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Cover photograph: Fight between rival *Tachypompilus analis* females; see p.3 (photo by Christophe Barthélémy).
Design and layout: Graham Reels and Christophe Barthélémy

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Preliminary description of the predatory and nesting behaviour of *Tachypompilus analis* (Pompilidae: Pompilinae) in Hong Kong, China.

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Abstract

Field observations of the hunting and nesting behaviour of *Tachypompilus analis* (Fabricius, 1781) (Pompilinae: Pompilini) were carried out by the author in the vicinity of his house in Hong Kong over several years. Behaviour on one particular nesting niche is described as well as the capture of a rare prey species.

It was noted that although the species is known to excavate shallow depressions in soil as nesting sites, *T. analis* also chooses pre-existing cavities in masonry. Additionally, *T. analis* was observed to prey upon a web-fabricating spider (Agelenidae or Amaurobiidae), a clear departure from the usual wandering type preyed upon by the genus. This choice affects the normal hunting sequences possessed by the genus. From fragmentary observations I suggest that *T.analis* may have some level of behavioural plasticity, probably providing a net gain in parental investment.

Key words: *Tachypompilus analis*; Pompilinae, Heteropodidae, Spassaridae, Lycosidae, Amaurobiidae, nesting sites.

Introduction

The Spider wasp *Tachypompilus analis* is a common representative of the Pompilidae (spider wasps) locally. This paper reports on the prey usage and hunting techniques of this pompilid, based on observations made by the author, over several years in his garden at Pak Sha O, Sai Kung, South East New Territories.

The Pompilidae is a cosmopolitan family comprising over 5,000 species in more than 230 genera worldwide (Pitts et al. 2005). All members are predatory, with the greater diversity occurring in the tropics. The family inner relationships have long been debated and several classifications have been proposed since the beginning of the 20th century. The latest cladistic analysis proposed by Pitts et al. (2005) recognises four subfamilies: Ceropalinae, Pepsinae, Ctenocerinae and Pompilinae. Pepsinae and Pompilinae make up the vast majority of the species in the family, with well over 2,000 species each. There have been only fragmentary and regional revisions of members of this family and considerable generic synonymy remains a problem (Pitts, 2005).

All members of the family prey upon spiders for larval food and invariably store the nest with one single paralysed prey item. There are only fragmentary records on the biology of members of the subfamily Pompilinae, but in all cases there seems to be a great variability of prey choice, with some species restricting themselves to a few members in one family, while others may use a wide range of prey in various families (Evans, 1953; Iwata, 1976; Wasbauer & Kimsey, 1985; O'Neill 2001; Pitts, 2005). Members of the genus *Tachypompilus* (Ashmead, 1902) are reported to be specialist predators of Lycosidae (wolf spiders) and the related families Pisauridae (fishing spiders) and Agelenidae (funnel web spiders) in the USA (Evans, 1953, Evans & Yoshimoto, 1962; Kurczewski & Kurczewski, 1968, 1973; Kurczewski, 1981, 1999; Wasbauer & Kimsey, 1985), although some also prey upon Heteropodidae (Huntsman Spiders) (Nakao & Iwata, 1964; Martins, 1991; O'Neill, 2001), and this is clearly a prey of choice for *T. analis* in Hong Kong.

Members of these spider families can be generally characterised as wanderers, without a permanent home, although most Agelenidae construct burrows with a silken finish. I report here on the observation in the field of the capture of a probable member of the Agelenidae or Amaurobiidae (lace-webbed spiders), families that build complex tangled webs terminating in a cavity where the spider lays in wait – necessitating a hunting strategy clearly in departure from that applied when hunting the normal wandering type of spiders. I also report on the intra-specific theft of prey.

Nesting habits of the Pompilidae range from leaving the prey *in-situ* after oviposition (ectoparasitoid), to dragging it into a pre-existing cavity before oviposition and, for the most "evolved", flying with dismembered prey and placing them in multi-cellular nests constructed wholly of foreign materials (mud) (Evans & West Eberhard, 1970; Iwata, 1976; O'Neill, 2001). Females of the genus *Tachypompilus* are known to drag paralysed prey backwards by the chelicerae or pedipalps to a dry spot, and excavate a shallow depression - by raking the soil with the front tarsi - into which the prey is deposited. An egg is laid on the abdomen of the prey and the depression is filled with the excavated soil and bits of debris, leaving no apparent traces of the nesting site (Evans & Yoshimoto, 1962; Wasbauer & Kimsey, 1985). I report here on the use of pre-existing cavities/crevices that the wasp may re-arrange as nesting sites.

Aculeate wasps are commonly compared to one another by using parental behavioural traits arranged on a increasing scale of behavioural complexity, culminating with the

eusocial species (Table 1)), a model thought to represent the trend of evolution in wasps. Pompilids have been placed on the lower levels of this scale (Level 1, 2, 3, 4a & 4b of Table 1), because no representatives are known to have departed from the habit of provisioning one prey per egg and many construct a nest after prey capture, both characteristics thought to preclude gradual provisioning seen as necessary step towards brood care and social interactions (Evans, 1953; Evans & West Eberhard, 1970; O'Neill, 2001). Additionally, only a few species are known to nest gregariously (Evans & West Eberhard, 1970) or to have generational overlap on the same nesting site (O'Neill, 2001; Barthélémy and Pitts, in preparation), none of which are in the subfamily Pompilinae.

There are relatively few species of *Tachypompilus* worldwide but they are widely distributed, occurring in the Ethiopian, Oriental, Nearctic and Neotropical regions. *Tachypompilus analis* is the only reported species in the genus locally. It is widespread from the Nansei islands in Japan to Taiwan, the Philippines, Hawaii, South-East Asia and South Asia. It is a medium large wasp, wholly black save for the last four metasomal segments (in females; last five in males) which are bright orange/red. Locally, females measure 16-21mm, while males are markedly smaller measuring approximately 11mm. These dimensions seem to be larger for females than those measured in Taiwan by Tsuneki (1989), where it was found that females measured 13-15 mm, while in the Philippines female specimens were even smaller at 12-14mm. Female individuals from the Nansei Islands (Japan) range from 15 to 20mm (Yamane et al,1999).

Adults are known to feed on floral secretions and may also feed on the haemolymph oozing from the sting wound of the prey. Larvae are fed locally with at least three species of spiders in three distinct families:

- Sparassidae; *Olios* sp. (Figure1)
- Heteropodidae; Undetermined sp.1. (Fig.2).
- Agelenidae or Amaurobiidae; Undetermined sp. 2.

Additionally, in Japan the species is reported to prey on *Heteropoda venatoria* Linnaeus (Heteropodidae) (Nakao and Iwata, 1964), a species that also occurs in Hong Kong (Hills, 1981).

The Pompilids *Xanthampulex* sp. and *Irenangelus luzonensis* (Rohwer) (Ceropalinae) are reported to be cleptoparasites of *T. analis* (Williams, 1919; O'Neill, 2001). Tachinid flies are noted to attack the paralysed spider and consume it (Williams, 1919), and it may be possible that the spider wasp's prey also is consumed by scuttle flies (Phoridae) or satellite flies (Anthomyiidae).

Materials & Methods

Casual observations of the wasps were made over several years in various spots around the author's house and garden, Pak Sha O, Sai Kung Country Park, Hong Kong (UTM: 50Q KK 242 849, 70m asl). One niche has been used consistently over the years and is situated in the crevices of a north-facing stone wall behind a rain-water drainpipe, access to which is approximately 120cm off the ground. The actual nesting site was hidden from view. Observations at this site are summarised below.

On 12 May 2008, at around 15:00h, I witnessed in a disused "greenhouse" in my garden the attack and capture of a spider, nest construction and closure over a period of approximately one hour; events also described below.

Prey transportation was documented photographically in many instances and some examples presented in the Plate section.

The activity period of the *T. analis* was monitored by a resident Malaise trap, set between 2001 and 2009 in the authors garden along with casual sightings.

Observations

A busy niche behind a rain- water drainpipe

Over the past years this site has been occupied by successive generations of *T. analis*, from spring well into autumn, the wasps seemingly able to find various prey (Sparassidae and Heteropodidae) in the close vicinity. Invariably the wasps were seen walking backwards while dragging the prey by the pedipalps, and when they reached a point close to the foot of the wall near the drainpipe they would let go of the prey, walk around with much antennation, inspect the prey and often fly off, to check the nesting site and fly back shortly after. The wasps would grab the paralysed spider by the pedipalps and start the vertical climb to the nesting site.

The ascension was never an easy affair and the trajectory was oblique, sinuous and somewhat indirect. On occasion (in fact relatively often) the wasps would accidentally drop the load, obliging them to start the climb all over again. They were all extremely persistent and prey were never abandoned.

When the wasp left her prey for nest inspection, the abandoned item sometimes attracted other *T. analis* dwelling in the vicinity who would attempt to steal it, presumably for their own use, as observed on 2 July 2006. However, on that day the rightful owner came back before the theft was consumed, found its prey and the thief and engaged her in a violent fight where much biting and apparently stinging attempts occurred (Fig.3). The original owner was able to repel the other wasp and both individuals seemed to be unscathed by the fight. The winner groomed and resumed dragging the prey to the nest shortly afterwards.

At regular intervals during the season this nesting site becomes the scene of frantic activity when numerous males are seen patrolling the close vicinity of the niche, presumably to attempt mating with newly emerged females. However (and unfortunately), no mating was ever observed.

