavities posteriorly open.

1. Claw-segment of hind tarsus strongly dilated. *Hyphasis*
- Claw-segment of hind tarsus not strongly dilated 2
2. (1) Pronotum and elytra densely pubescent. *Hespera*
- Pronotum and elytra not densely pubescent 3
3. (2) Pronotum evenly convex, without a distinct ante-basal, transverse impression (several spp. of *Aphthona* and *Manobidia* are somewhat depressed transversely at base or middle of pronotum) 6
- Pronotum with transverse impression, usually near and parallel to basal margin 4
4. (3) Elytron with punctation regularly arranged in 10 or 11 rows. Pronotum with ante-basal transverse impression not limited on sides by a short longitudinal line. Clypeus with anterior margin truncate. *Manobia*
- Elytron with punctation irregular, confused or obsolete 5
5. (4) Pronotum with ante-basal, transverse impression limited on sides by a short, longitudinal impression *Phygasia*
- Pronotum with ante-basal, transverse impression not limited on sides by a short, longitudinal impression *Altica*
6. (3) Tarsus with segment 3 entire. 7
- Tarsus with segment 3 bilobed 9
7. (6) Hind tibia not produced apically, tibial spine and tarsus inserted at apex 8
- Hind tibia produced apically, projection usually curved, tibial spine and tarsus inserted subapically. *Argopistes*
8. (7) Maxillary palpus stout, last segment pointed apically; elytron with epipleuron (more or less) horizontal. Prosternal process not longitudinally channeled. Clypeus entire, anterior margin truncate *Sphaeroderma*
- Maxillary palpus with 2 apical segments incrassate, forming a spherical globule; elytron with epipleuron vertical. *Chilocoristes*
9. (6) Elytron with punctation irregular, confused or obsolete 11
- Elytron with punctation arranged in 10 or 11 rows 10



Lateral view of end of the posterior tibiae and tarsus in *Hyphasis* showing the strongly dilated claw-segment (after Maulik 1926).

10. (9) Postantennal tubercles contiguous, not distinctly delimited from vertex *Aphthonomorpha*
 - Postantennal tubercles separated, distinctly delimited from vertex *Manobidia*
11. (9) Interantennal space broad, with breadth exceeding transverse diameter of eye. *Ivalia*
 - Interantennal space narrow, breadth much less than transverse diameter of eye 12
12. (11) Hind tibia with an axial excavation extending from apex to basal 1/4 or more. *Hemipyxis*
 - Hind tibia without, or with a short, sub-apical excavation 13
13. (12) Hind tarsus with segment 1 distinctly shorter than 1/2 length of tibia 14
 - Hind tarsus with segment 1 equaling or exceeding 1/2 length of tibia *Longitarsus*
14. (13) Elytron not pubescent. 15
 - Elytron with sparse, fine pubescence on apical edge; prosternum narrow; antenna with segments 2 and 3 small, nearly equal in length. *Luperomorpha*
15. (14) Each elytron white, with all the margins (including sutural) black and a thick black line running longitudinally from the anterior border for 3/4 of the elytral length. Pronotum almost square. Pronotum and head black. *Agasicles*
 - Not as above. 16
16. (15) Postantennal tubercles obsolete; hind tibia with apical spine inserted medially on apex *Phyllotreta*
 - Postantennal tubercles prominent; hind tibia with apical spine inserted laterally on apex *Aphthona*

Key 6 - *Hyphasis* species

1. Antenna black beyond segment 2; length generally 2.8-4.0 mm *Hyphasis moseri*
 - Antennae black or brown on last 6 or 7 segments; antennal segment 2 as long as 3; elytral punctures rather strong and close; length 2.0-2.8 mm *Hyphasis inconstans*

14. *Hyphasis moseri*

Weise 1922, Tijdschr. Ent. 65: 124

Length 3.0-4.0 mm. Body oblong ovate. Pronotum without an ante-basal impression; Antenna long, black beyond segment two. Elytral epipleura extraordinarily broad. Pronotum 2.3 times as broad as long and somewhat depressed with flattened margins. Dorsal surface dull yellow. Antenna passing a little beyond middle of elytra, segment 2 shorter than 3.

Host: *Vitex negundo* L var. *cannabifolia*

Imago: June – August.

Distribution: N. Vietnam, China (Jiangxi, Fujian, Guangdong and Hainan).

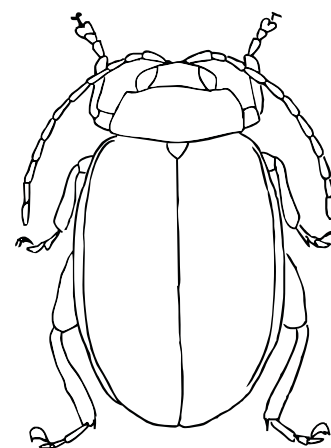
15. *Hyphasis inconstans*

Jacoby 1885, Zool. Soc. Lond., Proc. 1885: 733

Elytra very dark brown, very closely punctured. Pronotum dark orange with areas of large dark smudges. Compared with photographs of the type specimen in Harvard University.

Imago: April to July in south China. This is the first record of this species in Hong Kong 24 April 08 Tung Chung valley, Lantau Island.

Distribution: Japan, China (Giangxi, Guangdong, Fujian and Hainan) and Vietnam.



above right: sketch of *Hyphasis inconstans* after Gressitt 1963

16. *Hespera lomasa*

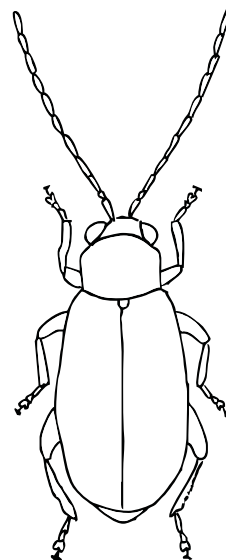
Maulik, 1926, Fauna India, Chrys. & Halt., 142

Length 2.0-3.0 mm; coloration varying from brown to brownish black. Pubescence dense, adpressed, usually golden-yellow or rarely silvery in colour. (the species name 'lomasa' coming from the sanskrit word for hairy). Apical segments of the antennae and the apex of the posterior femora, piceous.

Host: variety of flowers including *Ligustrum* sp. and *Rosa laevigata*.

Imago: March – September.

Distribution: Myanmar, India, Sri Lanka, China (Xikang, sichuan, Guangdong, Guizhou, Hubei, Jianxi, Fujian, Hainan) and Vietnam



above right: sketch of *Hespera lomasa* after Maulik 1926

17. *Manobia* sp.

Length 2.9 mm. Entirely reddish testaceous in colour. Last 5 antennal segments slightly expanded. Pronotum with a deeply impressed line in front of the basal margin. Scutellum with apex rounded. Elytra much broader at base than prothorax. Tarsal claws appendiculate.

Imago: commonly found in scrubby woodland and bamboo Lantau March - April 2009.

**Key 7 - species of *Phygasia* .**

1. Pronotum Orange or reddish brown *Phygasia ornata*
 - Pronotum black *Phygasia dorsata*

18. *Phygasia ornata*

Baly, 1876, Ent. Soc. Lond., Trans. 1876: 445

Length 4 – 6.5 mm. Elytra fulvous with basal and apical black or pitchy bands connected along suture and lateral margin with narrow dark stripe; extreme apex often orange or red. Elytron without costae.

Imago: May - September. Type from Hong Kong.

Distribution: China (Guangdong, Jiangxi,, Fujian, Guizhou and Taiwan) and Myanmar.

**19. *Phygasia dorsata***

Baly, 1878, Ann. Mag. Nat. Hist. Ser. 5, 2 : 231

Length 6 – 7.5 mm. Elytra flavous with sutural stripe widening in middle into large common central spot and apices black. Other body parts black. Elytron with 3 costae.

Imago: June (Yiu Vor 21 June 2007 Ng Tung Tsai).

Distribution: China (Yunnan, Sichuan), India, Indonesia and Vietnam.



Key 8 - species of *Altica* .

1. Dorsal surface finely or weakly shagreened or granulate *Altica viridicyanea*
 - Dorsal surface smooth *Altica cyanea*

20. *Altica cyanea**Galleruca cyanea* Weber, 1801, Observ. Ent. 1: 67

Length 5.0-5.5 mm. Dorsal surface smooth, dark blue, antennae black. Scutellum nearly black. Elytron without feebly impressed longitudinal sulcus laterally. Photo below of Larvae on 17/6/08 from Lam Tseun Valley on Polygonum sp.



Emerged (bottom right) 29/6/08, When originally emerged dirty brown, gradually becoming blue over 2 days.

Host: Gressitt 1963 lists Ludwigia spp, however in Hong Kong more frequently seen on Polygonum spp. Lee and Winney (1981) lists Oryza sativa.

Imago: March – November (April – December).

Distribution: Wide distribution from India to Japan and Australia. China (Shanxi, Hubei, Sichuan, Zhejiang, Xikang, Anhui, Fukian, Guangdong)

**21. *Altica viridicyanea****Graptodera viridicyanea* Baly., 1874, Ent. Soc. Lond., Trans. 1874: 191

Length 3.5-4.0 mm. Shining bluish green with ventral surface blackish blue. Antennae black. Ventral surfaces of aedeagus with a pair of feebly raised costae and their insides distinctly grooved, and these grooves run subparallel. Gressitt 1965 noted that this species is easily confused with *Altica fragariae* (Nakane 1955), an almost identical species. Can only be told apart in certainty by the male genitalia, in *A. viridicyanea* the ventral surface of the aedeagus has one distinct pair of costa, however in *A. fragariae* there is also a pair of feebly raised internal costa.

Imago: (July – September).

Distribution: Indian, Korea, Japan and China (Jilin, Hubei, Sichuan, Guizhou, Fujian, Guangdong and Yunnan).

Key 9 - species of *Argopistes*

1. Dorsal surface pitchy black, edged with brown all around the pronotal and elytral margins.
 *Argopistes lamprotes*
 - Not as above *Argopistes coccinelliformis*

22. *Argopistes coccinelliformis*

Csiki, 1940, Col. Cat. 169 : 524 (new name for *coccinelloides* Baly).

= *Argopistes coccinelloides* Baly, 1874 (nee Suffrain, 1868), Ent. Soc. Lond., Trans. 1874: 202

Length 3.2-4.0 mm. Elytron black, with a reddish area, occasionally almost entirely reddish brown;

Host: *Ligustrum* sp. Lee and Winney (1981) lists *Clausena lanium* and *Citrus* sp.

Imago: February – June (March – September.).

Distribution: Japan, South China (including Taiwan) and Vietnam.

Note: A third species of this genus has been incorrectly listed as occurring in Hong Kong. *Argopistes biplagiatus* Motschulsky 1860, is a Siberian and Japanese species.

**23. *Argopistes lamprotes***

Maulik 1926 Fauna of British India - Chrysomelinae and Halticinae p 297

Length 3.5 mm. Dorsal surface pitchy black, edged with brown all around the pronotal and elytral margins. Underside covered with brownish hairs. Double spine at the apex of the posterior tibia large and sharp.

Host: . Lee and Winney (1981) lists *Citrus* sp.

Distribution: India

24. *Sphaeroderma fuscicorne*

Baly, 1864, Ent. Monthly Mag. 1: 134

Length 2.2 – 2.8mm. Legs entirely reddish brown or yellowish; Body reddish brown above (more orange in live specimens). Antennae quite short, thickens after the fifth segment. Generally black with segments 1-4, and occasionally 5 or even all, pale. Males distinguished by broader anterior tibiae and dilated first segment to all antennae.

Host: *Akebia quinata* and *A. trifoliata*.

Imago: First records for Hong Kong. Only recorded June and July, both times at circa 500 m altitude on Sunset and Lantau Peaks, Lantau Island.

Distribution: Japan. Type specimen from China, exact location unknown.

**25. *Chilocoristes smilacis***

Gressitt and Kimoto 1963 Chrysomelidae of China & Korea - Pac Ins mon.1b

Length 4.3 mm. Strongly convex. Dorsum deep reddish brown to nearly pitchy on upper portions of elytron, becoming rich reddish brown on pronotum and median portion of elytron and quite pale reddish brown on outer borders of pronotum and elytron; antenna and legs fairly pale testaceous; head and ventral surfaces ochraceous, paler towards apex of abdomen. Dorsum glabrous; antenna, mouthparts, ventral surfaces and legs thinly clothed with short oblique golden buff hairs.

Host: *Smilax china*.

Imago: Type from Hong Kong July in Tai Po Kau.

Distribution: To date endemic to Hong Kong.

26. *Aphthonomorpha collaris*

Crepidodera collaris Baly, 1877, Ent. Soc. Lond., Trans. 1877

Length 2.2-2.5 mm. Head and pronotum red, elytra black. Abdominal sternite 1 with a pair of short, longitudinal intercoxal carinae.

Imago: Kimoto (1967) noted 1 specimen taken on 21 April 1965 from Tai Po Kau. (April – June)

Distribution: China (Jiangsu, Jiangxi, Fujien, Guangdong, Hunan, Hubei and Taiwan), Vietnam and Japan.

Key 10 - species of *Manobidia*.

1. Pronotum depressed at base; pale yellow-brown to dark brown; antenna flavous except apical segments darker; length 1.6 mm *M. intermedia*
- Pronotum not depressed at base; dark or pale reddish brown; abdomen and apical 1/2 of hind femur more or less piceous, in some cases abdomen and femora entirely reddish brown; length 1.5mm *M. simplicithorax*

27. *Manobidia simplicithorax*

Chen, 1934, Sinensia 5 (3-4) : 350, 360

Length 1.5mm. Pronotum not depressed at base; dark or pale reddish brown; abdomen and apical 1/2 of hind femur more or less piceous, in some cases abdomen and femora entirely reddish brown.

Imago: (April – July).

Distribution: Vietnam, China (Guangdong and Hainan).

28. *Manobidia intermedia*

Chen, 1934, Sinensia 5 (3-4) : 360

Length 1.6 mm. Pronotum depressed at base; pale yellow-brown to dark brown; antenna flavous except apical segments darker. Chen 1935 in the type description noted this species as occurring in Hong Kong.

Distribution: Vietnam.

29. *Ivalia* sp.

Length: 1.8 mm. These very small convex leaf beetles feed on moss and are probably totally nocturnal. The metasternum is expanded anteriorly, becoming vertical and covering mesosternums so the latter also becomes vertical, and is difficult to see. Metatibia curved in dorsal view with long metatibial spur.

Host: Moss on boulder.

Imago: 15 November 2008 Wang Tong, Lantau. A group of around 10, not present a week before or the next night – seen only in the night. Many feeding on moss. Only recorded in November.

Note: Gressitt described 2 species of *Taizonia* for China, neither of which meet the description of this species. *Taizonia* is a junior synonym of *Ivalia*. Alexander S. Konstantinov (pers comm.) commented that this is probably an, as yet undescribed species.

**Key 11 - species of *Hemipyxis* .**

Hong Kong species all have the elytra not distinctly marked or metallic. In this genus the lateral margins of the prothorax are rounded, somewhat explanate and reflexed. The elytral lateral margins are also somewhat explanate and reflexed. In many publications these species are placed synonymic genus *Sebaethe*.

1. Pronotum and elytra differing in colour *Hemipyxis flavipennis*
- Pronotum and elytra nearly alike in colour.. *Hemipyxis* sp.nr. *nigricornis*

[30. *Hemipyxis flavipennis*]*Sebaethe flavipennis* Baly, 1874, Ent. Soc. Lond., Trans. 1874

Pronotum moderately punctate and pitchy brown to piceous in colour. Elytron impunctate along lateral margins.

Host: *Alnus* sp.

Imago: Japan and south China.

Note: Gressitt 1963 indicated this species may occur in Hong Kong, possibly because Bowering collected specimens from south China.

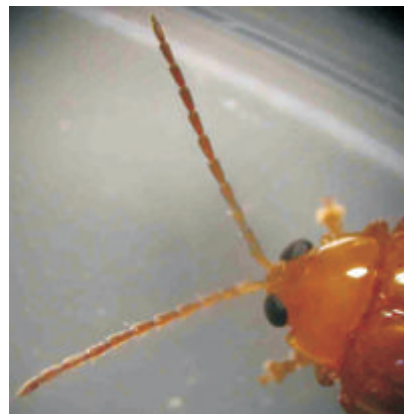
Distribution: Japan and South China.

31. *Hemipyxis* sp. nr. *nigricornis**Sebaethe nigricornis* Baly, 1877, Ent. Soc. Lond., Trans. 1877

Length: 3.4 – 3.8 mm The first 3 of 4 segments of the antennae are testaceous the rest becoming darker grey or blackish (though in one specimen I have seen even the apical segments are testaceous, though somewhat darker). These are close to *H. nigricornis*, but the whole insect is generally paler.

Host: found in mangroves, also seen attracted to village lights, close to the coast.

Imago: April, August – October.

**32. *Longitarsus belgaumensis***

Jacoby.1896 Ann. Soc. Ent. Belg XL p 260

Length 2.5 mm Body oblong, parallel sided. Colour obscure brown with elytral suture narrowly piceous, antennae brown with several of the apical segments darker. Labrum black. Punctures of the elytra confused. Interocular space without punctures. Posterior femora black at apex.

Host: Lee and Winney (1981) lists *Crotalaria* sp. In India is listed as a pest of *Phaseolus vulgaris* (French Bean)

Note: This genus is very large and several other species are more likely to occur here. This genus is diverse, however, the following characters are constant: Generally small in size; Antennae fairly long and slender, extending beyond the middle or even the end of the elytra. Posterior tibiae are long and flat above towards the apex.

Distribution: India, Nepal and Vietnam

33. *Luperomorpha rubra*

Chen, 1933, Sinensia 3(9)

Length 2.3-2.8 mm. Surface of pronotum smooth but not shagreened; Head, pronotum and elytra reddish brown. More orange in live specimens.

Host: seen on large variety of plants, sometimes attracted to village lights, or even under street lights.

Imago: April – October. Chen (1934) recorded this species from Hong Kong.

Distribution: Vietnam, China (Guangdong and Hainan).

**34. *Agasicles hygrophila***

Selman and Vogt, 1971

This south American species has been introduced to many parts of the world the naturalized south American aquatic perennial herb *Alternanthera philoxeroides*, which according to the Flora of Hong Kong (2006) is now common. Specimen from Yiu Vor, March 2007.

Distribution: Now quite widely distributed both North and South American and now Asia and Australia.