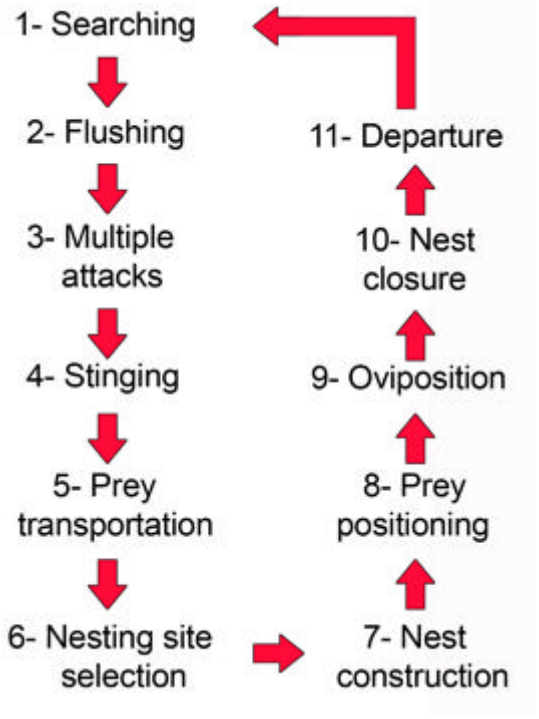
An unusual prey

A disused greenhouse was the site of a prolonged observation of prey capture, nest construction and closure. The soil was a dry mix of sand, clay and organic matter (disused vegetable patch). I was originally looking at the complex web that a spider had extended from the hollow end of a horizontal structural bamboo segment approximately 2 cm in diameter and 100cm off the ground. Numerous strands of silk had been spun from the bamboo to various elements of the greenhouse, forming an extremely tangled structure more or less conical extending horizontally for approximately 30cm and about 20cm at its maximum diameter. The webbing close to the bamboo was denser and formed a sheath or a funnel that extended into the hollow segment. The spider was laying in wait at the entrance of the bamboo cavity. From the architecture of this web I have tentatively identified the spider as belonging to either the Agelenidae or Amaurobiidae.

A *T. analis* wasp was seen shortly before landing on the web close to the entrance funnel. The flight seemed direct and the strands of silk did not stop the wasp. Upon landing she immediately penetrated the cavity without hesitation. This caused the spider to be flushed out with the wasp in pursuit. A small fight ensued, but the spider was faster on its web and managed to elude the wasp, and came to a halt on a strand of its web, while the wasp flew off. However, the wasp did not give up and circled the web again attacking the spider as soon as spotted, which prompted the spider to change position. It was obvious that the tangles of silk strands hindered the access to the spider, which managed to evade seven or eight attacks. However, under the constant harassment of the wasp, the spider eventually committed the fatal mistake of dropping to the ground, where she was immediately followed by the wasp. There, a very short pursuit ensued which resulted in the prompt paralysis of the spider. Unfortunately the sting location was not established. The spider was not much larger than the wasp.

As could be expected, the wasp used her mandibles to seize the spider by the pedipalps and drag it, walking backward for approximately 60cm, before dropping the prey. The wasp inspected a small patch of ground of approximately 40cm x 20cm, settling for one spot where she started to dig a cavity. However, she soon abandoned that position to begin at a new location, and in total, four sites were investigated before finally choosing one of them. Buttressed on her hind legs, she raked the soil very rapidly with her front tarsi, ejecting fine material under her body up to 10cm from the working area. Coarser bits and large items were seized by the mandibles and carried away. After approximately 40mins of digging – creating a conical cavity of approx 3.5cm in diameter and 1.5cm deep – the wasp stopped and started to compact the bottom of the cavity with rapid motions of the abdominal tip, doing so for less than two minutes. She walked to her prey, seized it and dragged it into the cavity, depositing it venter down, legs folded. Adjustments to the cavity were made for about five minutes and she continued to dig around and underneath the prey on one side then on the other, displacing the arachnid by using her abdomen as a leaver, cautiously placing the spider in the right spot. Oviposition was made ventrally on the prey but I cannot ascertain its exact position or the moment it happened. Covering up the prey took about 15mins, using the previously ejected soil but also new material. Finally, the area was compacted with the abdominal tip and there was no visible trace of the nesting site.

This behavioural sequence can be summarised as follows:



Sequence 2 and 3 could be grouped together under “Multiple attacks” and behaviours may contain sub-sequences, such as “Deposit prey” in sequence 5 and“Compacting” in sequence 7 and 10.

All through this observation, I saw a small fly hovering or resting at the proximity of the working site. *Tachypompilus analis* aggressively gave chase to this apparently passive fly when spotted, but the intruder would always reappear.

Discussion

The selection of nesting sites by the females and the choice of prey seem worthy of discussion.

Nesting sites

Using the evolutionary scale (Table 1) and the published literature (O'Neill, 2001) the genus *Tachypompilus* (and, in particular, *T. analis*) would be placed in Stage 3 by building a shallow depression. However, as described in this paper it often uses pre-existing cavities (possibly slightly modified), which would also place the species in Stage 2. It appears that *T. analis* may have a certain level of behavioural plasticity in its nesting patterns, excluding it from a clear classification on this evolutionary scale. The opportunistic use of variable nesting sites may in fact represent a net advantage in terms of parental investment and in this case offers more time to prepare more cells, increasing reproductive success although it has to be noted that the choice of an elevated nesting site rendered transportation difficult and on many occasions the prey was dropped, the wasp spending extra time and effort to deposit the item in the nest.

The descriptions by Williams (1919) and Iwata (1939) of the nesting behaviour of *T. analis* match the description above. Iwata (1939) also noted that the wasp would use both dry soil and crevices in walls. On the other hand, detailed descriptions of the nesting behaviour in the genus *Tachypompilus* by Strandtmann (1953) and Martins (1991) for *T.ferrugineus burrus* (Cresson) and *T. xanthopterus* Rohwer respectively – both New World species – show substantial differences. In both cases, the spider was placed venter up in the cavity and the wasp would manoeuvre herself underneath the prey to oviposit on the dorsal side, behaviour that is greatly different to what is described here, although other elements of behaviour such as carriage (5), site selection (6), cell construction (7) and cell closure (10) were essentially the same.

Prey

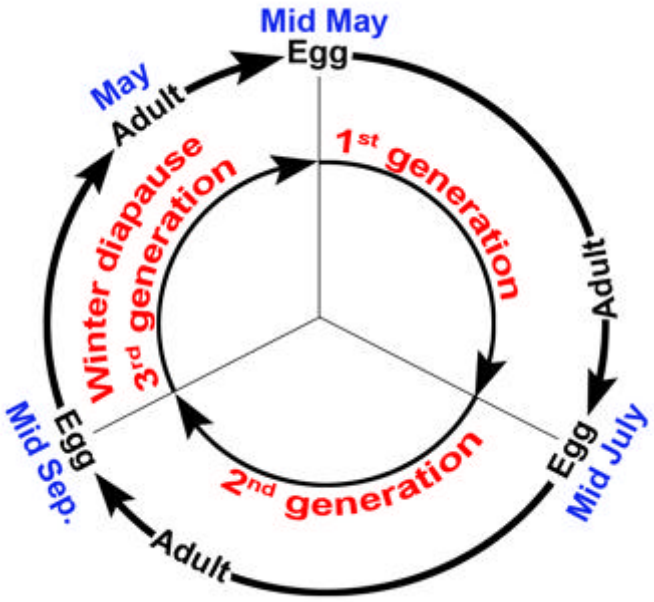
In the same way, prey choice in *T. analis* may show a level of flexibility that adapts it to various niches. Indeed, according to the literature the genus uses wandering spiders and is even considered a specialist hunter (Evans, 1953; Evans & Yoshimoto, 1962; Kurczewski & Kurczewski, 1968, 1973; Kurczewski, 1981, 1999; Wasbauer & Kimsey, 1985). The observation reported here of the predation on a web fabricating spider clearly departs from the known hunting habits, the wasp performing a particular initial set of behaviours ("1.search-2.flushing-3.multiple attacks-4.stinging") in conditions vastly different from those on the ground, a sequence that is more complex than the normal pattern of "1.search-2.pursuit-3.stinging" applied when hunting wandering spiders (Heteropodidae, Spassaridae, Lycosidae and Pisauridae).

Other members of the Pompilinae such as *Sericopompilus apicalis* (Say) or *Anoplius "marginatus"* (Say) are known to be predisposed to some level of variability in prey choice and hunting techniques (Kurczewski & Kurczewski, 1973; Kurczewski, 1981), but none have been described as "specialists". The possible plasticity of the hunting behavioural patterns may be the result of an adaptation to prey availability, although none of the normal prey are rare in the study area.

Voltinism

Assuming a development stage (from egg to adult) of approximately 45 days, we can infer that the species is at least bivoltine in Hong Kong and likely has three generations per year with the last one overwintering either as a diapausing larva, or a pupa. Additionally, it is very unlikely that any adult female would survive more than two months, meaning the active females sighted between July and October were not 1st generation individuals.

The activity period can be expressed by the following diagram:



Conclusion

While it is commonly accepted that complex behaviours evolve from simpler ones and are somewhat more adaptive, the example of *T. analis* perhaps shows that simple behaviours could also evolve from complex behaviours, depending on the situation. Could it be that our model of behavioural evolution remains an oversimplification of what evolution really is and that perhaps eusociality does not represent the most adaptive solution or the ultimate goal of evolution in wasps? However, the apparent plasticity of behavioural patterns in *T. analis* and in the genus generally may offer a rewarding research topic, to fully understand if these modifications are inherited behavioural traits or the result of experience. Further ethological studies in the sub-family/tribe and genus will be required in order to obtain sufficient series from which patterns can be extracted with confidence.

Acknowledgments

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References

Barthelemy, C and Pitts, J. In prep. Observations on the nesting behavior of two pepsine spider wasps (Hymenoptera: Pompilidae) in Hong Kong, China: *Macromerella honesta* (Smith) and an *Auplopus* species.

Evans, H.E., 1953. Comparative Ethology and the Systematics of Spider Wasps. *Systematic Zoology* 2(4): 155-172.

Evans, H.E. and Eberhard, M.J.W., 1970. *The Wasps*. The University of Michigan Press. Ann Arbor. 265pp.

Evans, H.E. and Yoshimoto, C.M., 1962. The Ecology and Nesting Behavior of the Pompilidae (Hymenoptera) of the Norteastern United States. *Miscellaneous Publications of the Entomological Society of America*, 3: 66-119.

Hill, D.S. and Phillipps, K., 1981. *Hong Kong Animals*. Government Printer, Hong Kong. 281pp.

Iwata, K., 1939. Habits of some solitary wasps in Formosa III. *Transactions of the Natural History Society of Formosa*, 29:119-128. [In Japanese].

Iwata, K., 1976. *Evolution of Instinct. Comparative Ethology of Hymenoptera* (translated from Japanese). Smithsonian Institution and the National Science Foundation, Washington, DC. 535pp.