35. *Phyllotreta striolata*Left: *Phyllotreta striolata*

Right: right hand elytra of
(1) *P. rectilineata* Chen 1939 and
(2) far right *P. striolata* (Fabricius)

*Crioceris striolata* Fab., 1801, Index Syst. Eleuth. 38

Length 2 – 2.2 mm. Distinctive patterned elytra and small size quite distinctive, however a similar species *P. rectilineata* Chen 1939 could well occur in Hong Kong, but as yet has not been recorded.

Host: Many species of *Cruciferae*. Lee and Winney (1981) lists *Rorippa nasturtium aquaticum*, *Raphanus sativus* L var. *longipinnatus*, *Brassica chinensis*, *B. juncea* and *B. parachinensis*.

Imago: Throughout the year.

Distribution: Holarctic.

36. *Aphthona strigosa*

Baly, 1874, Ent. Soc. Lond., Trans. 1874:

Length 2 – 2.4 mm. Upper side finely granulose, scarcely perceptibly punctate; color subopaque metallic green, sometimes slightly aeneous or bluish or even in some individuals blackish or blackish blue. *Aphthona wallacei* Baly a synonym of this species has been listed for Hong Kong.

Host: *Mallotus* spp. Lee and Winney (1981) lists *Mallotus apelta*. In colder weather can be found on citrus spp (and also commonly found on dark green railings).

Imago: Common throughout the year.

Distribution: Japan, China (Jiangxi, Fujian, Guangdong and Sichuan), Indonesia and Vietnam.

**Acknowledgments**

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異尾華枝蟻 Günther, 1940 (蟻目：長角枝蟻亞科) – 香港新紀錄竹節蟲

Sinophasma mirabile Günther, 1940 (Phasmatodea: Necrosiinae)

– a new record of stick insect from Hong Kong

何維俊 George, Wai-chun Ho
Email: georgehwc@hotmail.com

引言

華枝蟻屬(*Sinophasma*) Günther, 1940是德國人Klaus Günther根據在福建省採得的克氏華枝蟻作為此新屬的模式種(Günther, 1940)。Klaus Günther同時亦發表三種屬於此新屬的種，分別是採自福建的異尾華枝蟻、浙江的瓦腹華枝蟻以及江西的垂臀華枝蟻。

在Klaus Günther建立華枝蟻屬的隨後數十年，國內的竹節蟲學者至今已發表了22種關於此屬的新種。此屬現有26個種，其中25種分佈於中國境內(Hennemann, Conle & Zhang, 2008; Chen & He, 2008)，只有越北華枝蟻(Chen & Chen, 1999)分佈於中國境外。

在香港，根據Brock & Seow-Choen(2000)、Bi, Zhang & Lau (2001)、Brock (2002)、Ades & Kendrick (2004)、Xu(2005)及Hennemann et al. (2008)的文章，華枝蟻屬並未見報導。本文作者近年來對本地的竹節蟲作出調查研究，在大嶼山及香港島發現Klaus Günther所發表的異尾華枝蟻，無疑是香港的新紀錄竹節蟲品種。

縮寫 Abbreviations

字母略寫以代表標本的存放地方 Acronyms used for collections are as follows:

SMTD: Staatliches Museum für Tierkunde, Dresden / Germany

ZMFK: Zoologisches Forschungsinstitut und Museum, Alexander König, Bonn / Germany

GH: Private collection of George, W.C. Ho / Hong Kong

Sinophasma mirabile 異尾華枝蟻

Günther, 1940, Decheniana 237(1): 242, figs. C & J. [holotype ♂, Kuatun (2300m), Wuyishan Mts., Fujian Prov., China, 16.vii.1938. J. Klapperich (ZMFK), allotype ♀, Kuatun (2300m), 17.vii.1938, J. Klapperich (ZMFK), paratype ♂, Kuatun (2300m), 23.vii.1938, J. Klapperich (SMTD)]

Sinophasma mirabile; Chen & He, 1992: 45, fig. 127. Chen & Chen, 1997: 13, figs. S & T, Cai & Chen, 1999: 69. Hennemann, Conle & Zhang, 2008: 37. Chen & He, 2008: 144, fig. 112.

= *Sinophasma crassum*, Chen & He, 1995, Insects of Baishanzu Mt., East. China: 65, fig. 6 [synonymised by Chen & He, 2008: 144].

Material examined:

Sinophasma mirabile Günther, 1940 [♀ ♀, Aberdeen Country Park, Hong Kong Island, 29.vi.2008, Ho Wai Chun (GH), ♂ ♂, Lantau North Country Park, Lantau Island, 30.vi.2008, Ho Wai Chun (GH), ♀, same data (GH).]

Introduction

Sinophasma was erected by Klaus Günther (German) in 1940 (Günther, 1940). He described *Sinophasma klapperichi* (from Fujian) and subsequently selected it as the type species for this genus and together with three new undescribed species including *S. mirabile* (from Fujian), *S. hönei* (from Zhejiang) and *S. brevipenne* (from Jiangxi) in his paper.

Twenty-two new species were subsequently described after several decades of the establishment of this genus. Until now, twenty-six species are recognized and mainly distributed over Mainland China (Hennemann, Conle & Zhang, 2008; Chen & He, 2008). Exceptionally, *Sinophasma vietnamense* (Chen & Chen, 1999) is only known from North Vietnam outside China.

According to Brock & Seow-Choen (2000), Bi, Zhang & Lau (2001), Brock (2002), Ades & Kendrick (2004), Xu (2005) and Hennemann et al. (2008), the genus *Sinophasma* Günther, 1940 has not been mentioned in the checklist of Hong Kong. For recent years, the present author has surveyed several areas and has found Günther's *Sinophasma mirabile* in Lantau Island and Hong Kong Island. Undoubtedly, it is a new record of stick insect to Hong Kong.

註釋

存放在ZFMK的雄性個體(根據其模式標本相片及繪圖)，其臀節背板中央處明顯有一小刺突出。在香港所見的個體，雄性的臀節中央處只見粒狀突出物，沒有刺狀突出物。由於異尾華枝蠋亦屬華南地方的廣泛分佈種，相信在其他地方所見的個體亦可能有此特徵及形態上的變化。

描述

雄性(圖一)：整體深綠色，纖細。頭部呈橢圓形，淺棕色，頭頂有六條黑直紋，有單眼，不明顯，位於複眼及觸鬚凹窩之間。眼橢圓形。觸鬚長於前足，細長，棕色。第一節圓柱形，與頭前端緣等長，第二節較第一節短，第三節略長於第一節。

胸部：前胸有一道十字形淺溝，平滑。中胸與中足股節等長，中央有一道明顯的脊，背板及側板有不規則大小的顆粒狀瘤突。後胸包括中節長於頭部及前胸的總和。

腹部：腹節明顯長於頭及胸部的總和，第二至六腹節長度均等，第七節較第六節短，第八節擴展，呈現梯形，第九節延長，較第八節長，臀節是腹部最短節，後緣明顯向內凹入，形成兩側角，角內有齒。尾鬚七首形，基部寬，末端尖，與臀節等長。

翅膀：前翅短，角突鈍及黑色。後翅長，到達第六腹節中部。後翅前緣綠色，臀域玫瑰紅色。

足部：三對足中，後足最長，股節均為深綠色，脛節為橙棕色但端部為黑色。

雌性(圖二)：大部份特徵與雄性相似，體明顯較大。前翅短角突鈍及黑色。後翅較雄性短，只到達第五腹節。腹部第二、四及六節相等，第三節與第五節相等，但短於第二節。第九節及臀節相等，明顯為腹部最短節。臀節後緣U形凹入，肛上板接近三角形。尾鬚圓柱形，基部寬，末端尖鈍。

Comment

For the specimens deposited in ZFMK (by examining images of the type specimens and illustrations), the male (paratype) obviously has a small spine on the middle area of anal tergite. For the male found in Hong Kong, the spine is reduced as a small circle spot on the middle area of the anal tergite. Hence, this variation could probably be found in different individuals in other provinces of south China due to geographical and environmental differences.

Description

Male (Figure 1): Slender body, dull green overall. Head oval, light brown with six vertical black stripes on occiput. Ocelli less distinct. Eye oval. Antennae longer than fore leg. Light brown. First joint cylindrical as long as the apical margin of frons. Second joint shorter than the first joint. The third joint near as long as the first joint.

Thorax: Pronotum smooth, with the transversal and longitudinal sulcus. Mesonotum as long as the mesofemora, with the less distinct median longitudinal carina and irregular size of granules. Metanotum including median segment longer than the head and pronotum together.



圖一：雄性成體異尾華枝蠋

Figure 1: Adult male of *Sinophasma mirabile* Günther

Abdomen: Longer than head and thorax together. Second tergite to sixth tergite are similar in length. The seventh tergite shorter than the sixth tergite. The eighth tergite expand posteriorly, ladder-shaped. Ninth tergite longer than the eighth tergite. The shortest length being at the anal segment. The posterior margin of the anal margin curved inward obviously. Rounded posterolateral angle of apex. Cerci elongate, as long as the anal segment, dagger-like tapering at apex.

Wings: Tegmina short, the elevated portion is black. Wings long, projecting beyond the sixth tergite. Green at costal area and rose at anal area.

Legs: Hind leg is the shortest. Entirely green femora excepting the blackish tip.

Female (Figure 2): Rather stout and similar to male. Tegmina short, the elevated portion is black. Wings shorter than the wings in male, projecting beyond the fifth tergite. The second, forth and sixth tergite of abdomen are similar in length. The third tergite as long as the fifth tergite but shorter than the second tergite. the ninth tergite as long as the anal segment are the shortest tergites of abdomen. The hind margin of anal segment curved inward, U-shaped. Supra-anal plate with round apex, near triangular. Cerci cylindrical, broader at base and apex pointed.

表一：異尾華枝蠋的體長度 (mm.)

Table 1: Measurement of *Sinophasma mirabile* (mm.)

		雄性 Male	雌性 Female
體長	Length of Body	56	77
前胸	Pronotum	2.5	3
中胸	Mesonotum	9.5	14.5
後胸包括中節	Metanotum including Median segment	7	9
前足股節	Profemore	13.5	14.5
中足股節	Mesofemora	10	11
後足股節	Metafemora	15	15
前足脛節	Protibiae	11.5	12
中足脛節	Mesotibiae	9	9.5
後足脛節	Metatibiae	14	14
觸鬚	Antennae	43	41



圖二：雌性成體異尾華枝蠋

Figure 2: Adult female of *Sinophasma mirabile* Günther

生境

海拔約300至600米，見於成熟林區。

分佈

香港(香港仔郊野公園及北大嶼山郊野公園)及華南各省(廣東、廣西、湖南、福建及浙江)

結語

華枝蟥屬在中國可是一類害蟲，嚴重危害樹林(Chen & Chen, 1997; Chen, 1999)。異尾華枝蟥是新紀錄的竹節蟲品種，其在香港的分佈並不普遍，暫只見於兩處地方，數量稀少，因此未見大量成蟲聚集危害林木的情況。雖然如此，竹節蟲仍然是一種被視為危害林木的昆蟲，應加注意。

Habitat

Attitude between 300 to 600 meters, found in mature woodland.

Distribution

Hong Kong (Aberdeen Country Park and Lantau North Country Park) and South China (Guangdong, Guangxi, Hunan, Fujian and Zhejiang)

Conclusion

In China, *Sinophasma* is regarded as pest insect for woodland (Chen & Chen, 1997; Chen, 1999). *Sinophasma mirabile* is a new record of stick insect, however it is rather uncommon and few in numbers in Hong Kong. No large numbers of adults was observed to destroy the woodland. Even though stick insect is kind of pest insect, we cannot ignore its harmfulness to our environment.

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A note on *Vespa soror* (Hymenoptera: Vespidae) in Hong Kong

John X. Q. Lee

Email: vespa_bicolor@yahoo.com.sg

摘要

Vespa soror (黃紋大胡蜂) 為香港其中一種最大型並較為常見的胡蜂品種，在多數本地郊區環境均可見。然而本品種在香港尚未有記錄；這可能因為其常被誤認為 *Vespa ducalis* (黑尾胡蜂)。對於本種在其分佈範圍內的習性也尚未有任何相關資料。本文淺談本種在香港的習性及年度的蜂群生活循環。

Introduction

Vespa soror du Buysson, 1905 is one of the largest social wasps in Hong Kong and is reasonably abundant in country parks and rural areas. However, this species has not been previously recorded from Hong Kong, possibly because of its having been misidentified as *Vespa ducalis* Smith, 1852. There is also a total lack of information about the biology of this species throughout its range. This paper describes the behaviour and annual life cycle of *V. soror* for the first time.

Eight *Vespa* species are distributed in Hong Kong (personal observation); these large social wasps are commonly known as hornets and are often greatly feared due to their painful stings and supposed aggression. *V. soror* is apparently one of the largest among the *Vespa* species occurring in Hong Kong, having body lengths of 26mm to 35mm in the worker and 39mm to 46mm in the queen. Queens are, in most cases, easily distinguishable from workers by larger body size. *V. soror* can be distinguished (see figure 2) from other local species of *Vespa* by the gena strongly enlarged (in profile at least 1.8 times as wide as the eye in the female) and the vertex also prominently enlarged. These characteristics are found in *Vespa mandarinia* Smith, 1852, which is undoubtedly closely related to *V. soror* and is very rare in Hong Kong. *V. soror* was in fact once considered a subspecies of *V. mandarinia*. Archer (1991, 1995) then considered them to be two separate species, adding that both species showed no structural differences but could be separated by differences in colour. Nguyen et al. (2006) listed several morphological differences between the two, confirming them as different but closely related species.

V. soror in Hong Kong has often been labeled as either *Vespa tropica* (Linnaeus, 1758) or *Vespa ducalis* Smith, 1852. *V. ducalis* bears quite a strong resemblance to *V. soror*, but does not have the strongly developed gena as in *V. soror* (Fig. 2) and is generally smaller in body size and less stocky in shape. Finally, *V. ducalis* is usually darker in overall colour and often has a yellow apical band on the third gastral segment and the pronotum largely yellow, while these features are seldom seen on *V. soror* (personal observations). These differences in appearance allow general identification when individuals of both species are encountered in the wild, but structural characteristics are a more reliable way of identification with complete certainty. The differences between these three species can be seen clearly in figure 1.

Fig. 1A: *Vespa soror*Fig. 1B: *Vespa ducalis*Fig. 1C: *Vespa tropica*

Fig. 1D: Worker specimens of *Vespa soror*, *Vespa ducalis* and *Vespa tropica*, shown together for comparison



Fig. 2A: Head of *Vespa ducalis* (similar in proportion to other *Vespa* species besides *Vespa mandarinia*)



Fig. 2B: Head of *Vespa soror*. Note the greatly enlarged head, especially the gena (the part behind the eyes)



Fig. 3A: Nest site of *Vespa soror*, showing workers in the process of excavating soil to enlarge the nest cavity



Fig. 3B: Nest entrance

V. tropica also occurs in Hong Kong; it is very different in appearance from *V. soror* or *V. ducalis*. Nevertheless, *V. soror* has often been referred to locally as *V. tropica*, which is possibly due to that *V. ducalis* had often been treated as a subspecies of *V. tropica* until Archer (1991).

V. soror is present in North Thailand, North Vietnam and various parts of South China such as Guangdong, Fujian and Hainan Island; thus its presence in Hong Kong is not surprising. I have recorded *V. soror* from many places in Hong Kong, including Sai Kung, Ma On Shan, Sha Tin, Tai Po, Fan Ling, Sheung Shui, Yuen Long and Tuen Mun in the New Territories, as well as Repulse Bay, Aberdeen and Ocean Park in Hong Kong Island. It rarely appears around urban areas or residential districts, but is fairly common in country parks and rural areas.

Despite it being rather abundant, virtually nothing has been written on the biology of *V. soror* (Archer, 1995; Kojima, pers. comm.). The following information is based on observation of individual wasps and active colonies from 2004 to 2008.

Most colonies are found in forested areas. I have observed foraging individuals at altitudes ranging from sea level to over 700m, but nests appear most abundant at elevations of 60m to 500m, being rarer near sea level or at higher altitudes. The nest is usually located underground, often in the well-drained soil of a slope, with the entrance hole dug downwards into the soil surface at an angle, and often located among roots or stumps of large trees (fig. 3B). It is not known if cavities in which nests are built in are pre-existing or dug by the founding queens, although new queens can be seen searching for and entering all sorts of pre-existing cavities each Spring. As the nest grows in size, the workers constantly enlarge the cavity by excavating the soil inside. They usually carry pellets of hardened, compacted earth out and dump them some distance from the nest (fig. 3A). Colonies can often be spotted by the procession of wasps going in and out, some carrying pellets of soil, and by the pile of accumulated earth pellets outside the nest entrance. The depth at which the nest is located varies. Some nests are located in a fairly shallow situation and digging away the surface soil. Others are located deep underground, with a tunnel which may be 60cm or more in length between the nest and the entrance. Sometimes there are more than one tunnel and entrance leading to the nest, and the wasps can be seen emerging from two or three entrances in the soil surface. In many respects, the nesting behaviour of *V. soror* is similar to that of the closely related *V. mandarinia* (as described in Archer, 1995).

A very small number of nests are built inside buildings such as abandoned village houses. I have personally seen and heard of only such three or four instances, marked by the wasps going in and out from gaps in the walls or roof of the structures in question, but have never seen the actual nest because the interiors in all cases were inaccessible.

The nest comprises of several combs covered by a protective envelope. The envelope is thin, brittle and comprised of distinct, separate sheets, and is incomplete, exposing the bottommost combs. The combs in contrast are very heavy and sturdy. The maximum number of combs in a nest is not yet known. In December 2006 I collected a mature nest at Lam Tsuen, Tai Po, which had been treated with insecticide and thus no wasps were present. There were five combs, the first of which contained approximately 370 cells, and the last contained roughly 250 cells. The three middle combs contained approximately 700 cells each. Cells ranged from 9mm to 13.5mm in diameter, with a strong tendency towards distinctly larger cells on the last comb. Based on the activity observed from September till December, the colony which inhabited this nest was not exceptionally populous, so it is probable that the largest nests of this species can reach even larger sizes. The larger combs measured were circular and were approximately 45cm in diameter.

An immature colony was collected in the beginning of August 2008 at a village in Tuen Mun, after paralyzing the wasps with smoke and digging the nest out. Due to hurried conditions in the field, the combs were broken and some of the workers were not captured, but the colony probably contained approximately 60 workers. The nest consisted of three combs, of which the first two contained roughly 200 cells and were of a roughly oval shape, approximately 17cm by 13cm. The third comb had just been constructed and consisted of 12 or 13 incomplete cells. The nest was located roughly 40cm underground, and the entrance was at the base of a tree (**fig. 4A**) – the nest itself was affixed to part of the tree's roots. A thin sheet of envelope had been made across part of the roots, nearly 20cm from the nest itself, blocking the nest from view (**fig. 4B**). Another layer of envelope enclosed the sides of the combs in a neatly semi-circular shape.

In Hong Kong, the queens usually emerge from late March to April each year, and soon start searching for suitable nesting sites. The nest initiation probably begins in early May, while the first workers usually appear in June. Growth of the colony appears slow at first, with roughly up to an estimated hundred or more workers in the average colony in early September. At this point, the colony grows rapidly, all the way till December. I am not able to estimate the number of workers in an average mature colony, but most colonies seem quite large and active, with large numbers of wasps leaving and returning to the nest. Males and new queens (or gynes) emerge from November to early January, after which all colony activity ceases and the new queens enter a short hibernation period. There are roughly 7 months of colony activity, and *V. soror* can thus be considered to have a long colony cycle. During the early stages of the colony cycle, up till September, workers of *V. soror* are usually tolerant of people in the vicinity if the nest is not actually provoked, but can become ferociously defensive if there is any disturbance near the nest, and this species, like other large ground-dwelling hornets, has the potential to pose a serious threat if a nest is inadvertently disturbed. During September to December, the period leading up to the emergence of males and new queens, colonies become highly territorial and defensive. The workers maintain a defensive radius of around 2m or 3m from the nest, and individuals circle this territory. I have also observed them landing on vegetation surrounding the area and rubbing their abdomens on leaves and branches, a possible indication of use of pheromones to define territory. Workers aggressively circle any moving object within the defended area during this period, and will sting if one does not calmly retreat. The sting of *V. soror* is very painful and with long-lasting effects; it possibly has potent venom like *V. tropica* and *V. mandarinia*, both of which are considered the most dangerous among all stinging insects (Schmidt et al., 1986).



Fig. 4A: Entrance of an immature nest, located at the base of a tree



Fig. 4B: A thin separate layer of envelope stretched across part of the tree's roots, approximately 20cm from the nest itself



Fig. 5A: A worker of *Vespa soror* kills a captured gecko



Fig. 5B: A worker has captured an individual of *Vespa velutina*, another locally common hornet



Fig. 5C: Worker capturing a long-horned grasshopper or katydid

V. soror is an aggressive predator which will attack and kill any insect it can overpower (personal observation). I have observed workers returning to the nest with parts of mantids on several occasions, indicating that this species often kills mantids. It often forages in grassy fields and shrubs as well as in wooded areas, and frequently takes large butterflies, dragonflies and grasshoppers, as well as other wasps, including smaller species of hornets (fig. 5B). It may even prey on small vertebrates such as geckos (fig. 5A). Like *V. ducalis* and *V. tropica* (Archer 1991), *V. soror* often attacks the nests of the various Polistine wasps such as species of *Polistes* and *Parapolybia*, in order to capture the larvae and pupae as food for their own young. However, unlike *V. ducalis* and *V. tropica*, *V. soror* often attacks in groups.

On several occasions, I saw workers of *V. soror* approach large, mature nests of *Parapolybia indica* (de Saussure, 1854), *Parapolybia nodosa* Vecht, 1966 and *Parapolybia varia* (Fabricius, 1787). In each case, the hornet worker did not attack, but instead landed just inches away, usually on the branch or leaf supporting these nests, and proceeded to walk back and forth, rubbing its abdomen sideways on the surfaces near the nest. This could possibly indicate usage of pheromones or chemical signals to mark the nest for group attack. While I was never able to stay and watch, invariably I returned the following day to find the nest totally empty, with the adults gone and the brood removed. Although I have not personally observed this, several people I spoke to, including a beekeeper operating in Yuen Long, have noted multiple individuals of this species attacking honeybee hives together, resulting in hives completely ruined and piles of dead bees outside the hive, causing considerable losses. *V. soror* also appears to harm its victims considerably more than *V. tropica* and *V. ducalis*; while the latter two are usually content to drive the original occupants from the nest, *V. soror* often attacks them with its large mandibles if they resist or attempt to defend their brood, often killing or maiming them in the process.

In September 2006, I witnessed an attack on a subterranean colony of *Vespa bicolor* Fabricius, 1787, which is the smallest and apparently the most abundant hornet species in Hong Kong. This attack spanned three days. On the first day, a *V. soror* worker was seen circling the entrance of the *V. bicolor* nest and occasionally landing on the pavement and on vegetation nearby. This individual avoided contact with the *V. bicolor* workers, but two other individuals later appeared and one of these intercepted a *V. bicolor* worker returning to the nest, grabbing it and then carrying it to a nearby branch where it dismembered the *V. bicolor* and chewed the meat of its thorax with its mandibles before carrying it away. The

following day, I returned to the site and found a large number of *V. soror* workers present. At least five or six were circling the entrance and attempting to enter, while many others left or returned to the site; some emerged from the entrance, carrying what was most certainly *V. bicolor* larvae and pupae away. I could not count the exact number of workers involved, but at least twenty were involved. Large numbers of *V. bicolor* were flying in a frenzied manner around the nest entrance, and unfortunately I could not get close enough to take photographs. On the third day, there were only five or six workers returning to the site, and these were still entering the nest and taking larvae and pupae away. There were still *V. bicolor* workers swarming defensively around the nest site, and bodies of *V. bicolor* as well as one or two dead *V. soror* individuals which had possibly been killed by the defending workers were scattered around the area. On the fourth day there was absolutely no activity or any sign of both species around the nest site.

Christophe Barthelemy (personal communication) observed a group attack on a nest of *Parapolybia indica* in Sai Kung Country Park (See figure 6; photo copyright Christophe Barthelemy). A large, thriving colony was attacked over the course of a few hours, with five or six individuals present at any given time. As an experiment, some of these individuals were systematically netted and removed as they landed, and yet more arrived; this probably indicates that all these workers were from the same nest. Both this incident and my own observations suggest a strong possibility of *V. soror* using pheromones or other chemical signals, or otherwise having some form of communication in which they are able to direct the attention of other individuals from the same nest towards their target.

All these aspects of the predatory habits of *V. soror* are also in common with *V. mandarinia*, which is known to launch group attacks on beehives and even nests of other social wasps. However, there is still much to be learned about this little-known species.

Acknowledgements

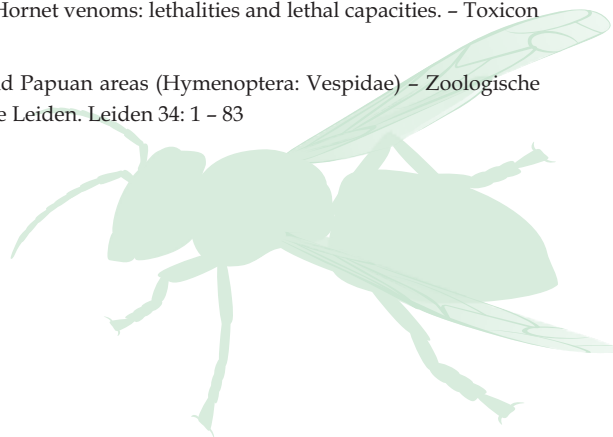
I am grateful to Dr. Junichi Kojima (Ibaraki University, Japan) for critique and commenting on an earlier version of this paper, and to Christophe Barthelemy for sharing observations and photos.



Fig. 6: Workers attacking nest of *Parapolybia indica*.

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香港虻類初探

A brief account of Orthorrhaphous Brachycera (Diptera) in Hong Kong

胡嘉麟 Wu Ka Lun, Kelvin
Email: kelvinklwu@gmail.com



引言

在香港，虻類比其他雙翅目成員(蚊和蠅)較少為人注意和研究，原因可能是由於很多虻類成員屬捕食性 / 蜜食性，甚少對經濟造成直接影響；即使嗜血的虻科昆蟲可傳播疾病，其嚴重程度亦遠不及牠們的近親。事實上，虻類中很多科在全世界已發現超過五千種，考慮本地其他昆蟲品種的豐度，相信香港仍有很多虻類待發掘。本文將結集以往文獻紀錄以及近年野外觀察所見，概述香港各科虻類品種，希望能為本地虻類研究作拋磚引玉之用。

Introduction

The Hong Kong Orthorrhaphous Brachycera fauna is less noticed and studied than their local Dipteran counterparts. It may be due to their predatory / nectarivorous habits that rarely have direct impact on our economy. Even the blood-sucking Tabanidae members are known to spread disease, the consequence is far less severe than their relatives. In fact, many families of Orthorrhaphous Brachycera contain over 5,000 species over the world. By comparing the abundance of other insects, it is believed that there are still many of this Dipteran group to be discovered in Hong Kong. This article summarizes records of Hong Kong Orthorrhaphous Brachyceran flies from both literatures and field observations, so as to formulate a basis for future studies.

虻類解構

在中文俗名中，以「虻」命名之昆蟲通常指雙翅目短角亞目中不屬於蠅型下目之成員。基於羽化時蛹皮裂口之形態，過去牠們被歸類作直裂下目，蠅型下目之成員則屬環裂下目。相信以往中國學者亦是基於此而將兩個分類群成員之名字分別綴以「虻」或「蠅」字。惟依照種系發生學之研究，顯示直裂下目為一側系群，故普遍學者已摒棄這種分類法。原來直裂下目之成員分別歸入食木虻型下目、虻型下目、水虻型下目及食蟲虻型下目；亦有學者將食蟲虻型下目的成員納入蠅型下目，意見紛紜。本文所討論的虻類昆蟲是指舊分類法中直裂下目之成員，分類系統參照Piotr Oosterbroek (1998)，當中引用McAlpine & Wood (1989)的分類方法。

虻類屬短角亞目中較原始的一群。與長角亞目一樣，牠們的蛹型為離蛹，蛹期時肢體通常可見而不能動，羽化時成蟲從頭部背面一條縱向裂紋破蛹而出，在其前方有時會有一條較小的橫裂，形成“T”字型裂縫，故被稱為直裂下目；環裂下目則形成圍蛹，羽化時從頭部破開圓洞爬出。虻類成蟲各科體型、外貌差別甚大，體長由一毫米至七十毫米不等。複眼通常佔頭部大半面積，單眼卻並非所有種類都有。捕食性和吸血性虻類(如虻科和食蟲虻科)通常具刮舔式口器，為雙翅目中所特有；而食腐、食樹汁等虻類(如木虻科和水虻科)則有如蠅類般的舔吸式口器。幼蟲為腐食性、捕食性或寄生性，一般為陸棲，而部分虻科和水虻科的幼蟲則在水中生活。

What are Orthorrhaphous Brachycera flies?

The collective term Orthorrhaphous Brachycera includes dipteran members of the suborder Brachycera that are not included in the infraorder Muscomorpha. Because of the straight aperture on the pupa when the adult emerges, they were once grouped in the infraorder Orthorrhapha, as opposite to Cyclorrhapha (now synonymous to Muscomorpha), the pupa aperture of which is in circular shape during emerging. It is believed that the former Chinese entomologists suffixed the Chinese common name of all “Orthorrhaphan” and “Cyclorrhaphan” flies with the words “虻” and “蠅” respectively based on this classification system. Phylogenetic studies, however, reveals that “orthorrhapha” is a paraphyletic group, and thus the term has become obsolete. The original orthorrhaphan flies are re-classified into infraorders Xylophagomorpha, Tabanomorpha, Stratiomyomorpha and Asilomorpha, and the latter is sometimes grouped under Muscomorpha. Until now their classification is still under debate. Flies discussed in this article are those belong to “Orthorrhapha” under old systems. Classification adopted by Pjotr Oosterbroek (1998), citing the system proposed in McAlpine & Wood (1989), is followed.

“Orthorrhapha” is the more primitive group in Brachycera. Similar to Nematocera, their pupae are obiect that the appendages are clearly visible and closely packed to the body. Pharates emerge from a longitudinal cleft at the dorsal side of the anterior end (hence the term “Orthorrhapha”). This is usually accompanied with a small horizontal one, the two forming a “T” shape opening. In Cyclorrhapha, the pupae are coarctate (i.e. encased by puparium), and the pharates emerge by pushing open a circular slit (hence the infraorder name). Adults are distinctly different among families in terms of appearance and size. Body lengths vary from 1mm to 70mm. Compound eyes usually occupy the majority of the head's surface area, while ocelli are not always present. Predatory / hematophagous species (e.g. Tabanidae and Asilidae) usually have scimitar-like mandibles that are unique in Diptera. Saprophagous and tree-sap suckling species (e.g. Xylomyidae and Stratiomyidae) are with sponge-like mouthparts similar to Muscomorpha. Larvae are saprophagous, predatory or parasitic, and usually live on ground. Larvae of some species in Tabanidae and Stratiomyidae are aquatic.

表1 虻類分科表

Table 1 Family Classification for Orthorrhaphous Brachycera (McAlpine & Wood 1989, cited by Oosterbroek 1998)

雙翅目 Order Diptera

短角亞目 Suborder Brachycera

食木虻型下目 Infraorder Xylophagomorpha
食木虻科 Family Xylophagidae

虻型下目 Infraorder Tabanomorpha
穴虻科 Family Vermileonidae
鵲虻科 Family Rhagionidae
流虻科/偽鵲虻科 Family Athericidae
虻科 Family Tabanidae

水虻型下目 Infraorder Stratiomyomorpha
木虻科 Family Xylomyidae
水虻科 Family Stratiomyidae

食蟲虻型下目 Infraorder Asilomorpha
網翅虻總科 Superfamily Nemestrinoidea
小頭虻科 Family Acroceridae
網翅虻科 Family Nemestrinidae

食蟲虻總科 Superfamily Asiloidea
蜂虻科 Family Bombyliidae
劍虻科 Family Therevidae
窗虻科 Family Scenopinidae
食蟲虻科 Family Asilidae
擬食蟲虻科 Family Mydidae
棘虻科 Family Apioceridae

舞虻總科 Superfamily Empidoidea
舞虻科 Family Empididae
阿舞虻科 Family Atelestidae
駝舞虻科 Family Hybotidae
小室舞虻科 Family Microphoridae
長足虻科 Family Dolichopodidae

除以上所列者外，虻類中尚有其他較新或具爭議的科，在此不予贅述。

In addition to the list above, there are still some new or controversial families of Orthorrhaphous Brachycera, the details of which are not discussed in this article.

本地文獻紀錄

過往有關香港虻類的紀錄寥寥可數，大部分散見於介紹本地昆蟲之著作中。下面撮錄了這些文獻中所紀錄的香港虻類品種。

Literatures on local species

In the past, descriptions on Hong Kong Orthorrhaphous Brachycera are few, mostly scattered in books on local insect fauna. Species recorded by these literatures are summarized as follows.

- (1) Hill, D.S. & Cheung, W.K.K. (1978) *Hong Kong Insects* 香港昆蟲. Urban Council, Hong Kong.

Family 科	Scientific Name 學名	Chi. name 中文俗名	Eng. name 英文俗名
Tabanidae 虻科	<i>Tabanus</i> sp.	虻	Horse Fly / Cleg

- (2) Hill, D.S. (1982) *Hong Kong Insects Volume II* 香港昆蟲卷二. Urban Council, Hong Kong.

Family 科	Scientific Name 學名	Chi. name 中文俗名	Eng. name 英文俗名
Tabanidae 虻科	<i>Tabanus</i> sp.	灰馬虻	Grey Horse Fly
Tabanidae 虻科	<i>Chrysops</i> sp.	斑虻/盲虻/綠眼馬虻	Green-eyed Horse Fly
Stratiomyidae 水虻科	<i>Stratiomya</i> sp.	水虻	—
Therevidae 劍虻科	<i>Thereva</i> sp.	劍虻	—
Asilidae 食蟲虻科	<i>Philodius javanus</i>	爪哇盜虻/海岸盜虻	Seashore Robber Fly
Asilidae 食蟲虻科	—	褐盜虻	Brown Robber Fly
Bombylinidae 蜂虻科	<i>Ligyra tantalus</i>	黑蜂虻/大黑蜂虻	Large Black Bee Fly
Bombylinidae 蜂虻科	<i>Anthrax</i> sp.	戀虻/小蜂虻	Small Bee Fly

- (3) Hill, D.S., Hore, P.M. & Thornton, I.W.B. (1982) *Insects of Hong Kong*. Hong Kong University Press.

Family 科	Scientific Name 學名	Chi. name 中文俗名	Eng. name 英文俗名
Stratiomyiidae	<i>Stratiomyia</i> sp.?	—	—
Tabanidae	<i>Tabanus</i> sp.	—	—
Tabanidae	<i>Chrysops</i> sp.	—	—
Asilidae	<i>Promachus indigenus</i>	—	—
Asilidae	<i>Philodius javanicus</i>	—	—
Bombylinidae	<i>Anthrax</i> sp.	—	—
Bombylinidae	<i>Ligyra tantalus</i>	—	—

- (4) Hill, D.S. & Phillipps, K. (1989) *A Colour Guide to Hong Kong's Animals (2nd Ed.)* 香港動物原色圖鑑. Government Printer, Hong Kong Government.

Family 科	Scientific Name 學名	Chi. name 中文俗名	Eng. name 英文俗名
Asilidae 食蟲虻科	<i>Trypanoides indigenus</i>	食蟲虻	Robber Fly
Bombyliidae 蜂虻科	<i>Ligyra tantalus</i>	黑蜂虻	Black Bee Fly
Tabanidae 虻科	<i>Tabanus</i> sp.	虻	Horse Fly

- (5) 饒戈 Yiu, V. (2006) *Insecta Hongkongica* 香港昆蟲圖鑑.

Hong Kong Lepidopterists' Society & Hong Kong Discovery 香港鱗翅目學會及野外動向.