Kurczewski, F.E., 1981. Observations on the Nesting Behaviors of Spider-Wasps in Southern Florida (Hymenoptera: Pompilidae). *The Florida Entomologist*, 64(3): 424-437.

Kurczewski, F.E., 1999. Comparison of Spider Wasp Faunas from Two Ecologically Distinct Sites in Erie County, Pennsylvania (Hymenoptera: Pompilidae). *Journal of the Kansas Entomological Society*, 72(4): 339-360.

Kurczewski, F.E., and Kurczewski, E.J. 1968. Host Records for Some North American Pompilidae (Hymenoptera) with a Discussion of Factors Influencing Prey Selection. *Journal of the Kansas Entomological Society*, 41(1): 1-33.

Kurczewski, F.E., and Kurczewski, E.J. 1973. Host Records for Some North American Pompilidae (Hymenoptera). Third Supplement. Tribe Pompilini. *Journal of the Kansas Entomological Society*, 46(1): 65-81.

Martins, R.P., 1991. Nesting Behavior of *Poecilopompilus algidus fervidus* and *Tachypompilus xanthopterus* (Hymenoptera: Pompilidae). *Journal of the Kansas Entomological Society*, 64(2): 231-236.

Nakao, S. and Iwata, K., 1964. Notes on the provisioning habits of some solitary hunting wasps of Southeast Asia (Hymenoptera, Aculeata) (In Japanese). *Kontyu*, 32(4): 504-511.

Pitts, J; Wasbauer, M.S. and von Dohlen, C.D., 2005. Preliminary morphological analysis of relationships between the spider wasp subfamilies (Hymenoptera: Pompilidae): revisiting an old problem. *Zoologica Scripta* 35(1): 63-84.

O'Neill, K.M., 2001. *Solitary wasps, behaviour and natural history*. Comstock Publishing Associates. Cornell University Press. 406pp.

Strandtmann, R.W., 1953. Notes on the Nesting Habits of Some Digger Wasps. *Journal of the Kansas Entomological Society*, 26(2): 45-52.

Tsuneki, K., 1989. A study on the Pompilidae of Taiwan. *The Japan Hymenopterist Association* 35.

Wasbauer, M.S and Kimsey, L.S., 1985. California Spider Wasps of the Subfamily Pompilinae (Hymenoptera: Pompilidae). *Bulletin of the California Insect Survey* 26: 129pp.

Williams, F.X., 1919. Philippine wasp studies. *Bull. Hawaii Sugar Planters' Exp.Sta., Ent. Ser*. 14: 19-181.

Yamane, Se.; Ikudome, S. and Terayama, M., 1999. *Identification Guide to the Aculeata of the Nansei Islands, Japan*. Hokkaido University Press, Sapporo. 831pp.

Figure 1 (left). *T. analis* dragging a paralysed Sparassidae, *Olios* sp. (Photo author).

Figure 2 (below). *T. analis* dragging a paralysed Heteropodidae up a wall. (Photo author).

Figure 3 (below). A violent fight between two individuals of *T. analis*, the consequence of a prey theft attempt (Photo author).

Table 1. Sequences of parental behaviours in the solitary aculeate wasps. From O'Neill, 2001. Text in bold indicates the actual sequence of behaviours.

Stage	Provisioning Sequence	Occurrence
1	Parasitoid that leaves prey in situ: **Prey-egg**.	Ancestral condition of Aculeata, occurs in all Drynidae, all non-cleptoparasitic Chrysididae and Mutillidae, most Bethylidae, Thipiidae, Scoliidae and some Pompilidae and Sphecidae
2	Parasitoid that drags prey to a nearby niche that is sometimes modified: **Prey-niche-egg**.	Some Bethylidae, Tiphiidae, Scoliidae, Pompilidae and Sphecidae.
3	Single prey in a single-celled nest built *after* hunting: **Prey-nest-egg-nest closure**.	Most Pompilidae and a few Sphecidae.
4	Single prey in a nest built *before* hunting:	
4.A	Single-celled nest: **Nest-prey-egg-nest closure**.	Pompilidae, Sphecidae.
4.B	Multi-cellular nest: **Nest-prey-egg-cell-nest closure**.	Pompilidae
5	Mass provisioning:	
5.A	Single-celled nest: **Nest-prey-egg-more prey-nest closure**.	Sphecidae
5.B	Multi-cellular nest (egg laid on first prey): **Nest-(prey-egg-more prey-cell closure)-(multiple cells in same nest)-nest closure**.	Sphecidae
5.C	Multi-cellular nest (egg laid on last prey): **Nest-(many prey-egg-prey-cell closure)-(multiple cells in same nest)-nest closure**.	Common in Sphecidae and Crabronidae.
6	Progressive provisioning (egg laid after 1st prey brought in):	
6.A	Single-celled nest: **Nest-(prey-egg-more prey over several days)-nest closure**.	A few Sphecidae and Crabronidae
6.B	Multi-cellular nest: **Nest-(prey-egg-more prey over several days)-(multiple cells)-nest closure**.	Some Crabronidae, some Eumeninae
6.C	Several single-celled nests provisioned progressively at the same time.	Some Ammophilinae.
7	Mass or progressive provisioning (egg laid in empty cell before provisioning)	
7.A	Progressively provisioned single cell nest: **Nest-(egg-many prey over several days)-nest closure**.	A few Crabronidae
7.B	Mass-provisioned multi-cellular nest: **Nest-(egg-many prey [or pollen mass]-cell closure)-(multiple cells)-nest closure**.	Most Eumeninae, all Masarinae.
7.C	Progressively provisioned multi-cellular nest: **Nest-(egg-many prey over several days-cell closure)-(multiple cells)-nest closure**.	Some Eumeninae.

Contribution to the Dermestidae of Hong Kong (Coleoptera: Bostrichoidea)

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Abstract

A list of all known dermestid species from Hong Kong is provided. *Orphinus (Falsoorphinus) pseudoovalis* Háva, 2004 and *Evorinea indica* (Arrow, 1915) are recorded from Hong Kong for the first time.

Key words: Coleoptera, Dermestidae, Orphinus, faunistics, China, Hong Kong.

Introduction

The family Dermestidae is one of the best known beetle families and currently contains about 1,300 species and subspecies worldwide (Háva 2009). From Hong Kong, 15 species were previously known (Háva 2009). We report two additional species newly recorded, and provide notes below on other recently collected material. A synonymic list of all 17 species known from Hong Kong is also provided.

Members of the Dermestidae are oblong to broadly ovate beetles, almost always clothed in erect or decumbent hairs or scales. The larvae usually feed on dry material of animal origin. Adults of some genera feed on pollen or nectar, others on the larval food and yet others do not feed at all. The family includes several cosmopolitan pests of stored food and other products of animal origin like wool, leather and also collections of dried insects.

Methods

The majority of material was collected by Paul Aston on Lantau Island. Additional material collected by G.M de Rougemont and Jason F. Maté from other parts of Hong Kong is also included. Identifications of specimens were made by the two senior authors.

The following abbreviations refer to the collections where the examined material is deposited:

AHEC - private collection of Andreas Herrmann, Stade, Germany;
JHAC - private entomological laboratory and collection, Jiøí Háva, Prague-west, Czech Republic;
NMPC - Czech Republic, Prague, National Museum (Natural History).

We follow the systematics of Dermestidae proposed by Háva (2004) and Lawrence & Slipinski (2005).
The distribution of Dermestidae is taken from Háva (2007: 2009).

The species

Subfamily Trinodinae
Tribe Trinodini

***Evorinea indica* (Arrow, 1915)**
Material examined: China: Hong Kong, Wang Tong Village, Lantau Island, 2.viii.2009 leg. Paul Aston, 1 female (AHEC).

New species for Hong Kong.

Subfamily Attageninae
Tribe Attagenini

***Attagenus* (*Aethriostoma*) *undulatus* (Motschulsky, 1858)**
Material examined: China: Hong Kong, Mui Wo, Lantau Island, 2.x.2006 leg. Paul Aston, 1 female (AHEC).

Subfamily Megatominae
Tribe Megatomini

***Orphinus* (*Falsoorphinus*) *pseudoovalis* Háva, 2004**
Material examined: China: Hong Kong, on flowers (unidentified) mid-slopes of Sunset Peak, Lantau Island ca 500 m altitude. 27.xi.2009 leg. Paul Aston, 1 female (AHEC). Wang Tong Village, Mui Wo, Lantau Island, on "Turn in the Wind Tree" (*Mallotus paiculatus* Muell.). 26.iv.2008 leg. Paul Aston, 1 female (AHEC). Wang Tong Village, Mui Wo, Lantau Island, in flowers of "Elephant Ear Tree" (*Macaranga tanarius* Muell.) 26.iv.2009 leg. Paul Aston, 1 male (AHEC).

New species for Hong Kong.

***Orphinus* (*Orphinus*) *fulvipes* (Guérin-Méneville, 1838)**
Material examined: China: Hong Kong, Jardine's Lookout, 26.iv.2001, leg. J. F. Maté, 1 ex. (AHEC).

***Thaumaglossa herrmanni* Háva, 2003**
Material examined: China: Hong Kong, Wang Tong Village, Mui Wo, Lantau Island, in flowers of "Elephant Ear Tree" (*Macaranga tanarius* Muell.), 26.iv.2009 leg. Paul Aston, 1 male (AHEC). Jardine's Lookout, 26.iv.2001, leg. J. F. Maté, 1 male (holotype , NMPC).

***Thaumaglossa cf. herrmanni* Háva, 2003**

Material examined: China: Hong Kong, Wang Tong Village, Mui Wo, Lantau Island, 30.v.2009 leg. Paul Aston, 1 female (AHEC).

The female specimen is similar to *T. herrmanni*, but slightly differs in elytral coloration. A large series from the same locality will be needed for determination.

***Thaumaglossa rufocapillata* Redtenbacher, 1867**

Material examined: China: Hong Kong, on flowers (unidentified) mid slopes of Sunset Peak, Lantau Island ca 500m altitude, 6.vil.2009 leg. Paul Aston, 1 female (AHEC). Pui O Village, Lantau Island, 7.viiil.2009 leg. Paul Aston, 1 female (AHEC). Wang Tong Village, Mui Wo, Lantau Island, 16.ix.2009 leg. Paul Aston, 1 male (AHEC). On flowers (unidentified) mid-slopes of Sunset Peak, Lantau Island ca 500m altitude, 27.ix.2009 leg. Paul Aston, 1 male (AHEC). New..Territorrries. Kadoorie Agricultural Research Centre, flight interception trap, vi.1996, Rougemont leg., 1 male (JHAC).

Synonymic list of all known Dermestidae recorded from Hong Kong

Subfamily Dermestinae
Tribe Dermestini

Dermestes (*Dermestes*) *ater* DeGeer, 1774
Syn.: *Dermestes cadaverinus* Fabricius, 1775
Dermestes piceus Thunberg, 1781
Dermestes felinus Fabricius, 1787
Dermestes domesticus Germar, 1824
Dermestes cinereus Motschulsky, 1848
Dermestes hispidulus Montrouzier, 1860
Dermestes chinensis Motschulsky, 1866
Dermestes subcostatus Murray, 1867
Dermestes noxius Mulsant et Rey, 1867
Dermestes domesticus var. *subsulcatus* Ballion, 1878
Dermestes favarcqui Godard, 1883
Dermestes rufoapicalis Pic, 1951
Distribution: cosmopolitan species.

Dermestes (*Dermestes*) *lardarius* Linnaeus, 1758
Syn.: *Dermestes lardarius* var. *conjunctus* Reitter, 1887
Dermestes lardarius var. *proximus* Reitter, 1887
Dermestes luganensis Stierlin, 1902
Dermestes lardarius var. *atrobasalis* Pic, 1951
Distribution: cosmopolitan species.

Dermestes (*Dermestinus*) *carnivorus* Fabricius, 1775
Syn.: *Dermestes carniforus* (emend. by Goeze, 1777)
Dermestes versicolor Laporte, 1840
Dermestes mucoreus LeConte, 1854
Dermestes sobrinus LeConte, 1854
Dermestes muscoreus Reitter, 1881
Dermestes impressicollis Reitter, 1881
Dermestes carnivorus var. *doemmlingi* Meier, 1899
Dermestes unicolor Lepesme, 1950
Distribution: cosmopolitan species.

Dermestes (*Dermestinus*) *frischii* Kugelann, 1792
Syn.: *Dermestes vulpinus* Herbst in Jablonsky, 1792
Dermestes pollinctus Hope in Pettigrew, 1834
Dermestes frischii ab. *uniformis* Rey, 1889
Dermestes Frischii ssp. *Heyrovskyi* Obenberger, 1917
Dermestes frischii var. *rufimembris* Pic, 1951
Dermestes frischii var. *sternimaculatus* Marcu, 1957
Distribution: cosmopolitan species.

Dermestes (*Dermestinus*) *maculatus* DeGeer, 1774
Syn.: *Dermestes marginatus* Thunberg, 1781
Dermestes vulpinus Fabricius, 1781
Dermestes australis Dejean, 1821 (nn)
Dermestes senex Germar, 1824
Dermestes lateralis Sturm, 1826 (nn)
Dermestes senegalensis Christofori et Jan, 1832 (nn)
Dermestes lupinus Christofori et Jan, 1832 (nn)
Dermestes elongatus Hope in Pettigrew, 1834
Dermestes roei Hope in Pettigrew, 1834
Dermestes lupinus Mannerheim, 1843
Dermestes semistriatus Boheman, 1851 (pars)
Dermestes cinereus Redtenbacher, 1867
Dermestes vulpinus var. *rattulus* Mulsant et Rey, 1867
Dermestes vulpinus var. *sudanicus* Gredler, 1878
Dermestes truncatus Casey, 1916
Dermestes maculatus var. *kurseongensis* Lepesme, 1939
Dermestes maculatus var. *cyprius* Pic, 1951
Dermestes maculatus ssp. *pakistanicus* Havelka, 1951
Dermestes maculatus ab. *nigropubescens* Kalík, 1955
Distribution: cosmopolitan species.

Subfamily Trinodinae
Tribe Trinodini

**Evorinea indica* (Arrow, 1915)
Syn.: *Apsectus indicus* Arrow, 1915
Evorinea hisamatsui Ohbayashi, 1977
Distribution: China: Guangdong, India, Japan, Taiwan

Subfamily Attageninae
Tribe Attagenini

Attagenus (*Aethriostoma*) *undulatus* (Motschulsky, 1858)
Syn.: *Aethriostoma undulata* Motschulsky, 1858
Attagenus rufipes Walker, 1859
Pseudotelopes testaceipes Pic, 1916
Pseudotelopes simoni Pic, 1916
Distribution: Comoros, Madagascar, Mauritius, Seychelles, Buru I., Cambodia, S China, India, Indonesia, Laos, Malaysia, Myanmar, Philippines, Sri Lanka, Thailand, Vietnam, Hawaiian Is., Papua New Guinea, S. Mariana Is.

Attagenus (*Attagenus*) *fasciatus* (Thunberg, 1795)
Syn.: *Anthrenus fasciatus* Thunberg, 1795
Anthrenus gloriosae Fabricius, 1798
Attagenus annulatus Dejean, 1821
Attagenus annulifer Laporte, 1840
Attagenus cinnamomeus Roth, 1851
Attagenus unifasciatus Fairmaire in Fairmaire et Coquerel, 1860
Trogoderma subfasciatum Chevrolat, 1863
Attagenus plebeius Sharp in Blackburn et Sharp, 1885
Attagenus gossypiatus Fauvel, 1903
Distribution: cosmopolitan species.

Attagenus (*Attagenus*) *unicolor* (Brahm, 1791)
Syn.: *Dermestes piceus* Olivier, 1790
Dermestes unicolor Brahm, 1790
Megatoma brevicornis Herbst, 1792
Dermestes megatoma Fabricius, 1798
Nitidula cylindricornis Schrank, 1798
Dermestes cilindricornis Melsheimer, 1806
Dermestes floricola Melsheimer, 1806
Dermestes obscurus Melsheimer, 1806
Dermestes schaefferi C. Sahlberg, 1819
Attagenus cylindricornis Say, 1825
Dermestes macellarius Duftschmid, 1825
Attagenus urbicola Gistel, 1857
Attagenus stygialis Mulsant et Rey, 1868
Attagenus fulvipes Mulsant et Rey, 1868
Attagenus japonicus Reitter, 1877
Attagenus cylindricornis Casey, 1900
Attagenus nankineus Pic, 1916
Attagenus canadensis Casey, 1916
Attagenus amurensis Pic, 1942
Attagenus amurensis Pic, 1943
Distribution: cosmopolitan species.

Subfamily Megatominae
Tribe Anthrenini

Anthrenus (*Anthrenodes*) *maculifer* Reitter, 1881
Syn.: *Anthrenus globiger* Arrow, 1915
Anthrenus multimaculatus Pic, 1918
Distribution: China, India, Indonesia: Mentawai Isl., Sumatra, Japan, Laos, Malaysia, Sabah, Sarawak, Myanmar, Nepal, Taiwan, Thailand, Vietnam.

Anthrenus (Anthrenus) flavipes LeConte, 1854
Syn.: *Anthrenus pimpinellae* var. *cinnamomeus* Gredler, 1878
Anthrenus fasciatus Reitter, 1881
Anthrenus vorax Waterhouse, 1883
Anthrenus fasciatus var. *albo-impletus* J. Sahlberg, 1903
Anthrenus seminiveus Casey, 1916
Distribution: cosmopolitan species.

Anthrenus (Nathrenus) verbasci (Linnaeus, 1767)
Syn.: *Byrrhus verbasci* Linnaeus, 1767
Bostrichus varius Fabricius, 1775
Anthrenus florilegus Fourcroy, 1785
Anthrenus adspersus Herbst, 1797
Anthrenus tricolor Herbst, 1797
Anthrenus pictus Germar, 1813
Anthrenus tomentosus Thunberg, 1815
Anthrenus destructor Melsheimer, 1844
Anthrenus nitidulus Küster, 1847
Anthrenus funebris Reitter, 1889
Distribution: cosmopolitan species.

**Orphinus (Falsoorphinus) pseudoovalis* Háva, 2004
Distribution: China: Hubei

Orphinus (Orphinus) fulvipes (Guérin-Méneville, 1838)
Syn.: *Globicornis fulvipes* Guérin-Méneville, 1838
Trogoderma brasiliensis Reitter, 1881
Cryptorhopalum brevicorne Sharp in Blackburn & Sharp, 1885
Trogoderma unicolor Kolbe, 1910
Trogoderma ruficeps Pic, 1937
Distribution: cosmopolitan species.

Thaumaglossa herrmanni Háva, 2003
Distribution: HongKong

Thaumaglossa laeta Arrow, 1915
Syn.: *Orphilus bimaculatus* Matsumura et Yokoyama, 1928
Distribution: China, Indonesia (Flores), Japan, Laos, Philippines, Taiwan, Thailand, Vietnam.

Thaumaglossa rufocapillata Redtenbacher, 1867
Syn.: *Anthrenus ovalis* Fleutiaux, 1887
Aethriostoma atricolor Pic, 1915
Orphiloides ovivorus Matsumura et Yokoyama, 1928
Thaumaglossa pygidialis var. *sinensis* Pic, 1951
Thaumaglossa pygidialis var. *sumatrana* Pic, 1951
Thaumaglossa africana Kalík, 1955
Distribution: Germany (intr.), Netherlands (intr.), Cameroon, Congo, Kenya, Madagascar, Nigeria, Tanzania, Zimbabwe, China, India, Indonesia, Japan, Korea, Laos, Malaysia, Nepal, Taiwan, Thailand, Vietnam.

Acknowledgements
We are obliged to Clive Lau of AFCD for his important comments

References
Háva J. 2003. Descriptions of five new species and distributional notes on some other *Thaumaglossa* species (Coleoptera: Dermestidae). *Lambillionea* 103: 205-213.

Háva J. 2004. World keys to the genera and subgenera of Dermestidae (Coleoptera), with descriptions, nomenclature and distributional records. *Acta Musei Nationalis Pragae, Series B*, Natural History 60: 149-164.

Háva J. 2007. Dermestidae. In: *Catalogue of Palaearctic Coleoptera. Volume 4. Elateroidea, Derodontoidea, Bostrichoidea, Lymexyloidea, Cleroidea and Cucujoidea* (Löbl I. and Smetana A. eds.). Stenstrup, Apollo Books, pp. 57, 299-320.