Family 科	Scientific Name 學名	Chi. name 中文俗名	Eng. name 英文俗名
Tabanidae 虻科	<i>Tabanus</i> sp.	虻	Horse Fly
Asilidae 食蟲虻科	—	食蟲虻	Robber Fly
Bombyliidae 蜂虻科	<i>Ligyra tantalus</i>	小亞細亞清蜂虻	Bee Fly

- (6) 香港自然探索學會 Society of Hong Kong Nature Explorers (2008)

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Family 科	Scientific Name 學名	Chi. name 中文俗名	Eng. name 英文俗名
—	<i>Ligyra tantalus</i>	小亞細亞清蜂虻	—
—	<i>Systropus</i> sp.	蜂虻	—
—	<i>Aulacophora indica</i> (應為手民之誤 Typo error)	食蟲虻	—
—	<i>Tabanus</i> sp.	虻	—

(7) 香港政府食物及環境衛生署：防治蟲鼠事務諮詢組曾處理之動物品種紀錄

Record of animal specimens handled by Pest Control Advisory Section, Food and Environmental Hygiene Department, Hong Kong Government. http://www.fehd.gov.hk/safefood/risk-pest-arthropod_detailslist.html

Family 科	Scientific Name 學名	Chi. name 中文俗名	Eng. name 英文俗名
Stratiomyidae 水虻科	<i>Hermetia illucens</i> (larvae)	—	—
Tabanidae 虻科	<i>Tabanus lineola</i>	—	—
—	<i>Tabanus rubidus</i>	紅色原虻	—

(8) 楊再華, 楊燕, 魏濂鰲及楊茂發 YANG, Zai-hua, YANG, Yan, WEI, Lian-meng, YANG, Mao-fa (2008) 中國水虻科名錄(雙翅目) A Checklist of Chinese Stratiomyidae (Diptera). In *Classification and Distribution of Insects in China* 昆蟲分類與分佈 (ed. Shen et al).

Sub-family 亞科	Scientific Name 學名	Chi. name 中文俗名	Synonym 同物異名
扁角水虻亞科 Hermetiinae	<i>Hermetia illucens</i> Linnaeus 1758	亮斑扁角水虻	—
扁角水虻亞科 Hermetiinae	<i>Ptecticus tenebrifer</i> (Walker) 1849	黑色指突水虻	<i>P. illucens</i> Schiner 1868b, <i>P. sinensis</i> Pleske 1928a
扁角水虻亞科 Hermetiinae	<i>Sargus mandarinus</i> Schiner 1868b	柑橘瘦腹水虻	—
扁角水虻亞科 Hermetiinae	<i>Sargus viridiceps</i> Macquart 1855	綠紋瘦腹水虻	—
水虻亞科 Stratiomyinae	<i>Odontomyia garatas</i> Walker 1849	黃綠斑水虻	<i>O. staurophora</i> Schiner 1868

從以上資料中可見虻科(尤其是虻屬)、食蟲虻科及蜂虻科(尤其是小亞細亞清蜂虻)記載較其他科為多, 原因可能是牠們體型較大, 較常遇見及容易分辨, 又或者因為其「害蟲」的身份(主要指虻科), 而其他科則因體型細小難以觀察而被忽略。事實上, 筆者在野外遇到長足虻科成員的次數和生境種類比虻科的還要多。

It can be seen that there are more records of Tabanidae (in particular *Tabanus* sp.), Asilidae and Bombyliidae (in particular *Ligyra tantalus*) than other families, probably because of their larger size, more frequent encounter, easier identification, or the identity as a “pest” (Tabanidae). Other families may be ignored due to their small size. Indeed, members of Dolichopodidae are more frequently encountered in various habitats by the writer than those of Tabanidae.

野外觀察紀錄

以下列出一些近年在香港野外觀察到的虻類。由於並無保留標本作仔細鑑定, 故部分屬名未能肯定, 僅供參考比較之用。

Field observation records

The followings are records of Orthorrhaphous Brachycera observed in Hong Kong nature in recent years. Since no specimen has been kept for identification, the genus name given for some species are indeterminate and are shown for reference and comparison only.

1. 虻科

外貌如大型蠅類，體型粗壯，頭呈半球型；複眼巨大，視覺是牠們的主要受感，多為日行性。幼蟲期生於水中，捕獵其他動物；成蟲吸食花蜜，雌蟲具刮舔式口器，可刮開動物表皮，吸食哺乳類動物血液，不單造成

痛楚，更可令牲畜出血過多或傳染疾病(如羅阿絲蟲病和炭疽病)，造成經濟損失，故被認為是害蟲。全世界虻科昆蟲約有四千多種，中國約有四百多種。

早於漢初之時，中國已有典籍記載虻蟲有散瘀積之藥效(見《淮南子》及《神農本草經》)。李時珍在《本草綱目》中提及三種可入藥的虻，包括木虻(相信並非指木虻科)、蜚虻及鹿虻(或稱牛虻)，從其「並能吸血」的描述，似乎所指的是虻科中的不同種類。

1. Tabanidae (Horse flies)

Large flies with robust body and hemispherical head with very large compound eyes. They depend largely on vision and are mostly diurnal. Larval stage aquatic, preying on other animals. Adults feed on nectar. Females possess scimitar-like mandibles that are used to peel off the epidermis of mammals for sucking blood. More than mere pain, it may cause severe blood loss in livestock or transmit diseases like loa loa filarial or anthrax. Because of the economic loss so incurred, they are often considered pests. Over 4,000 species of Tabanidae are described worldwide, 400 of which are found in China.

Horse flies were described to be effective in treating hematoma in Chinese medicine publications since the early Han dynasty. In the famous *Compendium of Materia Medica* by Li Shizhen, three types of "flies" were said to have medical use. From the description on their blood-sucking behaviour, it is believed that all these are Tabanidae species.

(i) 虻屬 (圖1.1)

體長約十五毫米，應是本港最常見的虻科昆蟲。

(i) *Tabanus* sp. (Figure 1.1)

Body length 15 mm. Should be the most common Tabanid species in Hong Kong.

(ii) 麻虻屬 (圖1.2)

全身均帶黑白斑紋，包括複眼及翅膀，觸角粗而長。

(ii) *Haematopota* sp. (Figure 1.2)

Variegated with white and black spots over the whole body, including compound eyes and wings. Antennae swollen and lengthy.

(iii) 異斑虻 (圖1.3)

色彩斑斕的虻，翅外緣及中段有黑斑。

(iii) *Chrysops dispar* (Figure 1.3)

A colourful Tabanid. Black bands along anterior edge and over the middle part of the wings.

(iv) 虻科品種 (圖1.4 及1.5)

其他未經辨認的虻科昆蟲。

(iv) *Tabanidae* sp. (Figures 1.4 and 1.5)

Other unidentified Tabanidae species.

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圖 1.1 虻屬
Figure 1.1 *Tabanus* sp.

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圖 1.2 麻虻屬
Figure 1.2 *Haematopota* sp.

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圖 1.3 異斑虻
Figure 1.3 *Chrysops dispar*

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圖 1.4 虻科品種
Figure 1.4 *Tabanidae* sp.

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圖 1.5 虻科品種
Figure 1.5 *Tabanidae* sp.

2. 鵝虻科

鵝虻屬中型虻類，腿部細長，腹部幼細，身體一般無剛毛；成蟲捕食其他昆蟲或吸血。全世界約五百種。



© Moody Au

圖 2.1 金鵝虻屬
Figure 2.1 *Chrysopilus* sp.

2. Rhagionidae (Snipe flies)

Snipe flies are medium sized flies with stilt legs and slender bodies, which usually lack bristles. Adults are predaceous or haematophagous. About 500 species were found worldwide.

(i) 金鵝虻屬 (圖2.1)

金鵝虻屬廣泛分佈全世界。此品種翅膀透明，前緣有一黑點；腹部黑色帶幼白間披細毛。

(I) *Chrysopilus* sp. (Figure 2.1)

The genus *Chrysopilus* is distributed worldwide. The species shown has transparent wings with a black spot near the anterior margin. Pilose abdomen with black and thin white stripes.

3. 木虻科

木虻科是較小的一科，全世界只有約一百一十種，其中四分之三屬於粗腿木虻屬。木虻以腐木為食，具舔吸式口器，雙翅摺疊於腹背上，與同屬水虻型下目的水虻科類似。



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圖 3.1 粗腿木虻屬
Figure 3.1 *Solva* sp.

3. Xylomyidae (Wood soldier flies)

Xylomyidae is a small family with only 110 described species worldwide. Three quarters of them are classified as genus *Solva*. Wood soldier flies are with sponge-like mouthparts and feed on decaying wood. The wings are folded on the back of abdomen when at rest, similar to Stratiomyidae under the same infraorder.

(i) 粗腿木虻屬 (圖3.1)

體長約八毫米，胸背黑色，具光澤鬃毛，腹部橙色，後足腿節粗壯。

(i) *Solva* sp. (Figure 3.1)

Body length about 8 mm. Dorsal side of thorax in black with shiny bristle. Orange abdomen. Hind legs with robust femora.

4. 水虻科

水虻科的幼蟲多在水體或濕地中生活，故名。成蟲小型至中型，普遍外貌擬態胡蜂，相對其他虻類較不活躍，休息時雙翅摺疊於腹背上。口器為舐吸式，與蠅類相似，食性多樣化。全世界已發現一千五百多種，楊再華等(2008)記載中國水虻科昆蟲一百八十三種，其中四種在香港有紀錄。



圖 4.1 金黃指突水虻
Figure 4.1 *Ptecticus aurifer*

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圖 4.2 瘦腹水虻屬
Figure 4.2 *Sargus* sp.

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圖 4.3 光亮扁角水虻
Figure 4.3 *Hermetia illucens*

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圖 4.4 小麗水虻屬
Figure 4.4 *Microchrysa* sp.

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圖 4.5 小麗水虻屬
Figure 4.5 *Microchrysa* sp.

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3. Stratiomyidae (Soldier flies)

Most larvae of Stratiomyidae live in water or wetland. Imago size small to medium. Many of them are mimics of wasps. They are less active and usually have their wings folded on the back of abdomen. Like Muscomorpha, they have sponge-like mouthparts, feeding on a variety of food types. About 1,500 species have been described in the world. Yang et al (2008) listed 183 species of soldier flies in China, four of them were recorded in Hong Kong.

- (i) 金黃指突水虻 (圖4.1)
全身橙黃色，複眼綠色，接近二十毫米長，常見於新界溪流附近。
- (i) *Ptecticus aurifer* (Figure 4.1)
Whole body in orange. Compound eyes in green. Body length near 20 mm. Commonly seen near streams in New Territories.
- (ii) 瘦腹水虻屬 (圖4.2)
黑色身軀，複眼紅色。未確定是否與有紀錄的兩種瘦腹水虻之一。
- (ii) *Sargus* sp. (Figure 3.2)
Black body and red compound eyes. Not sure if it is one of the two locally recorded *Sargus* sp.
- (iii) 光亮扁角水虻 (圖4.3)
這品種因人為因素成為全世界廣泛分佈的品種，其食腐性幼蟲常被應用在堆肥、寵物飼料或法證等方面。光亮扁角水虻的體型與外貌與方頭泥蜂科的 *Trypoxylon politum* 極為相似，尤其是仿蜂的特長觸角，與及模擬蜂腰、儼如透明的腹部基節。Hill et al (1982) 所提及的 *Stratiomyia* sp. 相信便是指此品種。
- (iii) *Hermetia illucens* (Black soldier fly) (Figure 4.3)
A species widely distributed over the world as a result of human activities. Their saprophagous larvae are commonly used in composting, as pet food or in forensic science. Its appearance highly resembles the organ pipe mud dauber *Trypoxylon politum* (Hymenoptera: Crabronidae), in particular the wasp-like elongated antennae and the "windows" in the base segments of the abdomen that mimic wasp waists. It is believed that the *Stratiomyia* sp. mentioned in Hill et al (1982) is indeed *H. illucens*.
- (iv) 小麗水虻屬 (圖4.4)
體型細小，頭部比例較大，複眼紅色，胸背板金屬綠色，近似黃腹小麗水虻。另亦見一種全身綠色的品種(圖4.5)。
- (iv) *Microchrysa* sp. (Figure 4.4)
A small fly with comparatively large head. Red compound eyes. Metallic green dorsum. Close to *M. flaviventris*. Another species with whole body in green has also been found. (Figure 4.5)



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圖 5.1 小亞細亞清蜂虻
Figure 5.1 *Ligyra tantalus*

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圖 5.2 清蜂虻屬
Figure 5.2 *Ligyra* sp.

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圖 5.3 卵蜂虻屬
Figure 5.3 *Anthrax* sp.

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圖 5.4 姬蜂虻屬
Figure 5.4 *Systropus* sp.

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圖 5.5 姬蜂虻屬
Figure 5.5 *Systropus* sp.

5. 蜂虻科

顧名思義，蜂虻科的成員是擬蜂的虻類，亦是雙翅目中的一個大科，全世界已發現約四千五百種。香港已知的品種外貌與熊蜂、姬蜂等十分相似，此擬態可讓牠們免受天敵襲擊。與蜂類一樣，一般蜂虻科成蟲均常訪花，以長喙吸食花蜜，幼蟲期為捕食性或寄生性。

5. Bombyliidae (Bee flies)

As the name suggests, bee flies are mimics of bees. It is a big family with over 4,500 described species worldwide. Species in Hong Kong resemble bumblebees and ichneumon wasps much and this can help to keep predators away. Like bees, bee fly adults are flower-visitors, using their long proboscis to feed on nectar. Larvae are predatory or parasitic.

- (i) 小亞細亞清蜂虻 (圖5.1)
可算是本港最常見的蜂虻，出沒於林地溪流附近，惟亦多見於郊外混凝土小徑上留連。
- (i) *Ligyra tantalus* (Figure 5.1)
Should be the commonest bee fly in Hong Kong. Occur near woodland stream, but also commonly seen on concrete trails in the countryside.
- (ii) 清蜂虻屬 (圖5.2)
另一種清蜂虻屬，胸及腹部被棕色毛，翅膀深棕色。
- (ii) *Ligyra* sp. (Figure 5.2)
Another *Ligyra* sp. with brown hair on thorax and abdomen. Wings in dark brown.
- (iii) 卵蜂虻屬 (圖5.3)
翅膀上半部棕黑色，下半部透明，體黑色，腹部被白色毛。
- (iii) *Anthrax* sp. (Figure 5.3)
Upper half of the wings in black and lower half transparent. Black body with white hair on abdomen.
- (iv) 姬蜂虻屬 (圖5.4及5.5)
極幼細的腹部及極長的後腿，為姬蜂的擬態，除了觸角以外與細腹蟲虻亞科亦很相似。香港暫時發現兩種姬蜂虻。
- (iv) *Systropus* sp. (Figure 5.4 & 5.5)
Extremely slender abdomen and long hind leg. Mimics of ichneumon wasps. Other than the antennae, it also looks like members of Leptogastrinae. Two species have been discovered in Hong Kong.

6. 食蟲虻科

食蟲虻屬中至大型虻類，可算是最大型的雙翅目成員。腹部一般較修長，胸部發達，足部強壯，複眼間頭頂凹陷，巨大的複眼佔頭部過大半面積，臉部被濃密鬃毛，用以在捕獵時保護雙眼。成蟲是捕獵能手，捕食其他昆蟲和蜘蛛，常見牠們於林區曠野枝頭上佇候，憑藉強壯身軀及優越的飛行能力捕捉獵物，捕獲後將刺吸式口器刺入獵物體內，注入唾液麻醉獵物及分解內部組織後再將其吸收；幼蟲期間為雜食性。

食蟲虻科是雙翅目中一個大科，全世界已知的成員約有七千種，中國已知二百五十多種。在香港，有紀錄的食蟲虻只有約兩至三種，惟根據近年野外觀察，估計香港約有十多種食蟲虻，牠們均屬中至大型品種，體長由十五毫米至五十毫米不等，體色多為灰、黑或橙、黑組合，從平地到山上的林緣均可發現其蹤影。

(i) 長吻蟲虻屬? (圖6.1)

相信是本港最大型的食蟲虻，體長接近五十毫米，腹部比翅膀長，末端節芒與頭三節等長。常見於林邊植物的樞枝上守候獵物。

(i) *Promachus* sp.? (Figure 6.1)

Believed to be the largest robber fly in Hong Kong, with body length about 50 mm. Abdomen longer than the wings. Arista equals the total length of the first three segments of antenna. Often seen perching on branches and waiting for prey.

(ii) 峰額蟲虻屬? (圖6.2)

體長約三十多毫米，軀幹及腿部橙色，是另一種較常見的食蟲虻。

(ii) *Philodacus* sp.? (Figure 6.2)

Body length about 30 mm. Body and legs in orange. Another locally common robber fly species.

(iii) 脹蟲虻屬 (圖6.3)

小型食蟲虻，略大於家蠅，約有十五毫米長；腹部較短，休息時翅膀完全覆蓋腹部；具兩列觸角節芒羽狀毛。

(iii) *Emphysomera* sp. (Figure 6.3)

Small robber fly slightly larger than house flies. Body length about 15 mm. Abdomen relatively short and wholly covered by wings when at rest. Plumose arista with two rows of hair.

6. Asilidae (Robber flies)

Robber flies are medium to large flies, and are the largest in Diptera in terms of body size. Usually with long abdomen, robust thorax and strong legs. There is a depression between the giant compound eyes, which cover the majority of their heads. Dense bristles called mystax are present on the faces to protect the eyes when hunting. Adults are skillful predators on other insects and spiders. They are often seen perching on branches in open areas of woodland, using their strong body and superb flight skills to prey. After capture, they use their proboscis to stab the prey, inject saliva to paralyze the prey and digest the internal body parts for their sucking. Larvae are omnivorous.

Asilidae is a big family in Diptera. About 7,000 species are known worldwide and 250 species are recorded in China. There are only two to three recorded species in Hong Kong, but field observations in recent years show that there may be more than a dozen species occur locally. All of them are medium to large size flies, with body length ranging from 15 mm to 50 mm. Body colours are usually combinations of grey and black or orange and black. They can be seen at the edge of woodlands from flatland to hillside.



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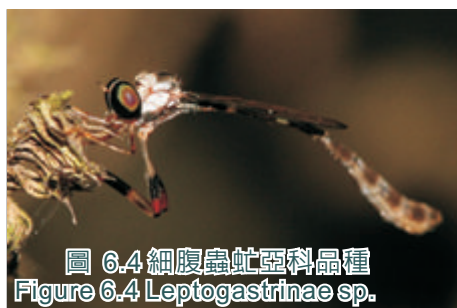


圖 6.4 細腹蟲虻亞科品種
Figure 6.4 Leptogastrinae sp.

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圖 6.5 Apocleinae sp.
Figure 6.5 Apocleinae sp.

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圖 6.6 Stenopogoninae sp.
Figure 6.6 Stenopogoninae sp.

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圖 6.7 食蟲虻科未分辨品種
Figure 6.7 Unidentified Asilidae sp.

(iv) 細腹蟲虻亞科品種 (圖 6.4)

屬比較原始的食蟲虻，腹部比其他亞科幼長，除了特長的後腿外，緩慢的飛行形態頗像豆娘。與其他食蟲虻不同，細腹蟲虻亞科會在飛行時直接在植物上掠走獵物，甚至可以在蛛網上捕獵蜘蛛。

(iv) Leptogastrinae sp. (Figure 6.4)

Primitive robber flies, with very slender abdomen and long hind legs. Looks like damselflies when in flight because of its slow speed and lengthy body. Unlike other robber flies, members of Leptogastrinae grab their prey directly from vegetation during flying. They can even catch spiders from the webs.

(v) Apocleinae sp. (圖 Figure 6.5)

(vi) Stenopogoninae sp. (圖 Figure 6.6)

(vii) 食蟲虻科未分辨品種
Unidentified Asilidae sp.
(圖 Figure 6.7)

7. 舞虻科及駝舞虻科

舞虻總科是虻類中最進化的類群。關於舞虻總科的分類目前尚存在很大爭議。捷克雙翅目專家Milan Chvála在其著作中提出把舞虻總科分為五個科，包括長足虻科、舞虻科、阿舞虻科、駝舞虻科及小室舞虻科，此系統廣為西方雙翅目學者所採納；楊定及楊集昆(2004)指出傳統舞虻科的成員(即除長足虻科以外的舞虻總科成員)屬單系群，故應予以保留，惟亦有人對此提出異議(Sinclair & Cumming 2006)。

全世界已描述的舞虻(廣義而言)有四千多種，中國約有四百多種，絕大部分不論成蟲或幼蟲階段皆為捕食性。牠們屬小至中型昆蟲，頭部呈圓球形，複眼巨大，普遍品種(尤其是雄性)的兩隻複眼在頭頂上長長地緊接，只露出少部分前額；口器近刺吸式，部分品種喙部特長，尤如彩鵲。由於好些品種在交配前會有群飛習性，故被稱為舞虻，好些品種的雄性更會贈送獵物予雌性以與其交配。楊定及楊集昆(2004)描述中國螳舞虻亞科和駝舞虻亞科(=駝舞虻科)品種，當中並沒包括廣東省或香港的紀錄；李文亮等(2007)描述廣東三種柄駝舞虻屬。從野外觀察可知在本港確實有舞虻的分佈，普遍屬小型品種。

7. Empididae (Dagger flies) and Hybotidae (Dance flies)

Empidoidea is the most evolved group in Orthorrhaphous Brachycera. Their classification is still under hot debate. In the publications of the Czech dipterist, Milan Chvála, Empidoidea members are classified into five families, including Dolichopodidae, Empididae, Atelestidae, Hybotidae and Microphoridae. This classification has been widely adopted by western dipterists. In Yang & Yang (2004), it is stated that the traditional Empididae (i.e. Empidoidea excluding Dolichopodidae) is a monophyletic group and therefore should be retained. Yet there were disagreements on this view (Sinclair & Cumming 2006).

There are about 4,000 species of dance flies and relatives (i.e. Empididae *sensu lato*) in the world, with 400 or so species in China. Both adult and larval stages are predatory. Body size small to medium. Spherical head with giant compound eyes that are often holoptic over a long distance at the upper side (particularly for males),



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圖 7.1 舞虻屬
Figure 7.1 *Empis* sp.

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圖 7.2 舞虻亞科品種
Figure 7.2 *Empidinae* sp.

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圖 7.3 螳舞虻亞科品種
Figure 7.3 *Hemerodromiinae* sp.

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圖 7.4 駝舞虻屬
Figure 7.4 *Hybos* sp.

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圖 7.5 隱脈駝舞虻屬
Figure 7.5 *Syndyas* sp.

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圖 7.6 平鬚舞虻屬
Figure 7.6 *Platypalpus* sp.

resulting in small frons. Mouthparts are in the form of a needle-like proboscis, which in some species are exceptionally long and make the insect look like greater painted snipes (hence the name dagger fly). Some species form dance swarms before mating (hence the name dance fly). Many of the males would give prey to female as a gift for courtship. No Guangdong or Hong Kong record was described in Yang & Yang (2004), which included Hemerodromiinae and Hybotinae (=Hybotidae) species in China. Li *et al* (2007) described three species of the genus *Syneches* in Guangdong. It is known from field observations that there are dance flies and relatives occurring in Hong Kong, most of them are small species.

- (I) 舞虻科：舞虻亞科：舞虻屬（圖7.1）
體長約六至七毫米，身體黑色，腹部修長；複眼紅色而巨大；喙部特長，有如匕首。另亦見類似個體，未確定是否同一品種。（圖7.2）
- (i) Empididae: Empidinae: *Empis* sp. (Figure 7.1)
Body length 6-7mm. Body in black. Slender abdomen. Big, red compound eyes. Long proboscis resembling a dagger. Another similar individual has been found, but it is not known whether they are the same species (Figure 7.2).
- (ii) 舞虻科：螳舞虻亞科品種（圖7.3）
頭部偏長，具捕捉式前足，基節很長，與螳螂相似。
- (ii) Empididae: Hemerodromiinae sp. (Figure 7.3)
Elongated head. Raptorial fore legs with long coxa that resemble those of mantis.
- (iii) 駝舞虻科：駝舞虻亞科：駝舞虻屬（圖7.4）
體長約七毫米，身體黑色，胸背具光澤；複眼紅色而巨大；後足腿節粗壯及具剛毛；足部跗節黃色。
- (iii) Hybotidae: Hybotinae: *Hybos* sp. (Figure 7.4)
Body length 6-7mm. Body in black with lustrous dorsum at thorax. Big, red compound eyes. Robust femur with bristle. Tarsus in yellow.
- (iv) 駝舞虻科：駝舞虻亞科：隱脈駝舞虻屬（圖7.5）
約五毫米長，頭部呈圓球形，複眼紅色，覆蓋全頭；身體黑色，胸背板隆起及具光澤，足部跗節黃色。
- (iv) Hybotidae: Hybotinae: *Syndyas* sp. (Figure 7.5)
About 5 mm long. Spherical head almost wholly covered with red compound eyes. Body in black. Humpbacked dorsum with lustre. Tarsus in yellow.
- (v) 駝舞虻科：合室舞虻亞科：平鬚舞虻屬（圖7.6）
複眼、胸部及腹背黑色，其餘部分棕黃色。
- (v) Hybotidae: Tachydrominae: *Platypalpus* sp. (Figure 7.6)
Black compound eye, thorax and dorsal side of abdomen. Other parts in yellow.

8. 長足虻科

長足虻體型較小，體長一般不超過十毫米，然而卻是雙翅目中種類最多、最進化的科之一。全世界已描述的長足虻約有七千多種，部分在香港也算常見，但卻甚少有文獻記載，可能是因為其細小而不顯眼，且主要為捕食性而非食腐性，對環境衛生沒有直接影響而為人忽略。絕大部分長足虻科成員足部修長，身體多為具金屬光澤的綠色、藍色或棕色。從個人觀察所見，香港的長足虻於水體附近（特別是溪流）較多出現。



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8. Dolichopodidae (Long-legged flies)

Long-legged flies are generally small in size, body length usually less than 10 mm. However it is one of the most evolved families and contains the most number of species among others. There are about 7,000 species described worldwide. Some of them are common in Hong Kong, but there were very few literature about local long-legged flies. People's ignorance to them may be due to their small size that makes them less visible, and their predatory instead of saprophagous habit that causes no environmental hygiene problem. Most long-legged flies are, as the name suggests, with long legs. Body colour usually metallic green, blue or bronze. From personal observations, long-legged flies are more often seen near water bodies (in particular rural streams).

(i) 金長足虻屬 (圖8.1)

本港最常見的長足虻，身長約八毫米，全身金屬綠色，觸角長度大於頭胸總長，翅膀透明，通常見於葉面步行或作短暫飛行，甚少駐足停下。未知本港是否有數個類似品種出現。

(i) *Chrysosoma* sp. (Figure 8.1)

The most commonly seen long-legged fly in Hong Kong. Body length about 8 mm. Whole body in metallic green. Antennae longer than the total length of head plus thorax. Wings transparent. Usually seen walking or flying in short distance on leaves. Seldom remains stationary. Not sure if there are several similar species occur in Hong Kong.

(ii) 毛瘤長足虻屬 (圖8.2)

外形和行為均與金長足虻屬類似，惟觸角較短，雙翅具黑斑。

(ii) *Condyllostylus* sp. (Figure 8.2)

Resembles *Chrysosoma* sp. in terms of both appearance and behaviour, but with shorter antennae and black patches on the wings.

(iii) 短跗長足虻屬 (圖8.3)

體型很小，只有約四至五毫米長，橙白色身軀，胸背板帶金屬藍色。本屬被歸於合長足虻亞科之下。另亦見一相似品種，應同為合長足虻亞科，但身分未知 (圖8.4)。

(iii) *Chaetogonopteron* sp. (Figure 8.3)

Very small size, about 4 to 5 mm long. Body colour orange white. Dorsum in metallic blue. The genus is classified under the subfamily Sympycninae. There is another species belonging to the same subfamily but the genus is undetermined (Figure 8.4).



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圖 8.5
弓脈長足虻 / 羽芒長足虻屬組別
Figure 8.5
Paraclius / Pelastoneurus sp. group



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圖 8.6 長足虻亞科品種
Figure 8.6 Dolichopodinae sp.



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圖 8.7 嵌長足虻屬
Figure 8.7 *Syntormon* sp.

(iv) 弓脈長足虻 / 羽芒長足虻屬組別 (圖8.5)

較大型之長足虻，身長約十至十五毫米，胸背金屬藍綠色，曾於晚上發現數十隻一同棲息在溪流旁植物上。另亦見類似品種，腹部呈金屬銅色，應同屬長足虻亞科，但身份未明(圖8.6)。

(iv) *Paraclius / Pelastoneurus* sp. group (Figure 8.5)

Relatively big long-legged fly. Body length 10 to 15 mm. Dorsum in metallic bluish green. Several dozens of individuals were found resting together on riparian vegetations at night. There is another similar Dolichopodinae species that are with bronze abdomen but of unknown identity (Figure 8.6).

(v) 嵌長足虻屬 (圖8.7)

體長約三至四毫米，觸角膨大。

(v) *Syntormon* sp.

(Figure 8.7)

Body length about 3 to 4mm with swollen antennae.

除了以上提及各個科外，筆者亦曾在梧桐寨目睹一隻具櫛狀觸角、形似雙翅目的昆蟲，有可能是食木虻科的肋角虻屬。

In addition to the families mentioned above, a Diptera-like insect with pectinate antennae, probably a *Rachicerus* sp. of Xylophagidae, has been observed in Ng Tung Chai.

總結

綜合文獻及野外觀察紀錄，可見香港至少可發現約九至十科虻類昆蟲。表二列出了本文提及這些虻類在本地、中國以及全世界已描述的大約種數。

粗略估計，香港的虻類昆蟲至少有三、四十種，若考慮牠們在中國以至全世界的種數，同時比較其他較多被研究的昆蟲(如蝴蝶和蜻蜓)在本地之分佈，香港虻類品種的實際數目可能還要多一至兩倍(尤其是舞虻總科)。即使是常見的虻類(如虻科和食蟲虻科)，我們對本地品種的認識依然匱乏，更遑論研究其習性與生活史。故希望各位能提供本地虻類觀察紀錄，同時亦歡迎對本文之分類提出指正及意見。

特別鳴謝借出照片以及在Diptera.info提供品種鑒別意見的朋友們。

表二 部分虻類科別的品種數目

Table 2 Number of species for selected Orthorrhaphous Brachyceran families

科	Family	香港* Hong Kong*	中國 China	世界 World
食木虻科	Xylophagidae	1?	?	110
虻科	Tabanidae	5	400	4,000
鵲虻科	Rhagionidae	1	?	500
木虻科	Xylomyidae	1	?	110
水虻科	Stratiomyidae	7 - 8	183	2,800
蜂虻科	Bombyliidae	5	?	4,500
劍虻科	Therevidae	1	?	1,600
食蟲虻科	Asilidae	7 - 8	250	7,000
舞虻科	Empididae	2 - 3	400	5,000
駝舞虻科	Hybotidae	3		
長足虻科	Dolichopodidae	7	?	7,000

* 只包括本文提及者 Includes only the species mentioned here

Conclusion

Records from literature and field observation demonstrate that at least 9 to 10 families of Orthorrhaphous Brachycera are represented in Hong Kong. Table 2 lists out the estimated number of known species for these families in Hong Kong, China and the World.

It is roughly estimated that there are at least about 30 to 40 species of Orthorrhaphous Brachyceran insects in Hong Kong. Taking into account the number of species in China and over the World, and comparing the distribution of taxons that are more studied (e.g. butterflies and dragonflies), the actual number of species in Hong Kong may indeed be one or two times more (in particular Empidoidea species). Our knowledge on the local species is still very limited even for the common families like Tabanidae and Asilidae, not to mention the study of their behaviour and life cycle history. Readers are encouraged to supplement records of Hong Kong Orthorrhaphous Brachycera. Comments on the classification mentioned in this article are also welcome.

Special thanks to those who have generously lent their photos or provided opinions on species identification in Diptera.info.

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Winter aggregation of Danaine Butterflies in Hong Kong (1999 - 2009)

Ten years records and a brief account



Abstract

Winter aggregation of danaine butterflies (sub-family Danainae) in Hong Kong involves 7 species out of the 12 known species in Hong Kong. Species composition, population size and the physical environment of 21 local aggregation sites are described and discussed. Mortality, feeding behaviour, reproductive activities, form of aggregation and selection of plant species for aggregation in the winter aggregation sites are also described and discussed. A hypothesis of the effect of aggregation pheromones on danaine butterflies' aggregation and dismissal is proposed.

■ YIU Vor 饒戈
Hong Kong Entomological Society, Hong Kong
yiuvor@hkentsoc.org

Introduction

Aggregation behaviour of non-social insects have been reported in all major insect orders – Coleoptera, Lepidoptera, Diptera, Hemiptera, Homoptera and Orthoptera. Insect aggregations are formed and maintained for a number of reasons, and by a number of mechanisms (J. Bengtsson, 2008).

Aggregation of local danaine butterflies can be seen in all seasons. 4 different purposes of aggregation of local danaine butterflies were noticed :

1. Concentration of male danaine butterflies on certain plants presumably for acquisition of pyrrolizidine alkaloids for synthesis of pheromones.
2. Concentration of danaine butterflies for overnight.
3. Mass movement of danaine butterflies over an area.
4. Concentration of danaine butterflies on trees or shrubs growing in sheltered river valley during winter.

The first formal report on aggregation of danaine butterflies in Hong Kong seems to be in 1938, by Konyil Chan : " ...Lying close to the northern of Lai Chi Kok, Kowloon, with a mountain stream running down from top of the range, the "Butterfly Valley" furnishes a wonderful outing ground....On December 10, 1938... We reached the valley at about 10 a.m. and to my surprise thousands of butterflies were seen swarming on the twigs and branches of pine tree and other bushes. In certain corners of the Valley the Schefflera octophylla (Lour.) Harms; known to local Chinese as Aap Keurk Shu (鴨腳樹) was seen to have attracted at almost incredible numbers of butterflies. The majority of the

butterflies seems on that day were *Euploea* (*Isamia*) *midamus* Linn., *Euploea* (*Crastia*) *amymone* Godart., *Danaus* (*Salatura*) *plexippus* Linn., *Danaus* (*Radenia*) *similis* Linn., and a few *Cupha erymanthis* Drury, ". The former two species being comparatively the most numerous."

Marsh (1968) also very briefly mentioned the congregation of hundreds of *Danaus genutia* at the flowers of "Ivy Tree". He also stated that *Euploea core* "often swarms in the Autumn".

Johnston & Johnston (1980) provided a little more details under their description of family Danaidae: "As winter draws near in Hong Kong, the butterflies of this family have a tendency to congregate in certain in places - the wooded areas around Tai Lam Reservoir is one – as if preparing for a move to warmer climes. But instead of doing so they seem to cluster in bunches on the trees for warmth. Most, however, seem to die at this time, falling to the ground where, poisonous or not, ants devour them leaving thousands of bodiless wings blowing forlornly about the breeze."

Bascombe, Johnston & Bascombe(1999) reported the observation of 50 males of *Euploea midamus* and *Euploea core* being attracted to *Heliotropium indicum*, congregation of danaines at *Lantana*, *Ruellia repens*, *Zanthoxylum avicennae*, *Schefflera octophylla* and other flowering trees and shrubs for nectar, congregation of large numbers "(several thousands in good years)" on or in the vicinity of *Schefflera octophylla* or *Melaleuca leucadendron* trees. They also reported that "the great majority of those taking part are *E. midamus* and *E. core*, small number of *Parantica aglea*, *Ideopsis similis*, *Tirumala limniace* and *Danaus genutia* usually also present." Moreover, they gave a brief description of "a steady southward stream of *E. midamus* crossed a garden on a hillside above the high-rise buildings on the north shore of Hong Kong Island."

Three years after the accidental discovery of the danaine butterflies aggregation site in Siu Lang Shui, Tuen Mun, by V. Yiu and J. J. Young. J. J. Young gave a brief report uploaded to the web site of the Hong Kong Lepidopterists' Society in 2001.

A booklet, "The Winter Butterfly Valleys of Hong Kong" (Written in Chinese) authored by V. Yiu was published in December, 2002. History of the discovery of the 2 winter aggregation sites (Siu Lang Shui, Tuen Mun and Fan Lau, Lantau Island), species density and composition, daily activities, the physical environment were briefly described in the booklet.

In December, 2003, Henry Tang of the Hong Kong Lepidopterists' Society discovered the aggregation site in Deep Water Bay river valley, Hong Kong Island. A detailed species list was written by him. Dr. P. C. Lee also provided description of the discovery. Both reports were posted on the web site of the Hong Kong Lepidopterists' Society in 2004.

Eric Wong *et al.* (2004) used capture-mark-recapture experiment to study the species composition, sex ratios and population dynamics of the winter aggregating danaine butterflies in Siu Lang Shui. Migration of the butterflies from Shing Mun Country Park to Siu Lang Shui was also proved, which are 20 kilometers apart.

No study of aggregation of danaine butterflies have been reported in mainland China. Only oral reports of aggregations in Shenzhen and Guongzhou were heard. Wang & Emmel (1990) gave a detailed report on the autumn migration of nine species of danaine butterflies

from northern Taiwan to southern Taiwan for overwintering. The nine species are: *Euploea sylvester*, *E. eunice*, *E. mulciber*, *E. tulliolus*, *Parantica aglea*, *Ideopsis similis*, *Tirumala limniace*, *T. septentrionis* and *Danaus genutia*. Kitching & Zalucki (1981) reported the overwintering aggregation of *Euploea core corinna* in Australia. Orr (1992) and Ishii (1993) reported the aggregation of *Euploea tulliolus*, *E. sylvester* and *E. modesta* in tropical Malaysia.