Háva J. 2009. Catalogue of Dermestidae World (Coleoptera). Downloaded from http://www.dermestidae.wz.cz

Hill , D. S., Hore , P. & Thornton, I. W. B.1982. *Insects of Hong Kong*. Hong Kong University Press, Hong Kong, 503 pp.

Hua L.Z.. 2002. *List of Chinese Insects. Vol. II*. Zhongshan (Sun Yat-sen) University Press. Guangzhou, 612 pp.

Lawrence F.F. and Slipinski, A.. 2005. Three new genera of Indo-Australian Dermestidae (Coleoptera) and their phylogenetic significance. *Invertebrate Systematics* 19: 1-30.

Liu Y., Zhang S. 1986. *Chinese Dermestid Beetles Associated with Stored Products*. Agriculture Publishing House, Beijing, 170 pp. [In Chinese].

Mroczkowski M. 1968. Distribution of the Dermestidae (Coleoptera) of the world with a catalogue of all known species. *Annales Zoologici* 26: 15-191.

Figures

Figure 1. *Evorinea indica* (Arrow, 1915) Female. W ang Tong Village, Mui Wo, Lantau Island, 2 July 2009.

Figure 2. *Attagenus* (*Aethriostoma*) *undulatus* (Motschulsky, 1858). female. Mui Wo, Lantau Island, 2 December 2006.

Figure 3. *Orphinus* (*Falsoorphinus*) *pseudoovalis* Háva, 2004. Male left, female right 26 April 2008, Mui Wo, Lantau.

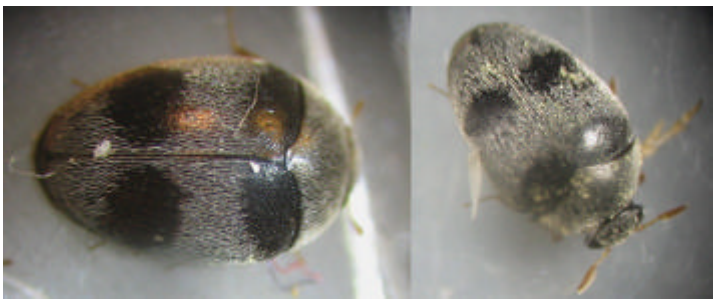


Figure 4. *Thaumaglossa herrmanni* Háva, 2003. male, Wang Tong, Mui Wo, Lantau 26 April 2009.

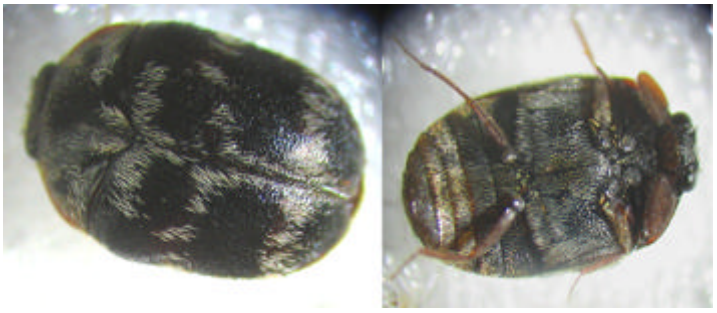
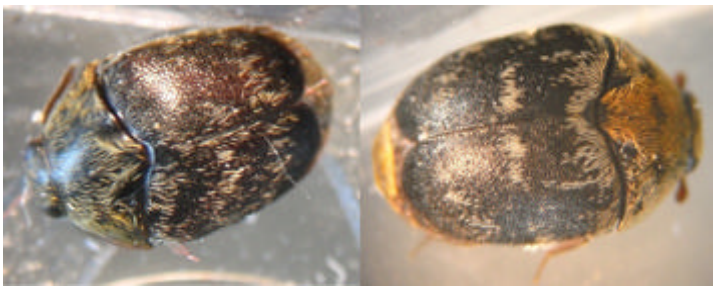


Figure 5. *Thaumaglossa cf. herrmanni* Háva, 2003. female Wang Tong Village, Mui Wo, Lantau Island, 30 May 2009.

Figure 6. *Thaumaglossa rufocapillata* Redtenbacher, 1867. Left: male 16 September 2009 Wang Tong, Mui Wo, Lantau. Right: female 7 August 2009 Pui O, Lantau.



Moths of Fung Yuen SSSI & Butterfly Reserve – a preliminary investigation

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Abstract

A summary of two light trap recording events and other opportunistic diurnal recording events of moths at Fung Yuen Site of Special Scientific Interest and Fung Yuen Butterfly Reserve, Tai Po, New Territories, Hong Kong is presented. A total of 387 species was recorded, of which seven species are recorded from Hong Kong for the first time, and a further 6 species await confirmation of being new records to Hong Kong. Based on the available data, 18 species are of conservation concern, five potentially meet IUCN Red List criteria for threatened species in one of the three main categories "Critically Endangered" (two species), "Endangered" (two species) and "Vulnerable" (one species) and a further 13 species potentially meet "Near Threatened" criteria. For the time being these 18 species should be regarded as IUCN Data Deficient, pending further investigation. Twelve of the species recorded are currently only known from Hong Kong; all are among the 18 species of conservation concern.. Although based upon just two light trap surveys and a small amount of opportunistic diurnal recording, it is likely that the moth species richness at Fung Yuen will prove to be one of the highest in Hong Kong, mirroring the butterfly species richness for which the site is already renowned. The high number of new records to Hong Kong and the number of species potentially meeting IUCN Red List criteria for threatened species from such a small amount of recording effort suggests that the site is of conservation significance for moths. The moth assemblages recorded are typical of human-disturbed forest, feng shui woods and orchards, with a relatively low Geometridae component, but include only a small number of low-conservation interest species normally associated with agriculture and open habitats that were found in the SSSI.

Key Words: Lepidoptera, moths, checklist, Fung Yuen, Hong Kong, IUCN Red List

Introduction

Following a request by Tai Po Environmental Association (TPEA), the Fauna Conservation Department of Kadoorie Farm & Botanic Garden (KFBG) agreed to undertake two moth surveys at Fung Yuen Site of Special Scientific Interest (SSSI) and the adjacent Fung Yuen Butterfly Reserve, Tai Po, New Territories, Hong Kong (see Figure 1 for site location map) to provide a baseline documentation of the moth diversity there. The surveys took place on 24th April and 16th October 2009. The work (Kendrick, 2010) adds to previous Lepidoptera work undertaken at the site in a conservation project summarised by Yau et al. (2007). Other unpublished historical data on the moth assemblage at Fung Yuen is also held by KFBG as part of the KFBG insect collection and by the author, to whom was passed the unpublished moth recording notes of the late Kent H.K. Li, by his wife, in October 2008. There also exists a growing body of information on the moths from Fung Yuen on two Internet website forums, Hong Kong Wildlife Net (www.hkwildlife.net), whose moth forum is moderated by the author, and the Hong Kong Moths group on Flickr (www.flickr.com/groups/hongkongmoths/), also administrated by the author. This paper was brought about to pull together the unpublished information with the data from the moth survey in 2009 (Kendrick, 2010), upon which this paper is based, so as to provide as much information as possible to assist TPEA with the wildlife conservation management of Fung Yuen.

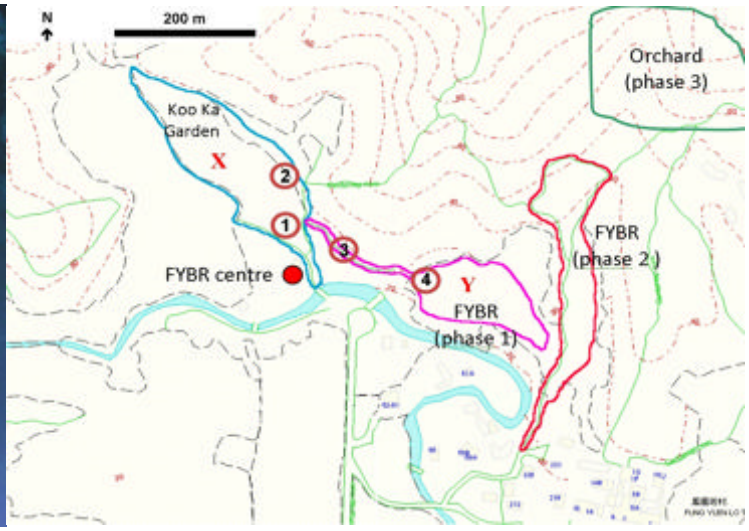
The history of the site is documented by Tai Po Environmental Association (2004). It had been actively farmed for some 300 years until the 1970s and, following the expansion of Tai Po in the late 1970s and 1980s, became abandoned due to migration of the villagers for work elsewhere. The site is now managed by TPEA in a private-public partnership with the local village landowners and with funding provided by the Environment & Conservation Fund. Due to multiple ownership of land, the site contains a mosaic of habitats, comprising orchards, abandoned agricultural land (paddy / marsh), a few streams, regenerating secondary forest, some grassland and shrubland. Small areas of the site (Koo Ka Garden within the SSSI and Phase 1 of the Butterfly Garden, see Figure 1) are actively managed to encourage butterflies through the planting of nectar-rich plants and butterfly larval hostplants. The site was designated as a SSSI on the basis of its high butterfly species richness.

Methods

Moth recording by KFBG took place with ultra violet emitting lights (125W MBF mercury vapour lights) either mounted on Robinson or Skinner traps (Fry & Waring, 2001), or mounted on a tripod and projecting onto a white sheet, on 24 April 2009 and 16 October 2009. Traps were located at least 50m apart (locations shown on Figure 1) to maximise coverage of the site, noting that the effective trapping radius of the light sources varies according to habitat and moon phase (Frank, 1988; Nowinszky, 2004). Other records were made from daytime larval searching and opportunistic observations of adult moths, recorded photographically and posted to Hong Kong Wildlife Net or Flickr, or recorded with a voucher specimen now housed at the KFBG insect collection. Precise location data for the recording events

Figure 1(a) Location of Fung Yuen SSSI & Butterfly Reserve within Hong Kong.

Fig. 1(b) plan of Fung Yuen SSSI & Butterfly Reserve, indicating locations recorded by the KFBG survey.



was only noted for the KFBG sessions (using a Garmin global positioning system unit GARMAP 60 CSx); for the remaining observations, no record exists of which part of Fung Yuen the observations were made.

Moths were identified to species level wherever possible, based upon Kendrick 2002(2003), updated following Clarke (1965), Robinson et al. (1994), Holloway (2005, 2008, 2009), Kononenko & Pinratana (2005) Wang & Kendrick (2009) Wang et al. (2009) and Li et al. (2010). Sesiidae were identified to genus by Axel Kallies (pers. comm.), based upon Arita & Gorbunov (1995) and Pühringer & Kallies (2004). Voucher specimens retained from the KFBG survey are housed in the KFBG insect collection.

Assessment of species against IUCN Red List criteria (IUCN, 2001) follows and adds to work undertaken by Kendrick (2007), including the existing "Hong Kong Moth Recorder" database of the author, amounting to just over 60,000 records, and Chinese distributional data from collections at South China Agricultural University and Nankai University Insect Collection. The species richness ratio of Geometridae to Noctuidae (following Kitching et al., 2000) was compared with that of Kadoorie Farm to gain insight on the level of disturbance at Fung Yuen.

Results

A total of 387 moth species from 36 families are herein documented to have been recorded from Fung Yuen SSSI and Fung Yuen Butterfly Reserve. These species are listed in Appendix 1, in taxonomic order to subfamily, based upon Kendrick (2004), updated for Noctuoidea according to Lafontaine & Schmidt (2010). A total of 18 species of conservation concern are found at Fung Yuen (Table 1).

Table 1. Moth species found at Fung Yuen which potentially meet IUCN Red List criteria for endangered / near threatened species, all must be regarded as IUCN Data Deficient pending further investigation

provisionally Critically Endangered (CR) criteria B1 (extent of occurrence) and D1 (small population)	**provisionally Near Threatened** (NT) criterion B2 (area of occupancy)
Stereodytis brevignatha Wang & Kendrick, 2009	*Dasyses* sp. nr. *correpta*
Ichneumonella sp. A	*Edosa* sp. B
provisionally Endangered (EN) criteria B2 (area of occupancy) and D1 (small population)	*Edosa* sp. C
	Promalactis biovata Wang, Kendrick & Sterling, 2009
	Aeolanthes sp. nr. *erebomicta*
Stereodytis acutidens Wang & Kendrick, 2009	*Psilalcis galsworthyi* Sato, 1996
Macrotarsipus sp. A	*Sigilliclystis kendricki* Galsworthy, 1999
provisionally Vulnerable (VU) criteria B2 (area of occupancy) and D1 (small population)	*Scopula* sp. C (undescribed)
	Apha sp. A (undescribed)
	Bellulia galsworthyi Fibiger, 2008
	Cerynea discontenta Galsworthy, 1998
Luceria striata Galsworthy, 1997	*Ugia purpurea* Galsworthy, 1997
	Athetis hongkongensis Galsworthy, 1997

Further significant records from the KFBG survey were at least seven species that have not been seen in Hong Kong before; they are *Hypenagonia* sp. A, *Mecodina diastriga* Hampson, 1926 (subsequently recorded at KFBG the following night and seen at KFBG, Tai Po Kau Headland and Ng Tung Chai in 2010 (pers. obs., unpublished data), *Frisilia* sp. A, *Frisilia* sp. B, *Faristenia* sp. A, *Helcystogramma* sp. A and *Nepticulidae* sp. A. Identifications on the six unidentified species are in progress. In addition, records of another five species tentatively identified as Cosmopterigidae sp. indet. 1, *Assara* sp. indet. 2, *Helcystogramma* sp. indet. B, *Epicephala* sp. indet. 1 and Psychidae sp. indet. 1, may also be first records for Hong Kong, though this is subject to comparison with collections in the B.P. Bishop Museum, Honolulu, The Natural History Museum, London and the collection of M.J. Sterling, St. Albans, England.

A further 10 species of local conservation interest occur at Fung Yuen SSSI & Butterfly Reserve. In the April 2009 survey, there were three other species, Nolini sp. indet. #1, *Pelosia* sp. indet. #1 and *Comibaena cassidara* (Guenée, 1857 [1858]), recorded for the second, fourth and seventh time, respectively, in Hong Kong. Other rare species include *Ramadasa pavo* (Walker, 1856) (Figure 2) and Araeopteroninae sp. 1 (possibly also undescribed) (Figure 3). During the October 2009 survey, other notable species recorded included a 5th Hong Kong record of the plume moth *Stenoptilia taprobanes* (Felder & Rogenhofer, 1875), an unidentified snout moth (*Pleuroptya* sp. A, Figure 4) representing a likely new species for Hong Kong, the third site in Hong Kong for the unidentified fan-foot moth *Herminia* sp. A (Figure 5) and 5th Hong Kong records for the leaf-twirler *Dichomeris microsphena* (Meyrick, 1921) and the china-mark *Eristena* sp. nr. *bifurcalis*. Also of interest was the occurrence of the fruit-piercing noctuid moth *Oraesia emarginata* (Fabricius, 1794) (Figure 6), a close relative of Hong Kong's own blood-sucking (see Zaspel et al., 2007) moth, *Calyptra minuticornis* (Guenée, 1852). During both KFBG surveys, one further species of note was recorded, *Chorsia perversa* (Walker, 1863), indicating that a well established population of this species exists at Fung Yuen. Only single individuals had been seen in Hong Kong prior to the eight seen over the two surveys at Fung Yuen.

Fung Yuen appears to be the most important site in Hong Kong for the epiplemine moth *Orudiza protheclaria* Walker, 1861, with at least four (of five from Hong Kong) recent records of this species, which was noted by Holloway (1998) from Borneo as uncommon (as it is in Hong Kong), "all recent material being taken in lowland alluvial forest regenerating on abandoned farmland" – a similar habitat to Fung Yuen; globally the species is recorded from the Oriental tropics to Sulawesi (Holloway, 1998).

Figure 2. *Ramadasa pavo* (Noctuidae, Bagisarinae) – a rare moth in Hong Kong, confined to three sites in the central New Territories

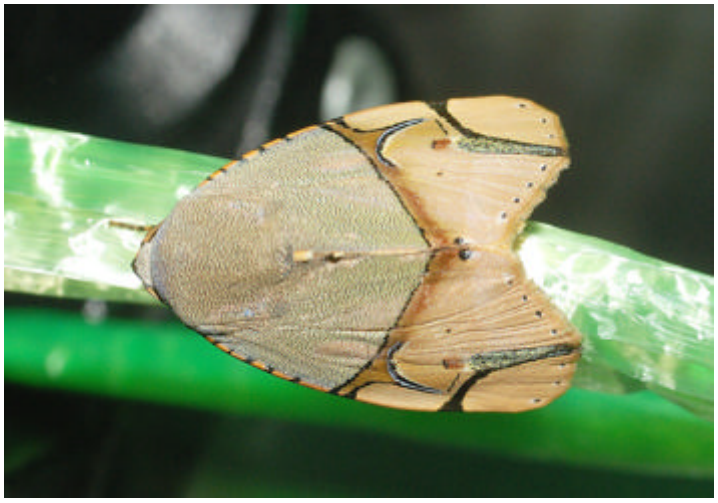


Figure 3. Araeopteroninae sp. indet. A (Erebidae) – one of the many undescribed species of moth found at Fung Yuen during the surveys

Figure 4. *Pleuroptya* sp. A (Crambidae, Spilomelinae) – an unidentified snout moth that may be a new record for Hong Kong

Figure 5. *Herminia* sp. A (Erebidae, Herminiinae) – an unidentified, and possibly undescribed, fan-foot moth; Fung Yuen is the third known site for this species

Figure 6. *Oraesia emarginata* (Erebidae, Calpinae) is a close relative of the blood-sucking moth *Calyptra minuticornis,* which was also recorded at Fung Yuen

Discussion

Considering the present study only covered two surveys, there were a high number of species new to Hong Kong and also several species which have the potential to meet the IUCN Red List criteria for threatened species (IUCN, 2001), indicating that the site has a high conservation value, mirroring the high butterfly species richness found at Fung Yuen. It must be noted that all the species in Hong Kong should, strictly speaking, be regarded as Data Deficient for IUCN Red List analysis, as there is little published data available on the distribution and assemblages of moths in the South China region. The collections at South China Agricultural University and Nankai Univeristy, Tianjin, contained none of the suspected Hong Kong endemic species from localities outside Hong Kong. Further recording throughout Guangdong and Guangxi will help establish an understanding of moth distributions and populations at the regional level, with particular emphasis on sites near Hong Kong to the north, north-east and east-north-east, such as Guangdong Guanyinshan National Forest Park, Wutongshan National Forest Park and remaining forests as far as Chiliangshan.

Based upon this initial survey and comparing with data for Kadoorie Institute and Kadoorie Farm & Botanic Garden (Kendrick, 2002(2003)), it is very likely a more thorough moth survey undertaken on a monthly basis over several years would increase the species richness at Fung Yuen to in excess of 1,000 species.. Further uncollated records are known to exist (e.g. there are an additional fifty or so unidentified specimens in the part of the J.J.Young collection not housed at KFBG (J.J.Young, pers. com.), as well as four undated records for *Lyssa zampa* Butler, 1869).

Species seen were a mix of habitat specialists and generalists, most singletons recorded were not habitat associates except for forest species (Geometridae, subfamilies Geometrinae and Ennominae) at the Butterfly Reserve, and riparian species in the subfamily Acentropinae, such as *Paracymoriza vagalis* (Walker, 1866) (Figure 7), whose larvae are aquatic, at Ko Kaa Garden in the SSSI.