Hong Kong is located in eastern Asia, on the southeast coast of China and adjacent to the Pearl River estuary, facing the South China sea, belongs to the Indomalaya ecozone. Hong Kong's climate is sub-tropical, tending towards temperate for nearly half the year. Coolest in January and February, with occasional cold fronts followed by dry northerly winds, it is not uncommon for temperature to drop below 10°C in urban areas, usually a few degree lower in rural areas. Warmer and humid in March and April. May to August are hot and humid with occasional showers and thunderstorms. During November and December, there are plenty of sunshine and warm temperatures.

There are 12 species of danaine butterflies known in Hong Kong (*Tirumala hamata*, *Danaus plexippus* and *Euploea eunice* are considered as vagrant because their local records are too old and their distribution ranges do not cover Hong Kong (Bascombe, Johnston & Bascombe, 1999)), status of each are list in Table 1. Adult rarity follows Walthew (1997). Breeding status follows Young, Yiu & Yau (2007a, 2007b, 2008).

Table 1: List of 12 species of Danaine butterflies of Hong Kong

Species	Adult rarity	Breeding status
<i>Parantica aglea</i> 絹斑蝶	Common	Breeding locally
<i>Parantica melaneus</i> 黑絹斑蝶	Very rare	Not known
<i>Parantica sita</i> 大絹斑蝶	Rare	Breeding locally
<i>Ideopsis similis</i> 擬旖斑蝶	Very common	Breeding locally
<i>Tirumala limniace</i> 青斑蝶	Common	Breeding locally
<i>Tirumala septentrionis</i> 喬青斑蝶	Very rare	Not known
<i>Danaus chrysippus</i> 金斑蝶	Uncommon	Breeding locally
<i>Danaus genutia</i> 虎斑蝶	Very common	Breeding locally
<i>Euploea midamus</i> 藍點紫斑蝶	Very common	Breeding locally
<i>Euploea sylvester</i> 雙標紫斑蝶	Very rare	Not known
<i>Euploea mulciber</i> 異型紫斑蝶	Uncommon	Breeding locally
<i>Euploea core</i> 幻紫斑蝶	Very common	Breeding locally

Materials and methods

From 1999 January to 2009 March, danaines aggregation sites were visited and studied. More accessible sites were visited more frequently, approximately 5-10 times in winter. Species composition, spatial distribution, activities were checked on site. Abundance of aggregating butterflies were estimated by direct count. For large population size, 100 was used as the counting unit. This was usually done in low temperature when butterflies were less active and more clustered together. Photos were taken by a Single Lens Reflect camera equipped with a lens of 100 mm - 400 mm focal length. Approximately 2,000 photos were taken. Photos are examined to check for rare species and for estimation of relative species density. Aggregation of danaine butterflies in other seasons were also examined for comparison.

Results and discussion

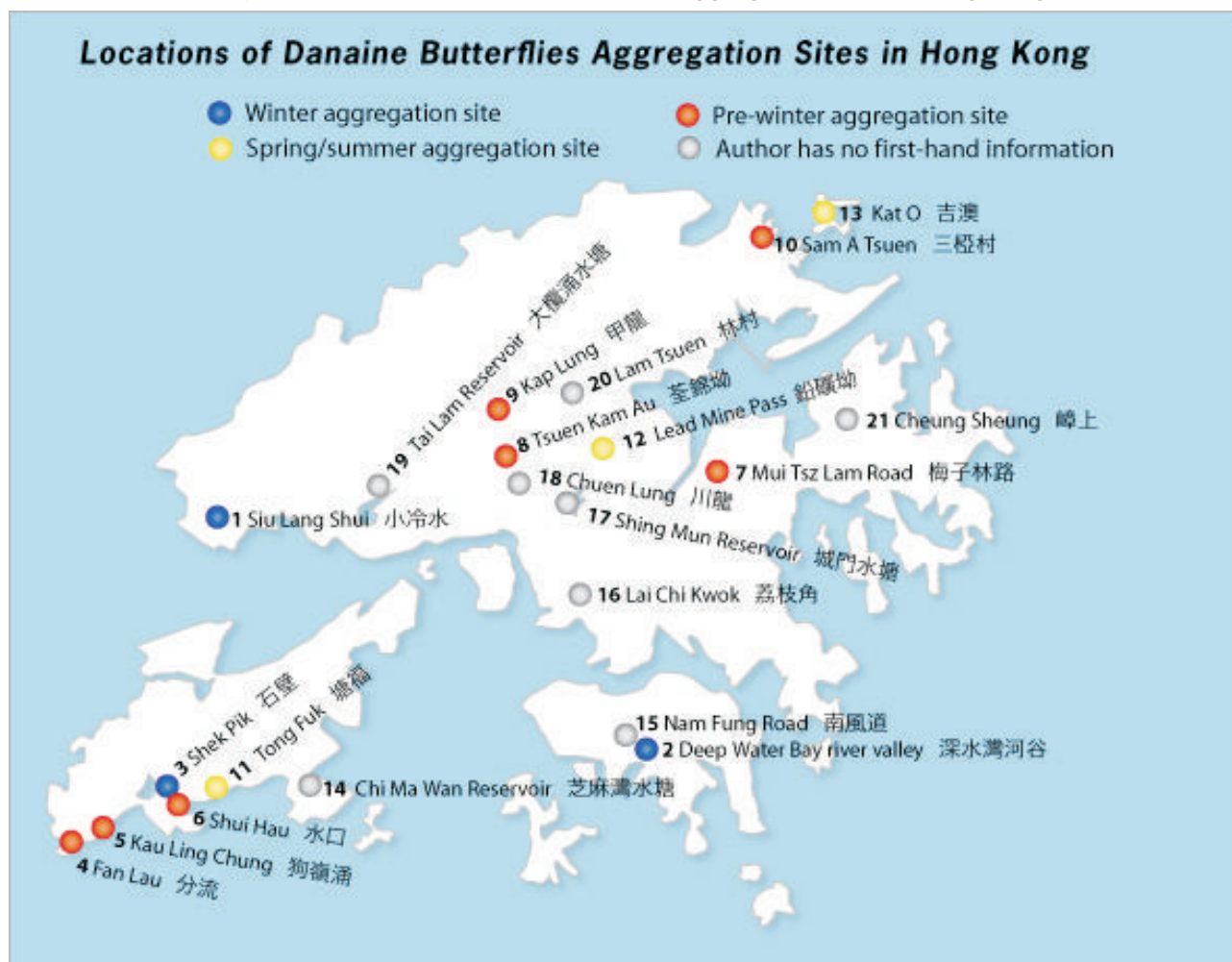
Aggregation sites, population size and species composition

Totally, 21 sites with records of aggregating danaine butterflies can be identified (Map 1). According to the timing of aggregation, they can be classified into 3 categories:

- Winter aggregation site — aggregating butterflies can be seen in December, January and February, sometimes also in Early March. Aggregating butterflies may or may not stay over winter.
- Pre-winter aggregation site — aggregating butterflies can be seen in October and November, and sometimes in Early December. Butterflies do not stay till mid-December.
- Spring/summer aggregation site — aggregating butterflies can be seen from March to September.

The 3 categories may not be mutually exclusive, a site could be a whole-year aggregation site.

Map 1: Locations of *Danaine* Butterflies Aggregation sites in Hong Kong



Winter Aggregation sites

1. Siu Lang Shui, Tuen Mun (Photo 1)



Photo 1 Siu Lang Shui

This site is a southwest facing river valley located at the southwest extreme of the New Territories. Northeast to the river valley is Castle Peak which is 760 meters high. The site had been used as a landfill, 1.2 million tons of solid waste had been dumped on an area of 12 hectares. The landfill was closed on 1983. Then, the landfill was covered by a layer of soil and introduced tree species were planted on the land. Main tree species are *Eucalyptus torelliana* 毛葉桉, *Acacia confusa* 台灣相思 and *Leucaena leucocephala* 銀合歡。Small amount of *Acacia auriculiformis* 耳果相思 and *Casuarina equisetifolia* 木麻黃 were also planted. The site is comprised of 3 woodlands which are separated by a 2-meter wide concrete road. Largest woodland is situated at the east side. Since the first discovery in early January, 1999 by members of the Hong Kong Lepidopterists' Society (J. J. Young and V. Yiu), aggregating butterflies have been recorded in every winters in the northern part of this woodland. Concerning the population size of aggregating butterflies involved, this is the largest danaine butterflies aggregation site ever known in Hong Kong. Variation of population size over the past 10 years is shown in Table 2. Species composition in Jan - Feb, 1999 was studied in more detail and results are : *Euploea midamus* 85%, *Euploea core* 9%, *Euploea mulciber* <1%, *Danaus genutia* 3%, *Ideopsis similis* < 1%, *Tirumala limniace* < 1%, *Tirumala septentrionis* <1%. Study by Wong et al. in 2002/2003 in this site shows similar results. Few individuals of *Parantica aglea* and *Parantica sita* were also recorded in the later years. However, study in December, 2004 shows a different ratio of *Euploea midamus* to *Euploea core*, which was 3:1.

2. Deep Water Bay Valley (Photo 2a, Photo2b)

The site is located at the southern side of Hong Kong Island, which is a well vegetated southwest facing river valley with little human intervention. 800 meters south

to the valley is the sea. Between the sea and the valley is a golf court sized 8 hectares approximately. The site is surrounded by Shouson Hill, Mount Nicholson and Violet Hill, leaving only the southwest outlet. Danaine butterflies aggregating in this area was first discovered in December, 2003 by Henry Tang of the Hong Kong Lepidopterists' Society. Variation of the population over the past 10 years is shown in Table 2. In 2001 and 2002, concentration of hundreds of danaine butterflies in later afternoon in summer had been observed. More or less, it could be classified as spring/summer aggregation site as well. No visit has been made in October and November, existence of pre-winter aggregation is not clear. Species composition shows obvious fluctuation on the ratio between *Euploea midamus*, *Euploea core*, *Tirumala limniace* and *Ideopsis similis* in different years. Overall results are : *Euploea midamus* (50-80%), *Euploea core* (15-50%), *Tirumala limniace* (1-10%), *Ideopsis similis* (10-20%), *Tirumala septentrionis* (<1%), *Danaus genutia* (1-2%), *Parantica aglea* (1-2%), *Parantica melaneus* (<1%), *Parantica sita* (<1%) *Euploea mulciber* (<1%). In Jan 18, 2004 and Jan 14, 2008, the aggregating population size did not significantly drop. this suggests that the site may have been used for over-wintering, at least for some years. A more frequent visits to the site in Jan and Feb of 2009 also indicate that hundreds of *Ideopsis similis* and small number of various species stay there until early March without significant drop in the population size.



Photo 2a Deep Water Bay river valley



Photo 2b Deep Water Bay river valley

Table 2: Variation of population size in 4 major aggregation sites from 1998 to 2009

Year	Siu Lang Shui	Deep Water Bay	Shek Pik	Shui Hau	Fan Lau
1998 - 1999	30,000 1999Jan09	No record	No record	No record	10,000 1998Dec13
	15,000 1999Jan16				400 1998Dec27
	30,000 1999Feb12				
1999 - 2000	5,000 1999Dec??	No record	No record	No record	5,000 1999Nov128
					5,000 1999Dec05
2000 - 2001	40,000 2000Dec09	No record	No record	No record	No record
	40,000 2000Dec29				
	40,000 2001Jan16				
	0 2000Feb15				
2001 - 2002	2,000 2001Nov17	No record	No record	No record	3,000 2001Dec15
	10,000 2001dec08				
	20,000 2001Dec22				0 2002Jan02
2002 - 2003	No record	No record	No record	No record	4,000 2002Dec12
2003 - 2004	2,000 2003Nov22	10,000 2003Dec30	10,000 2003Dec25	No record	200 2003Dec07
	2,000 2003Dec20	10,000 2004Jan18			
2004 - 2005		4,000 2004Dec15	3,000 2004Dec19	10,000 2004Dec03	7,000 2004Dec05
	15,000 2004Dec27	4,000 2004Dec18		400 2004Dec27	7,000 2004Dec11
	4,000 2005Jan01	3,000 2005Jan09			
2005 - 2006	1,000 2005Nov05	1,000 2005Nov21	No record	2,000 2005Nov07	No record
	1,000 2005Nov21				
	7,000 2005Dec04				
	3,000 2005Dec15				
2006 - 2007		4,000 2006Dec10	200 2006Dec02	8,000 2006Nov11	100 2006Dec02
	200 2006Nov04				
	20,000 2006Nov12				
	10,000 2006Dec06				
	15,000 2006Dec10				
	10,000 2006Dec16				
	5,000 2007Jan01				
2007 - 2008	5,000 2007Jan07	5,000 2007Dec30	No record	No record	No record
	0 2007Jan77				
	1,200 2007Nov21				
	40,000 2007Nov24				
	40,000 2007Dec09				
2008 - 2009	40,000 2007Dec30	2,500 2008Jan07	No record	No record	No record
	500 2008Jan13				
2008 - 2009	50 2008Nov13	0 2008Nov22	0 2008Nov22	20 2008Nov22	50 2008Nov22
	50 2008Nov19	50 2008Nov29			
	8,000 2008Nov29	100 2008Dec10			
	100 2008Dec19	300 2008Dec21			
		300 2009Jan01			
		150 2009Jan25			
		300 2009Feb01			
		300 2009Feb15			
		200 2009Feb22			

3. Shek Pik (Photo 3)

The site is a plantation woodland situated as the base of the southwest slope of Lantau Peak. 300 meters west to the site is the Shek Pik Reservoir, 800 meters southwest to the site is the sea. A water channel runs across the southwest side of the woodland. *Acacia confusa* 台灣相思 and *Lophostemon confertus* 紅膠木 are the main introduced tree species planted there. Aggregation in this site was orally reported by hikers for years since late 90's and the first formally reported was in December, 2003. Only 3-year data has been collected, the status of this site is not really certain. Species composition in 2003 were : *Euploea midamus* (88%), *Euploea core* (11%), *Tirumala limniace* (1%), *Tirumala septentrionis* (1 individual). Ratio of *Euploea midamus* to *Euploea core* reversed in a study on Dec 19, 2004, the ratio was 1:5.



Photo 3 ShekPik

Pre-winter aggregation sites

4. Fan Lau (Photo 4a, Photo 4b)

The site is a headland located at the southwest extreme of the Lantau Island. Southern part of the area is a more or less abandoned village and abandoned farmland. Northern part of the area is a mixture of natural woodland and Fung Shui Wood (A woodland situated behind the a village, which is comprised of local plant species and maintained or protected by the villagers for the interests of the village). Eastern side and western side of the area are sea coast which are 500 meters apart. Aggregating butterflies were usually seen at the small river valley leading to the east coast. The site was first discovered by the members of the Hong Kong Lepidopterists' Society in Early December, 1998. Butterfly aggregation was observed in late November and early December of each years since then. Not aggregation was observed in any visit made after mid-December. Status in spring and summer is not known. It should also be noticed that a small colony of *Crotalaria retusa* 吊裙草 (Fabaceae) form strong attraction to the danaines throughout the aggregation period (Photo 4b). The plant is also a well-known source of pyrrolizidine alkaloids (PAs). Although varies in different years, the aggregating butterfly population is obviously dominated by *Danaus genutia* which constitute about 60% of the total number of individuals. Ratio of other members are as follows: *Euploea core* (67%), *Euploea midamus* (22%), *Tirumala limniace* (8%), *Tirumala septentrionis* (<1%), *Ideopsis similis* (1%), *Parantica aglea* (1%), *Parantica sita* (<1%), *Danaus chrysippus* (<1%).



Photo 4a FanLau



Photo 4b Danaines attracted to *Crotalaria retusa*

5. Kau Ling Chung

This is a southwest facing bay which is about 1.5 km east to Fan Lau. In Dec. 5, 2004, hundreds of danaine butterflies was observed aggregating in the woodland behind the beach. The aggregating butterflies disappeared in the visit on Dec. 11, 2004. On Dec 2, 2006, about 300 danaine butterflies were seen. Species composition is similar to that in Fan Lau. Status in other seasons is not known.

6. Shui Hau (Photo 5a, Photo 5b)

It is a east facing sheltered bay in Lantau Island. Behind the coast is a large marsh which had been used for cultivation many years ago. It was first reported in December 2003 that large amount of danaine butterflies were seen from mid-October to late November. A visit was made on mid-December of the same year but no aggregating danaine butterflies was found. Around 10,000 danaine butterflies were recorded in a visit on Dec. 3, 2004. Hundreds to thousands of the butterflies were gathering on the flowering herb - *Adenostemma lavenia* (Asteraceae) 下田菊 which was quite densely growing in the area. As the amount of nectar available from this flowers is minimal, but the visiting duration is long and involved large number of individuals, it is possible that this plant provides pyrrolizidine alkaloids (PAs) from which some pheromones of the danaine butterflies derive. It has been reported that this plant genus contains PAs (Erhard Roeder, 1999). Small amount of the butterflies (both males and females) can also be seen on the dense flowers of *Mikania micrantha* 薇甘菊. A small woodland predominantly occupied by a large shrub *Paliurus ramosissimus* 馬甲子 is situated near the coast. Inside the woodland is the place where assemblage of danaine butterflies was found. On Nov 11, 2006, 2000 danaine butterflies were found aggregating in the orchard (Lychee 荔枝 and Longan 龍眼) near the junction of South Lantau Road and Lantau Trail Stage 9. Although aggregating butterflies generally dismissed before early December, about 400 danaine butterflies (mostly *Danaus genutia*) were still recorded in Dec 27, 2004. The status of this site is marginal. To certain extent, it may play the role of winter aggregation site as well. About half of the individuals were *Danaus genutia*, most of the remaining half are *Euploea midamus* and *Euploea core*, ratio of the former to the latter is about 3:1. Other recorded members includes *Euploea mulciber*, *Tirumala limniace*, *Ideopsis similis*, *Parantica aglea* and *Danaus chrysippus*. A colony of *Asclepias curassavica* 連生桂子花 were growing in the area and immature stages of *D. Chrysippus* could be found on the plant in winter months.



Photo 5a Shui Hau

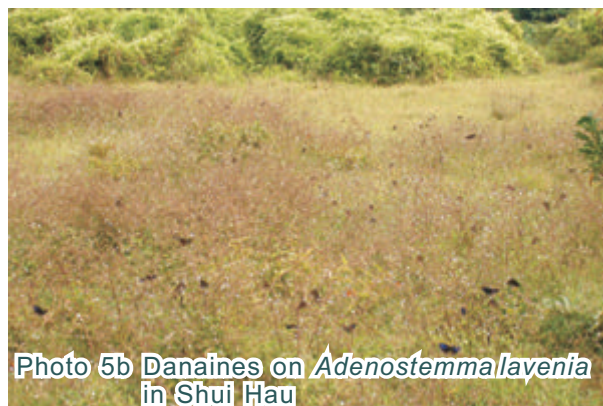


Photo 5b Danaines on *Adenostemma lavenia* in Shui Hau

7. Mui Tze Lam Road

There has been only one record, at the dusk of Nov. 19, 2005, 600 *Tirumala limniace* densely aggregated into 2 separate groups (Photo 6). Male to female ratio is about 1:6. 7 individuals of *Danaus genutia* mixed with the population. The aggregation disappeared on the next day.



Photo 6 Aggregating *Tirumala limniace* in Mui Tze Lam

8. Tsuen Kam Au

It is a small wetland located at 480 meter above sea level, the site is surrounded by plantation woodland. A small population of *Adenostemma lavenia* (Asteraceae) 下田菊 growing in the site which attract the danaine butterflies. Aggregation of about 100 butterflies was recorded on Oct. 21, 2005 and Sep. 23, 2004 respectively.

9. Kap Lung

The record was taken on Oct. 30, 2005. About 200 danaine butterflies were seen aggregating in the plantation woodland situated at the lower end of the Kap Lung Ancient Trail.

10. Sam A Tsuen

It is a large marsh with densely growing *Adenostemma lavenia* (Asteraceae). Aggregation of danaine butterflies was first seen

on late September, 2002. About 500 individuals were recorded in the site on Oct. 10 of the same year, most of them were gathering on the *Adenostemma lavenia*. Small portion of them were hanging on the small tree of the adjacent woodland. Similar scene was observed again on October, 2004. The danaine butterflies were mainly *Euploea midamus*, *Euploea core*, *Tirumala limniace* and *Ideopsis similis*, ratio were 6:2:1:1. Nearly all male. Other recorded species were *Euploea mulciber* and *Parantica aglea*.

Spring/Summer aggregation site

11. Tong Fuk

In May 11, 2002. Hundreds of various species of danaine butterflies were found crowded around the well known PAs source plant - *Heliotropium indicum* (Boraginaceae) 大尾搖 (Photo 7) which was densely growing on the large abandoned farmland in front of the village. The site was visited again on May 26, 2002, the scene was the same. Since then, most *Heliotropium indicum* was cleared leaving a small colony growing near the road. Although frequently disturbed, the small colony of *Heliotropium indicum* kept attracting 50-100 danaine butterflies at most of the time during its flowering period. Most of the danaine butterflies were *Tirumala limniace*, *Danaus genutia* and *Danaus chrysippus*, a few *Euploea midamus*, *Euploea core*, *Euploea mulciber*, *Tirumala septentrionis* and *Parantica aglea* were also seen. No female recorded.



Photo 7 Danaines on *Heliotropium indicum*

12. Lead Mine Pass



Photo 8 Danaines on *Ageratum conyzoides*

On Feb. 24, 2001. 50 - 100 *Parantica aglea* and *Parantica sita* were seen attracted to the well known PAs source - *Ageratum conyzoides* 藿香薷 (Asteraceae) (Photo 8) growing in the place. Few *Euploea midamus* were also seen. The situation remained unchanged on another visit on March 4 of the year.

13. Kat O

After the news of the first local record of *Euploea sylvester* in Kat O, a visit was organized by the Hong Kong Lepidopterists' Society on June 12-13, 1999. Hundreds of danaine butterflies of various species were seen crowded on the dense colony of *Heliotropium indicum* growing around a small pond in an abandoned field. Recorded species includes *Parantica aglea*, *Ideopsis similis*, *Tirumala limniace*, *Tirumala septentrionis*, *Danaus genutia*, *Euploea midamus*, *Euploea sylvester* and *Euploea core*.

Other Aggregation Sites

14. Chi Ma Wan Reservoir.

It was reported by a butterfly watcher on December, 2003 that thousands of *Euploea* spp., mainly *Euploea midamus* were aggregating near the Chi Ma Wan Reservoir.

15. Nam Fung Road

As mentioned by Wong et al. (2004): "The migration of Danaiids in Hong Kong usually starts from November and small aggregates of butterflies would be seen in areas such as Nam Fung Road Site of Special Scientific Interest (SSSI)." The place is a well vegetated Fung Shui Wood which is 1 km away from the Deep Water Bay river valley.

16. Lai Chi Kwok

As mentioned above, the site was first documented by Chan in 1938. The place is also called "Wu Tip Kuk". The Chinese meaning is "Butterfly Valley". People may already know the swarming of butterflies in the valley for a long time. It was orally reported by a naturalist that aggregation of butterflies in the place was still seen in 1970s'. Although the valley was still densely vegetated in 1990s', it may already become unsuitable for winter aggregation of butterflies as the area around the valley had been rapidly developed in the 1980s'. All vegetation was removed to give way to a highway in 2000s'. In the past few years, small south westward stream of *Euploea* spp. could still be seen crossing the area in late November and early December.

17. Shing Mun Reservoir.

It is situated in the central New Territories. The place around the reservoir is a mixture of plantation woodland and natural vegetation. Paul Aston (1998) reported 3 aggregation sites around Shing Mun in winter of 1997. Wong et al. (2004) reported butterfly aggregates greater than 300 individuals observed in Shing Mun on Nov. 7, 2002 and Nov. 14, 2002. In April of some years, when the water level of the reservoir was low, around a hundred of danaine butterflies of various species were attracted to the densely growing *Ageratum conyzoides* and *Heliotropium indicum* on the north east shore of the reservoir. Comparatively, *Heliotropium indicum* is more attractive to the butterflies than *Ageratum conyzoides*.

18. Chuen Lung

It is a large river valley situated on the southern slope Tai Mo Shan. It was mentioned by Wong et al. (2004), but no details was given.

19. Tai Lam Reservoir

Wong et al. (2004) said: "The migration of *Danaids* in Hong Kong usually starts from November and small aggregates of butterflies would be seen in areas such as ... Tai Lam Country Park." Tai Lam Country Park covers an area of 5370 hectares, but it can be inferred from the given map in the paper that the site is somewhere near the Tai Lam Reservoir.

20. Lam Tsuen

A bird watcher reported that "over 200 *Danaus genutia* holding on two dead tree trunks" in a small Fung Shui Wood in Lam Tsuen, on late December, 2008.

21. Cheung Sheung

It was reported by a hiker on Dec. 16, 2004 that large group of danaine butterflies were found near Cheung Sheung (a flat land 400 meters above sea level situated in Sai Kung District). A few days after, Dr. P. C. Lee went there to check and estimated that there were about 400 individuals of *Danaus genutia* aggregating there.

From the above information, a few points can be noticed:

1. Spring/summer aggregation is formed by the strong attraction to PAs source plants namely *Adenostemma lavenia* 下田菊 (Asteraceae) (Flowering period May - Dec), *Heliotropium indicum* 大尾搖 (Boraginaceae) (Flowering period April - Oct), *Crotalaria retusa* 吊裙草 (Fabaceae) (Flowering period Jan - Dec) and *Ageratum conyzoides* 藿香薷 (Asteraceae). (Flowering period June? - Oct). Species so far recorded on these plants are all known species of the local *Danainae* sub-family. After checking hundreds of photo records of danaine butterflies on these plants, unlike other nectar source plants, no female butterfly is found on this plants except 2 incidents involving a female *Euploea mulciber* and a female *Parantica aplea* respectively on *Ageratum conyzoides*. This may be explained by the fact that the plant also provides nectar as members of other butterfly families can also be found visiting its flowers. Whenever available, the PAs source plants are also strong cohesive force in pre-winter and winter aggregation sites. Danaine butterflies do not stop collecting PAs in winter.

2. It should be pointed out that only very small amount or none of the host plants (Table 3) of the local danaine butterflies can be found within or around all the aggregating sites. Although most of the host plants are locally common, they never occur in high density. In fact, no specific site have been reported as a significant breeding ground of any species of the danaine butterflies. It is quite certain that aggregation of danaine butterflies in the sites are not connected with the distribution of host plants.

Table 3: List of host plants for Hong Kong
Danaine Butterflies

Host Plant	Known Hong Kong danaine butterflies feeding on
<i>Strophanthus divaricatus</i> 羊角拗	<i>E. midamus</i>
<i>Nerium oleander</i> 夾竹桃	<i>E. core</i>
<i>Urceola rosea</i> 酸葉膠藤	<i>E. core</i> , <i>E. mulciber</i>
<i>Asclepias curassavica</i> 連生貴子花	<i>P. aplea</i> , <i>I. similis</i> , <i>T. limniace</i> , <i>D. chrysippus</i>
<i>Graphistemma pictum</i> 天星藤	<i>D. chrysippus</i> , <i>D. genutia</i>
<i>Dregea volubilis</i> 南山藤	<i>T. limniace</i>
<i>Tylophora ovata</i> 娃兒藤	<i>P. aplea</i> , <i>P. sita</i> , <i>I. similis</i>
<i>Gymnema sylvestre</i> 匙羹藤	<i>E. core</i> , <i>E. mulciber</i>
<i>Cryptolepis sinensis</i> 白葉藤	<i>E. mulciber</i>
<i>Toxicarpus wightianus</i> 弓果藤	<i>E. core</i> , <i>E. mulciber</i>
<i>Hoya carnosa</i> 球蘭	<i>P. sita</i>
<i>Ficus microcarpa</i> 細葉榕	<i>E. core</i>

3. Pre-winter sites generally have wind-shielded woodland (plantation woodland or naturally developed woodland). It may be located at any elevation up to 500 meters above sea level.

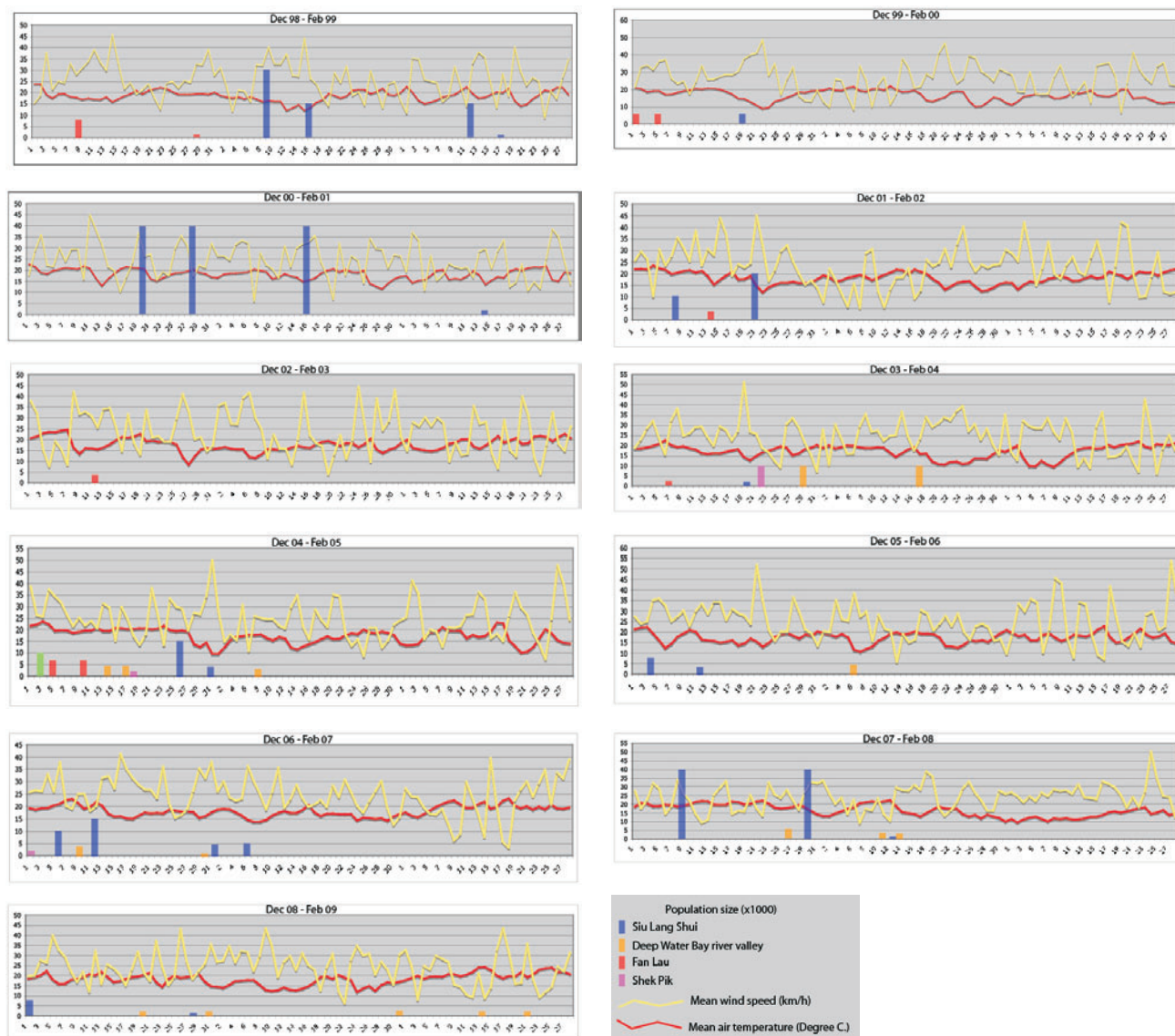
4. Winter aggregation sites are all located at southern or south western extremes of the territory or Islands. They are all dense woodland (plantation woodland or naturally developed woodland) located in south western facing river valley no further than 1 kilometer away from the sea. 2 kilometer east to the Siu Lang Shui Site is the Butterfly Beach (Wu Tip Wan). 700 meters north west to the beach is the Mong Hau Shek (Pillar Point) valley. The geography of the site is very similar to that of Siu Lang Shui. 38 hectare of the Mong Hau Shek valley was used as landfill site which was closed in 1996. So far no information is found about the origin of the name of the place "Butterfly Beach".

5. Table 1 shows that aggregating butterflies in Siu Lang Shui appear at early to mid November and the population size continue to grow until early December. It takes about 3 weeks for the population to increase to maximum. Segregation of arrival timing suggests that the butterflies may come from different origins. The aggregating butterflies disappear in late December to early January, but no latter than mid January. There have been only 2 exceptions : The 1998/1999 aggregation which dismissed at late February, and the 2000/2001 aggregation which dismissed before mid February. That is to say, over the 10 years, only 2 years, Siu Lang Shui was used as an over-wintering site. One would definitely ask : What made the difference in timing of dismissal? Were the dismissal induced by arrival of strong cold front? Changes of population size are plotted against changes of temperature and wind speed over the time period of December to February in chart 1. Neither the temperature nor the frequency and strength of cold fronts were exceptional in 1998/1999 and 2000/2001. In the 2 year sessions. Although low temperature and strong cold fronts still prevail in January and early February, the danaine butterflies chose to stay until the end of winter. Furthermore, if it is the result of sudden change of weather factors, it would be difficult to explain why the butterflies left Siu Lang Shui no latter than mid January in all of the other 8 years.

"Aggregation pheromones are important semiochemicals in insects that play a key role in mating and other social behaviour" (Jiang, Lei & Zhang, 2002. Written in Chinese). Chemistry of the aggregation pheromones in a number of insects are already known. Hick, Luszniak and Pickett (1999) stated that "*The hair pencil pheromones produced by male Lepidoptera have usually*

only close range aphrodisiac-like activity, but those male butterflies from the genus Euploea also display their hair pencils during patrolling flights, suggesting other possible activities". Jiang et al. (2002) studied the chemical signals originating from the ovaries of gravid females of *Musca domestica* (Diptera: Cyclorrhapha: Muscidae) attract ovipositing females to common egg-laying sites and found dose-dependent aggregation of gravid females in oviposition bioassays. Aggregation pheromone in danaine butterflies is yet to be reported. Suppose dose dependency mechanism also apply to the dispersal and aggregation behaviour in danaine butterflies and dose is related to the number of aggregating individuals, then the exceptional over-wintering behaviour of the aggregating danaines in 1998/1999 and 2000/2001 could be the results of the exceptional large population size. Also suppose the aggregation hormone is mediated by the length of daylight, like the diapause mechanism in many insects. The whole process of annual aggregation and dismissal in winter and spring respectively may then be logically explained: When daylight length decreases in autumn, aggregation hormone develops, individual danaine butterflies begin to aggregate to form small groups, and small groups to form larger groups. South westward migration is driven by the north easterlies and the desire to move away from low temperature. More danaine butterflies aggregate results in high concentration or dosage of the aggregation pheromones. When the dosage is high enough, danaine butterflies form stable aggregates. In South China, shortest daylight in the year is on Dec 22 or Dec 23. After that day, daylight length increases, synthesis of aggregation pheromones begins to be suppressed or weakened. If the population size is large enough, stable aggregates can still be kept. When daylight length continues to increase, the bonding becomes weaker and weaker. At the same time, diapause ends and the butterflies become active and finally dismiss at mid Feb or late Feb. However, if the population size is still "marginal" at late December, under the effect of increasing daylight length and weakening of aggregation pheromones, the aggregates choose to leave in January and continue the south westward migration until they meet other groups and form larger aggregate in the journey. Finally, the butterflies may settle on places like Hainan Island to stay a few more weeks until spring comes. (Map 2)

Chart 1: Variation of winter aggregation population, mean air temperature and mean wind speed from Dec to Feb



6. Winter and pre-winter aggregation sites on Lantau Island are dominated by *Danaus genutia*. However, neither the spring/summer aggregation site (Tong Fuk), nor other butterfly watching sites on Lantau Island visited in spring and summer shows similar species composition. Whether there be a tendency of the *Danaus genutia* moving south westward to the Island in autumn and winter is not known.