Figure 7. *Paracymoriza vagalis* (Crambidae, Acentropinae) – a chink-mark moth, whose larvae are aquatic and require unpolluted water to survive

As yet, it is not possible to draw many conclusions about species assemblages due to insufficient recording effort, but some generalist species were present. Six of the seven species found at all the sub-sites recorded in the 2009 survey (Kendrick,

2010) – *Hydriris ornatalis* (Duponchel, 1832), *Creatonotos transiens* (Walker, 1855), *Laspeyria ruficeps* (Walker, 1864), *Ugia purpurea* Galsworthy, 1997, *Eublemma ragusana* (Freyer, 1845) and *Nodaria externalis* Guenée, 1854 occur throughout Hong Kong in many different habitats; the last of these is a detritivore in the larval stages. The seventh species found throughout Fung Yuen is *Parapoynx diminutalis* Snellen, 1880, a stream associated species with aquatic larvae, which is known to wander some distance from streams. There were also some specialist or habitat associated species recorded. The presence of six species of Acentropinae, which have stream dwelling larvae, indicates low pollution levels in the water (Speidel & Mey, 1999) and the presence of 14 species of Lithosiini (Arctiinae), is high by Hong Kong's standards, indicating a low level of local SO_2 pollution, as this group of moths have larvae that feed on lichens (e.g. Scoble, 1992), which are susceptible to SO_2 pollution (e.g. Hawksworth & Rose, 1976, Blett et al., 2003; Fenn et al., 2007).

The low Geometridae : Noctuidae (including quadrifine noctuoid taxa) ratio observed by the KFBG surveys in 2009 (Kendrick, 2010) (58 geometrid species to 159 noctuid species, i.e. a ratio of 1:2.75) is indicative of high human disturbance (Kitching, et al. 2000), with relatively few true forest species recorded. When compared to KFBG (231 geometrid species to 567 noctuid species, 1:2.45), there is a lower proportion of Geometridae recorded at Fung Yuen. However, there were very few open habitat species recorded, such as Noctuinae (e.g. genera *Mythimna*, *Sasunaga*, *Agrotis*) and Plusiinae, species which are common in open habitats (grassland, agriculture, abandoned agriculture) in Hong Kong, indicating the overall moth fauna composition at Fung Yuen comprises forest and orchard species rather than open habitat species, with a significant number of generalists.

If the aim of managing the site is to maintain or increase the biodiversity of the Lepidoptera fauna at Fung Yuen, then managing the site in favour of lowland forest and orchard habitats, retaining the streams, would be likely to sustain the existing level of moth and butterfly diversity. Obtaining a more complete temporal picture of the moth community variation throughout at least a one-year study period would greatly enhance the existing level of understanding about the moth diversity at Fung Yuen and how to maintain this rich diversity.

Conclusions

Of the species recorded, 18 are of conservation concern and should be listed as IUCN "Data Deficient", noting that of these 18 species, five potentially meet IUCN Red List criteria for threatened species in one of the three main categories "Critically Endangered" (two species), "Endangered" (two species) and "Vulnerable" (one species" and a further 13 species potentially meet "Near Threatened" criteria. Twelve of the species recorded are currently only known from Hong Kong, all are potentially within one of the four IUCN threatened or near threatened categories listed. Seven species are recorded from Hong Kong for the first time, and a further 6 species await confirmation of being new records to Hong Kong.

Several groups of moths (Acentropinae and Lithosiini), which were seen in good numbers by Hong Kong standards, are indicative of low levels of stream pollution and SO_2 pollution respectively.

Although based upon just light trap two surveys and a small amount of opportunistic diurnal recording, it is likely that the moth species richness at Fung Yuen will prove to be one of the highest in Hong Kong, mirroring the butterfly species richness for which the site is already renowned. The number of new records to Hong Kong and the number of species meeting IUCN Red List criteria for threatened species from just such a small amount of recording effort suggests that the site is possibly of international conservation significance for moths.

The moth assemblages recorded are typical of human disturbed forest, feng shui woods and orchards, with a relatively low Geometridae component, but includes only a small number of low-conservation interest species normally associated with agriculture and open habitats that were found in the SSSI.

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References

Arita, Y. & Gorbunov, O., 1995. A review of the genus *Macrotarsipus* Hampson, [1893] (Lepidoptera, Sesiidae) of the Oriental region. - *Transactions of the Lepidopterological Society of Japan* 46(2), 103-111.

Blett, T., Geiser, L. & Porter, E., 2003. Air Pollution-Related Lichen Monitoring in National Parks, Forests, and Refuges:

Guidelines for Studies Intended for Regulatory and management purposes. *U.S. Dept. of the Interior Technical Report* NPSD 2292. 25pp.

Clarke, J.F.G., 1965. *Catalogue of the Type Specimens of Microlepidoptera in the British Museum (Natural History) described by Edward Meyrick Meyrick*. *Vol. 5: Timyridae - Scythridae*. London: British Museum, pp. 1-255.

Fenn, M., Geiser, L., Bachman, R., Blubaugh, T.J. & Bytnerowicz, A., 2007. Atmospheric deposition inputs and effects on lichen chemistry and indicator species in the Columbia River Gorge, USA. *Environmental Pollution* 146: 77-91.

Frank, K.D., 1988. Impact of outdoor lighting on moths: an assessment. *Journal of the Lepidopterists' Society* 42: 63-93.

Fry, R. & Waring, P., 2001. A guide to moth traps and their use. *The Amateur Entomologist Series 24*. Amateur Entomologists' Society. U.K. 60 pages, 8 b/w plates, 21 figs.

Hawksworth, D.L. & Rose, F., 1976. *Lichens as Pollution Monitors*. Edward Arnold Ltd. London, UK. 59pp.

Holloway, J. D., 1998. The Moths of Borneo, Part 8; Families Castniidae, Callidulidae, Drepanidae and Uraniidae. *Malayan Nature Journal* 52: 1-155.

Holloway, J. D., 2005. The Moths of Borneo: Family Noctuidae, subfamily Catocalinae. *Malayan Nature Journal* 58: 1–529.

Holloway, J.D., 2008. The Moths of Borneo: family Noctuidae, subfamilies Rivulinae, Phytometrinae, Herminiinae, Hypeninae and Hypenodinae. *Malayan Nature Journal* 60: 1-268.

Holloway, J.D., 2009. The Moths of Borneo. Family Noctuidae, subfamilies Pantheinae (part), Bagisarinae, Acontiinae, Aediinae, Eustrotiinae, Bryophilinae, Araeopteroninae, Aventiinae, Eublemminae and further miscellaneous genera. *Malayan Nature Journal* 62: 1–240.

IUCN, 2001. *IUCN Red List Categories and Criteria: Version 3.1*. IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK. ii + 30 pp.

Kendrick, R.C., 2002 (2003). *Moths (Insecta: Lepidoptera) of Hong Kong*. Ph.D. thesis, The University of Hong Kong. xvi + 660 pp.

Kendrick, R.C., 2004. Checklist of Hong Kong moths. In: *Hong Kong Fauna – A Checklist of Selected Taxa* (Ades, G.W.J. & Kendrick, R.C., eds.). Kadoorie Farm & Botanic Garden, Hong Kong: 12-51.

Kendrick, R.C., 2007. The conservation assessment of moths in Hong Kong. In: *Proceedings of the First South East Asian Lepidoptera Conservation Symposium, Hong Kong 2006* (Kendrick, R.C., ed.). Kadoorie Farm & Botanic Garden, Hong Kong: 71-82.

Kendrick, R.C., 2010. *Kadoorie Farm and Botanic Garden Publication Series: No 6. Fung Yuen SSSI & Butterfly Reserve Moth Survey 2009*. Kadoorie Farm & Botanic Garden, Tai Po, Hong Kong. 25 pp.

Kitching, R.L., Orr, A.G., Thalib, L., Mitchell, H., Hopkins, M.S. & Graham, A.W., 2000. Moth assemblages as indicators of environmental quality in remnants of upland Australian rain forest. *Journal of Applied Ecology* 37: 284-297.

Kononenko, V.S. & Pinratana, A., 2005. *Moths of Thailand Vol. 3. Noctuidae: an illustrated catalogue of the Noctuidae (Insecta, Lepidoptera) in Thailand: Part 1: Subfamilies Herminiinae, Rivulinae, Hypeninae, Catocalinae, Aganainae, Euteliinae, Stictopterinae, Plusiinae, Pantheinae, Acronictinae and Agaristinae*. Brothers of St Gabriel in Thailand. Bangkok. 260 pp.

Lafontaine, J.D. & Schmidt, B.C., 2010. Annotated check list of the Noctuoidea (Insecta, Lepidoptera) of North America north of Mexico. *ZooKeys* 40: 1–239. doi: 10.3897/zookeys.40.414

Li, H.H., Zhen, H., Kendrick, R.C. & Sterling, M.J., 2010. Microlepidoptera of Hong Kong: Taxonomic study on the genus *Dichomeris* Hübner, 1818, with description of three new species (Lepidoptera: Gelechiidae). *SHILAP Revista de Lepidopterologia* 38: 67-89 pp.

Nowinszky, L., 2004. Nocturnal illumination and night flying insects. *Applied Ecology & Environmental Research* 2: 17–52.

Pühringer, F. & Kallies, A., 2004. Provisional checklist of the Sesiidae of the world (Lepidoptera: Ditrysia). - *Mitteilungen der Entomologischen Arbeitsgemeinschaft Salzkammergut* 4: 1-85; updated by F. Pühringer 1 September 2010 at http://members.mywave.at/m204259aa/Checklst.htm, accessed on 14 September 2010.

Robinson, G.S., Kevin R Tuck, K.R. & M Shaffer, M., 1994. *A field guide to the smaller moths of South-East Asia*. Natural History Museum (London, England) & Malayan Nature Society, Kuala Lumpur, Malaysia. 309 pp, 32 col plates, 51 figs, 2 maps.

Scoble, M.J., 1992. *The Lepidoptera: Form, Function & Diversity*. Oxford University Press / The Natural History Museum, London. xi + 404 pp.

Speidel, W. & Mey, W., 1999. Catalogue of the Oriental Acentropinae (Lepidoptera: Crambidae). *Tijdschrift voor*

Entomologie 142: 125-142.

Tai Po Environmental Association, 2004. *Brief History of Fung Yuen*. Website, accessed 25 May 2010 from http://www.fungyuen.org/%5Epage=heritage&lang=eng/default.htm.htm.

Wang, S.X. & Kendrick, R.C., 2009. The genus *Stereodytis* Meyrick (Lepidoptera: Oecophoridae) from China, with descriptions of two new species. *Entomologica Fennica* 20: 186-190.