7. Population size and species composition ratio of *Ideopsis imilis* in the winter aggregation site on Hong Kong Island (Deep Water Bay river valley) is exceptionally high (Photo 9). Butterfly watching sites in all places of Hong Kong territory visited in other seasons does not show similar high ratio of *Ideopsis similis*. Whether there be a tendency of this butterfly moving to and gathering in Deep Water Bay river valley in winter is not known. More frequent visits to Deep Bay Valley in 2008-09 revealed that *Ideopsis similis* starts aggregating late (around mid-December) in comparing with *Euploea* spp. in Siu Lang Shui (around mid-November). In this



winter, only small amount of *Euploea* spp. appeared in Deep Water Bay river valley, but the number of *I. similis* remain fairly constant (~300) when compared with those in the previous years in the same site. No significant change in population size was observed in the weekly visits in the period of Jan. to early March. This suggests that the *I. similis* may have used Deep Water Bay river valley as an over-wintering site.

8. No strict site specification is found. *Euploea midamus*, *Euploea core*, *Ideopsis similis*, *Danaus genutia* and *Tirumala limniace* were recorded in almost all aggregation sites although in different ratio. Nevertheless, preference of the former 4 species on selecting pre-winter and winter aggregation sites is clear and consistent over the years. A significant larger proportion of *Danaus genutis* chooses to aggregate in sites of Lantau Island except in Shek Pik. A significant larger proportion of *Ideopsis similis* chooses to aggregate in Deep Water Bay river valley of Hong Kong Island. A significant larger proportion of *Euploea midamus* and *Euploea core* chooses to aggregate in Siu Lang Shui of the New Territories. Is it a reflection of the

uneven local distribution of the 4 species and they simply choose a proximate site? Or it reflects that they are migrating on different routes and stop at different sites? Study by Wong *et al.* indicates that among the 189 marked individuals, a male *E. midamus* and a male *E. core*, both marked on Nov. 7, 2002 at Shing Mun Country Park, were recaptured in Siu Lang Shui on Dec 6 and Dec 12, 2002 respectively. The study shows that a south western movement of the aggregating butterflies among different sites did occur. Does this apply to all other sites and all other involved danaine butterflies are yet to be studied.

Activities in the winter aggregation site

Mortality

It is generally agreed that larvae of the Danainae derive toxic cardiac glycosides, often referred to as cardenolides, from their larval food plants. Cardenolides are toxic to vertebrates. Among the 12 known local larval food plants (Table 3), 11 species belong to the family Asclepiadaceae 蘿藦科 and family Apocynaceae 夾竹桃科. Members of both families are generally believed to contain toxins (Tsiang & Li, 1977. Written in Chinese). One host plant species, *Ficus microcarpa*, fed by *Euploea core*, belongs to the plant family

Moraceae. Moraceae is generally not regarded as toxic plants. However, the cytotoxin, Phenanthroindolizidine alkaloids had already been isolated from *Ficus septica*. Whether *Ficus microcarpa* has similar substances is yet to be studied. It is reasonable to expect that predation by vertebrates such as birds and reptiles would not be an important factor causing mortality of danaines. Over tens of hours of on-site observation, only 2 incidents of a *Euploea midamus* being attacked were observed: the first was by a Chinese Bulbul, *Pycnonotus sinensis* 白頭鵲, in Feb. 2002; the second was by a Great Tit, *Parus major* 大山雀, in Dec. 2007. In both cases, the butterfly was released and no further attack by the same bird was observed.

A visit to Siu Lang Shui on Jan. 16, 1999 found that large amount of the danaine butterflies fell on the ground, almost motionless. Affected by a strong north easterly, the minimum temperature recorded in Hong Kong Observatory Station dropped to about 10°C on Jan. 12, until Jan. 17. A measurement on Jan. 16 in Siu Lang Shui showed that the air temperature was 7°C at 11 am. Moreover, as there was trace amount of rainfall, a large portion of the butterflies on the ground had their wings adhered to the wet surface. Many butterflies on the ground had their abdomen been freshly removed, cause unknown. It was estimated that about half of the population dropped onto the ground. Another significant event of mortality occurred in late Dec. 2004, in Siu Lang Shui (Photo 10). The estimated number of individuals on Dec. 27, 2004 was 15,000. A visit on Jan 1, 2005 revealed that only 3,000 were still alive, thousands of dead bodies were found on the ground. According to the weather information records of Hong Kong Observatory, the minimum temperature dropped sharply from 13.8°C on Dec. 27 to 8.0°C on Dec. 28 (air temperature in Siu Lang Shui is usually a few degrees lower), low temperature lasts until Jan. 3, 2005. No rainfall was recorded during these days. Apparently, no matter there is rainfall or not, air temperature below 10°C could be fatal to the danaine butterflies, or at least to the *Euploea* spp.. This is probably the most obvious ecological reason for southern migration of the danaines in the winter. Similar results were shown in the study by Wang & Emmel (1990). They reported that the air temperature in the winter aggregation sites normally remains above 10°C, and if an extraordinary strong cold front arrives and causes the temperature drop below 4°C, disastrous losses occur in the colonies.

Such high proportion of mortality has not been recorded in Deep Water Bay river valley on Hong Kong Island. Whether it could be attributed to the more natural and sheltered physical environment in Deep Water Bay river valley is yet to be studied.



Feeding behaviour

Scheffera heptaphylla, being one of the few widely distributed plants blossoming in December, becomes exceptionally attractive to all nectar-feeding insects. When weather is fine, danaine butterflies can always be found collecting nectar on the *Scheffera heptaphylla* inflorescence (Photo 11). Other nectar plants attracting the danaine butterflies in winter are *Bidens alba* (Photo 12), *Mikania micrantha* (Photo 13), *Asclepias curassavica* and *Eucalyptus torelliana* (Photo 14). Both males and females could be found on the flowers, this behaviour is probably not sex linked. In pre-winter aggregation site as Fan Lau and Shui Hau, most of the danaine butterflies present were seen visiting the nectar plants in warmer days. In wintering aggregation sites, however, only a small portion of the aggregating population could be seen visiting the flowers for nectar, no matter how fine is the weather conditions. It is doubtful that the presence of certain amount of nectar plants is essential to the formation of a winter aggregation site.

When it is warm and bright, certain amount of danaine butterflies could be found sucking water on wet soil or on wet rock surfaces near the streams (Photo 15, Photo 16), this behaviour is common in most butterfly families and is commonly called mud-puddling. It is generally agreed that the purpose is to collect sodium ion from the water (Arms, Feeny & Lederhouse 1974, Beck, Mühlenberg & Fiedler 1999, Boggs & Dau 2004). This behaviour is often restricted to male butterflies. Launer *et al.* (1993) reported that considerable number of female *Euphydryas editha bayensis* (Nymphalinae) were also seen drawing moisture from mud, sand and gravel, along a seasonal creek in California. Although mud-puddling behaviour was observed a number of times in Fan Lau, Shek Pik, Deep Water Bay river valley and Siu Lang Shui, it had not been studied in detail. As most *Euploea* spp. close their wings during mud-puddling, it is not possible to distinguish the sex of individual butterflies. By reviewing limited amount of *Euploea* spp. with wings open during mud-puddling as well as limited amount of *T. limniace* from tens of photo records, it seems that most were male but not exclusive, few individuals of female were also found. It should also be emphasize that only a small portion (usually no more than 1,000) of the aggregating butterflies flied to water each times. How important of a water source in a winter aggregation site is yet to be studied.



Photo 11 *E. midamus* on *Scheffera heptaphylla*



Photo 12 *Euploea* spp. on *Bidens alba*



Photo 13 *D. genutia* on *Mikania micrantha*



Photo 14 Various danaines on *Eucalyptus torelliana*



Photo 15 *Euploea* spp. mud-puddling on wet concrete surface



Photo 16 *Euploea midamus* mud-puddling on wet soil

Reproductive activities

The over-wintering monarch butterflies in North American remain reproductive inactive during the over-wintering period (Urquhart 1960, Brower 1977). This is also called reproductive diapause. Reproductive diapause is characterized by depressed growth of reproductive organs (Herman, 1981) and much prolonged adult longevity (Herman & Tater, 2001). It is also found to be regulated by juvenile hormone (Herman & Tater, 2001). Studies of the over-wintering *Euploea* spp. in Taiwan by Lee & Wang (1997) shows that mating behaviour could be seen even in early stage and became more frequent towards the end of the over-wintering period. In the contrary, no mating behaviour had been observed earlier than mid-February in the winter aggregation sites of Hong Kong. Courtship behaviour as patrolling flights and extruding hair pencils in the air have not been seen in December and January, and only begin to appear around mid-February. Frequency of mating activity increases towards late February. It is not clear what proportion of the over-wintering population mate in the aggregation site before they left. In 1999 and 2001, aggregating danaine butterflies stayed in Siu Lang Shui until late February. The larval host plants near the site were thoroughly checked, but neither eggs nor larvae were found. In 2009, a portion of the aggregating danaine butterflies stay in Deep Water Bay river valley until early March, larval host plants were also thoroughly searched, neither eggs nor larvae were found. The over-wintering population may have probably moved to somewhere else to find their larval host plants. Among the members of winter aggregating danaine butterflies, only *Parantica aglea* has its eggs and larvae been found in December and January. This indicates that *Parantica aglea* probably keeps breeding locally in winter. Earliest records of immature stages of other members of the family in the year is in late March and early April. It should be noticed that *Danaus chrysippus* is also breeding locally in winter. It is recorded in Shui Hau, but not other winter aggregation sites is simply because the presence of large amount of its larval host plant - *Asclepias curassavica*, in Shui Hau.

Form of aggregation

It is quite obvious that the winter aggregating danaine butterflies have an inclination to form aggregates of the same species, so long as they have enough number of individuals to form aggregate. This is true to all recorded species. This may be a result of differentiation of aggregation pheromones chemistry between different species. However, the phenomenon is not exclusive. For very large aggregates containing thousands of individuals, usually 3-6 different species can be found

(Photo 17, Photo 18). For species with very small population size, they would choose to joint aggregates formed by other species, rather than staying along. How does a particular species find the aggregates formed by different species? Does it imply the aggregation pheromones of a particular species also has effect to different species?



Photo 17 Mixed species on *Garcinia oblongifolia*
Deep Water Bay river valley



Photo 18 Mixed species on *Eucalyptus storelliana*
Siu Lang Shui

Another interesting phenomenon is that several mimic of the *Euploea* spp. - *Hypolimnas bolina*, both male and female, has been recorded every years in Siu Lang Shui and Deep Water Bay river valley. They sometimes even joint the *Euploea* spp. aggregates.

The butterflies tend to form aggregates on leaves and small branches. Most exposed and highest positions of the woodland are avoided. They also stay away from vegetation too close to the ground. The aggregating butterflies may hold the upper or lower surface of the leaves, or the leaf stalks. In warmer afternoon with sunlight, butterflies show strong preference to stay on surfaces facing the sun, no matter they are leaves, tree trunks or rocks.

Activity of the butterflies are highly affected by air temperature. In general, when the temperature is above 16°C, the butterflies are very responsive to any disturbance and will quickly dismiss and fly away from



Photo 19 A sparse aggregate on *Acacia confusa*

the aggregate. Aggregates are also small and sparse (Photo 19). Between 10°C to 16°C, although they are responsive but are more reluctant to fly. They only fly away under stronger disturbance and quickly form new aggregate again. When temperature drops below 10°C, butterflies are immobile, cannot fly even touched. The aggregates become larger and may consist of more than 5,000 individuals. The aggregates are also formed at lower positions, either on shrubs, small trees, lower side branches of large trees, or on tree trunks. When the temperature drops below 7°C, a significant portion of the butterflies become incapable to hold firmly and drop onto the ground.

Selection of plant species for aggregation

Winter aggregation have been recorded on various large trees, small trees, shrubs, bamboos and vines including: *Acacia confusa* 台灣相思、*Acacia auriculiformis* 耳果相思、*Eucalyptus torelliana* 毛葉桉、*Lophostemon confertus* 紅膠木、*Ficus microcarpa* 細葉榕、*Neolitsea* sp. 新木薑子、*Litsea glutinosa* 潺槁樹、*Mallotus paniculatus* 白楸、*Sterculia lanceolata* 假蘋婆、*Garcinia oblongifolia* 黃牙果、*Dimocarpus longan* 龍眼、*Litchi chinensis* 荔枝、*Schefflera heptaphylla* 鴨腳木、*Bridelia tomentosa* 逼迫仔、*Cerbera manghas* 海芒果、*Microcos paniculata* 布渣葉、*Psychotria asiatica* 九節、*Zanthoxylum avicennae* 筲欖、*Paliurus ramosissimus* 馬甲子、*Aporosa dioica* 銀柴、*Bambusa* sp. 竹、*Arundinaria* sp. 托竹、*Byttneria aspera* 刺果藤、*Toxocarpus wightianus* 弓果藤 and *Lygodium* sp. 海金沙。No strong preference on any specific plant(s) can be seen.

It is the availability, position and general form of the plants which determine the choice of danaine aggregates. In general, most available plants are chosen so long as the plant is located at sheltered positions, has dense foliage and the leaf size of which is not too small. Sometimes, dead twigs and bare rock surfaces were also chosen (Photo 20). In Siu Lang Shui, *Leucaena leucocephala* 銀合歡 and *Casuarina equisetifolia* 木麻黃 are quite abundant, but they have never been chosen for aggregation. Their foliage units are both exceptionally small, thin and sparse. It should also be noticed that the *Eucalyptus torelliana* in Siu Lang Shui are becoming less attractive to the danaines. In the past 3 years, most winter aggregating danaines in Siu Lang Shui chose to stay on the *Acacia confusa* instead. This may be attributable to the fact that the *Eucalyptus torelliana* (an introduced plant from Australia) is growing exceptionally fast. Most of the *Eucalyptus torelliana* in Siu Lang Shui are now 20-25 meters high and the canopy becomes more exposed to the wind. At the same time, lower side branches of *Eucalyptus torelliana* are becoming more limited for the butterflies to stay on.



Photo 20 *Ideopsis similis* on dead twig and rock surface

Origin of the winter aggregating danaine butterflies

Euploea midamus and *Euploea core*, being the largest component of the overall pre-winter aggregates and winter aggregates, are more worth discussing. Although they are both classified as "very common" locally. Whether we have a comparable local population size in spring/summer is doubtful. Highest records in Siu Lang Shui were around 40,000 individuals of danaine butterflies. Total area of Hong Kong is approximately 1,000 square kilometers. It means in average there should be 40 individuals of *E. midamus* / *E. core* in 1 square kilometer of land. This is apparently not consistent with the general observations in the field during spring and summer. Would some of the *E. midamus* and/or *E. core* originate from places outside Hong Kong? According to C. L. Chan (詹家龍) (2008. Written in Chinese), since 2000, there have been several cases of *Parantica sita* marked in Taiwan being recaptured in Japan and *Parantica sita* marked in Japan being recaptured in Taiwan. The longest travelling distance recorded was 2,035 Kilometers. Sin (2007) (申慧媛) reported a case of travelling 1,500 kilometers in 16 days, which means the travelling speed is about 100 kilometers per day. After years of extensive capture-mark-recapture experiment done in Taiwan, Chan (2008) reported that the longest

recorded travelling distance of *Euploea sylvester* is 255 km, that of *Euploea eunice* is 291 km, that of *Euploea mulciber* is 299 km, that of *Euploea tulliolus* is 125 km. 299 km north east to Hong Kong is the boundary between Guangdong and Fujian and 299 Km north to Hong Kong is the boundary between Guangdong and Hunan. Aston (1999) stated that “Numbers of *Euploea* are regularly seen flying across Mirs Bay” and reported a record on Nov 1998 that over 150 *Euploea* congregated outside the border fence at Mai Po and trying to move in a southerly direction. On Nov. 6, 2005, a stream of danaine butterflies was seen crossing a peak (702 m above sea level) of Tai Mo Shan situated in the central New Territories, and moving steadily to south west at the level of about 2 m above the ground surface. They were mainly *E. midamus*, some *E. core* and *T. limniace*, and a few *D. genutia*. The speed was accessed by measuring the numbers of seconds taken (by a stop watch) to travel across a distance of 10 meters. Measured speed of travelling was approximately 3m/s (~11km/h). Use this speed, it only takes about 3.5 hours to travel from the north border to the south border of Hong Kong. Suppose the butterflies fly 5 hours a day, it only takes 6 days to travel from Fujian to Hong Kong. Not to mention the speed of flying could be significantly accelerated by strong north easterlies occasionally blowing in that season. Although not proved yet, it is highly possible that *E. midamus* and *E. core* do have the ability to travel from other area of the Guangdong province or even from other provinces to Hong Kong. According to Chou (1999), there is only one sub-species namely *Euploea midamus midamus* known in China and it is only recorded in the 6 provinces located at the south China - Zhejiang, Fujian, Guangdong (including Hong Kong), Guangxi, Yunan and Hainan. It is also recorded in vietnam and Thailand. The sub-species *Euploea core amymone* of Hong Kong is only known in Guangdong (including Hong Kong), Guangxi and Hainan. Aggregation of *Euploea midamus* at Kinmen Island (an Island 10 km east to Xiamen) in October (private conversation with C. L. Chan), tens of thousands of various danaines on Hebao Island in late December and January, *Euploea* spp. at Hainan in February (private conversation with C. L. Chan) have been noticed. It is not difficult to imagine a large scale annual autumn/winter migration of at least some *Euploea* spp. all the way from Zhejiang, Fujian, Guangdong, to Hainan for over-wintering, and Hong Kong is one of the transitional stop of this large scale and long distance migration. (Map 2)

However. Kitching & Zalucki (1981) studied the over-wintering population of *Euploea core corinna* in Australia, and suggested that the butterfly is not migratory. The over-wintering aggregation represent contractions in its distribution in response to unfavourable seasonal conditions and not the end-points of some regular directional mass movement. To what extent is this applicable to different species of danaine butterflies in Hong Kong, needs further studies.

Conclusion

Studying the winter aggregation of danaine butterflies in Hong Kong is indeed inducing more questions rather than providing answers. We do not know the origin of the winter aggregates. We do not know the destination of the winter aggregates. We do not know the routes(s) of travelling. We do not know the mechanism of aggregation and dismissal. We do not know how do they re-colonize their breeding sites after winter. We do not know the correlation of the weather conditions with the migration and cannot predict the effect of global warming to it.

This study only represents a beginning in this field of study in Hong Kong and probably only represents the tip of the iceberg. There may be a large scale annual migration of danaine butterflies in South China. Experience in North American and Taiwan tells us that the most direct method to find out the timing and routes of the migration is through years of large scale mark-release-recapture work. With the rapid advancements in genetics and chemical ecology, the issue could be studied by very different approaches.

Map 2 Possible winter migration routes of *E. midamus* & *E. core* in south China



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