Wang, S.X., Kendrick, R.C. & Sterling, P., 2009. Microlepidoptera of Hong Kong: Oecophoridae I: the genus *Promalactis* Meyrick. *Zootaxa* 2239: 31-44.

Yau., W.K., Li, S.W. & Wong, L.H., 2007. Collaboration among government, green groups and villagers: a key component contributing to the real success of Fung Yuen Butterfly Conservation Project [abstract & presentation notes]. In: Kendrick, R.C. (ed.), *Proceedings of the First South East Asian Lepidoptera Conservation Symposium, Hong Kong 2006*. Kadoorie Farm & Botanic Garden, Hong Kong: 111-116.

Zaspel, J.M., Kononenko, V.S. & Goldstein, P. Z., 2007. Another Blood Feeder? Experimental Feeding of a Fruit-Piercing Moth Species on Human Blood in the Primorye Territory of Far Eastern Russia (Lepidoptera: Noctuidae: Calpinae). *Journal of Insect Behavior* 20: 437-451.

Appendix 1. List of moths recorded at Fung Yuen SSSI & Butterfly Reserve

KEY

HK – endemic to Hong Kong
pCR / pEN / pVU / pNT – IUCN Data Deficient, meets IUCN endangered species red list criteria based upon available information and **provisionally** assigned Critically Endangered / Endangered / Vulnerable / Near Threatened
intr – non-native, accidental introduction

vr – very rare r – rare s – scarce
u – uncommon f – frequent c – common
vc – very common rd – restricted l – local
w – widespread dd – data deficient
NR – new record for Hong Kong

Family - subfamily

Species number	*species* Species Author(s) *[c.f. Kendrick (2010)]*	HK Status & Distribution	Total Count	Date(s) recorded
Nepticulidae - Nepticulinae				
1 *1*	Nepticulidae sp. indet. #1	vr, rd **NR**	1	24 Apr 2009
Tineidae - Hapsiferinae				
2 *2*	*Dasyses* sp. nr. *correpta*	p**NT** s, l	2	24 Apr 2009
Tineidae - Perissomasticinae				
3 *3*	*Edosa* sp. B	p**NT** u, l	1	16 Oct 2009
4 *4*	*Edosa* sp. C	p**NT** u, w	2	16 Oct 2009
Psychidae - unplaced to subfamily				
5 *5*	Psychidae sp. indet. #1	dd	1	24 Apr 2009
Gracillariidae - Gracillariinae				
6 *6*	*Caloptilia* sp. nr. *protiella*	r, rd	1	24 Apr 2009
7 *7*	*Epicephala albifrons* (Stainton, 1859)	f, w	1	24 Apr 2009
8 *8*	*Epicephala* sp. A (albifrons group)	dd (r, rd)	1	24 Apr 2009
Plutellidae - Plutellinae				
9 *9*	*Plutella xylostella* (Linnaeus, 1758)	c, w	5	24 Apr 2009, 16 Oct 2009
Yponomeutidae - unplaced to subfamily				
10 *10*	Yponomeutidae genus & sp. B	sc, l	2	24 Apr 2009
Gelechiidae - Dichomeridinae				
11 *11*	*Dichomeris microsphena* (Meyrick, 1921)	s, w	1	16 Oct 2009
12 *12*	*Dichomeris moriutii* Pomonarenko & Ueda, 2004	u, w	1	16 Oct 2009
13 *13*	*Dichomeris orientis* Park & Hodges, 1995	s, l	1	24 Apr 2009
14 *14*	*Helcystogramma triannulella* (Herrich-Schäffer, 1854)	s, w	2	16 Oct 2009
15 *15*	*Helcystogramma* sp. A	vr, rd **NR**	1	16 Oct 2009
Gelechiidae - Chelariinae				
16 *16*	*Anarsia patulella* (Walker, 1864)	u, l	3	24 Apr 2009
17 *17*	*Anarsia phortica* Meyrick, 1913	r, rd	1	24 Apr 2009
18 *18*	*Anarsia* sp. A	dd (r, rd)	1	16 Oct 2009
19 *19*	*Anarsia* sp. nr. *isogona* Meyrick, 1913	f, l	2	16 Oct 2009
20 *20*	*Faristenia* sp. 1	vr, rd **NR**	1	16 Oct 2009
21 *21*	*Hypatima arignota* (Meyrick, 1916)	f, l	1	24 Apr 2009
22 *22*	*Mesophleps albilinella* (Park, 1990)	s, l	1	24 Apr 2009
23 *23*	*Mesophleps palpigera* (Walsingham, 1891)	r, rd	1	24 Apr 2009

Autostichidae - Autostichinae					
24	*24*	*Autosticha calceata* Meyrick, 1908	c, w	1	16 Oct 2009
Lecithoceridae - Lecithocerinae					
25	*25*	*Frisilia* sp. 1	vr, rd **NR**	1	24 Apr 2009
26	*26*	*Frisilia* sp. 2	vr, rd **NR**	1	24 Apr 2009
27	*27*	*Homaloxestis myloxesta* Meyrick, 1932	c, w	1	24 Apr 2009
Oecophoridae - Oecophorinae					
28	*28*	*Promalactis biovata* Wang, Kendrick & Sterling, 2009	p**NT HK**; f, w	1	24 Apr 2009
29	*29*	*Promalactis semantris* (Meyrick, 1906)	s, w	2	24 Apr 2009, 16 Oct 2009
30	*30*	*Stereodytis acutidens* Wang & Kendrick, 2009	**pEN HK**; u, l	1	24 Apr 2009
31	*31*	*Stereodytis brevignatha* Wang & Kendrick, 2009	p**CR HK**; r, rd	2	24 Apr 2009
Oecophoridae - Stathmopodinae					
32	*32*	*Stathmopoda* sp. G	dd	1	24 Apr 2009, 16 Oct 2009
33	*33*	*Stathmopoda stimulata* Meyrick, 1913	c, w	1	24 Apr 2009
Coleophoridae - Blastobasinae					
34	*34*	*Blastobasis* sp. A	c, w	1	24 Apr 2009
Elachistidae - Aeolanthinae					
35	*35*	*Aeolanthes* sp. nr. *erebomicta*	p**NT** r, l	2	24 Apr 2009
Cosmopterigidae - Chrysopeleiinae					
36	*36*	*Ascalenia* sp. nr. *thoracista* (Meyrick, 1915)	c, w	38	24 Apr 2009
Cosmopterigidae - Cosmopteriginae					
37	*37*	*Labdia oxychlora* Meyrick, 1932	u, w	1	24 Apr 2009
38	*38*	*Labdia semicoccinea* Stainton, 1859	r, rd	2	24 Apr 2009
39	*39*	Cosmopterigidae sp. indet. #1	vr, rd	1	24 Apr 2009
Tortricidae - Tortricinae					
40	*40*	*Adoxophyes privatana* (Walker, 1863)	c, w	9	24 Apr 2009
41	*41*	*Homona coffearia* (Neitner, 1861)	c, w	8	24 Apr 2009
42	*42*	*Homona eductana* (Walker, 1863)	c, w	1	24 Apr 2009
43	*43*	*Meridemis furtiva* Diakonoff, 1976	c, w	2	16 Oct 2009
Tortricidae - Olethreutinae					
44	*44*	*Arcesis threnodes* (Meyrick, 1905)	s, l	3	24 Apr 2009
45	*45*	*Bactra venosana* (Zeller, 1847)	dd (r, rd)	2	24 Apr 2009
46	*46*	*Cryptophlebia ombrodelta* (Lower, 1898)	c, w	1	24 Apr 2009
47	*47*	*Cryptophlebia repletana* (Walker, 1863)	c, w	2	16 Oct 2009
48	*48*	*Cryptophlebia* sp. A	r, rd	1	16 Oct 2009
49	*49*	*Dudua aprobola* (Meyrick, 1886)	c, w	2	24 Apr 2009
50	*50*	*Gatesclarkeana idia* Diakonoff, 1973	s, w	3	24 Apr 2009
51	*51*	*Lobesia aeolopa* Meyrick, 1907	c, w	1	24 Apr 2009
52	*52*	*Lobesia* sp. B nr. *pyriformis*	dd (r, rd)	1	24 Apr 2009
53	*53*	*Loboschiza koenigiana* (Fabricius, 1775)	f, w	1	24 Apr 2009, 16 Oct 2009
54	*54*	*Fibuloides* sp. indet. #1	dd	1	24 Apr 2009
55		*Pseudacroclita hapalaspis* (Meyrick, 1931)	c,w	~ 20 (larvae)	6 Sep 2008
56	*55*	*Ophiorrhabda cellifera* (Meyrick, 1912)	s, w	1	24 Apr 2009
57	*56*	*Ophiorrhabda mormopa* (Meyrick, 1906)	u, l	3	16 Oct 2009
58	*57*	*Rhopobota naevana* (Hübner, [1814-1817])	dd (r, rd)	1	24 Apr 2009
59	*58*	*Rhopobota* sp. B	dd (u, l)	1	24 Apr 2009
60	*59*	*Rhopobota* sp. C	dd (u, l)	1	24 Apr 2009
61	*60*	*Sorolopha archimedias* (Meyrick, 1912)	f, w	1	24 Apr 2009
62	*61*	*Sorolopha* sp. B	r, rd	1	24 Apr 2009

63	*62*	*Statherotis discana* (Felder & Rogenhofer, 1875)	c, w	1	24 Apr 2009
Sesiidae - Sesiinae					
64		*Ichneumonella* sp. A	**r, rd NR**	2	10 May 2006, 15 Apr 2007
65		*Macrotarsipus* sp. A	p**VU vr, rd NR**	2	10 May 2006
Choreutidae - Choreutinae					
66	*63*	*Choreutis fulminea* Meyrick, 1912	s, l	1	16 Oct 2009
67		*Brenthia* sp. A	u, l	2	29 Apr 2009, 5 May 2009
Zygaenidae - Procridinae					
68		*Artona hainana* Butler, 1876	**s, w**	1	2 Oct 2006
Zygaenidae Chalcosiinae					
69	*64*	*Eterusia aedea* (Clerck, 1759)	c, w	2	24 Apr 2009
Limacodidae - unplaced to subfamily					
70	*65*	*Phlossa conjuncta* (Walker, [1855])	f, w	1	24 Apr 2009
Cossidae - Cossinae					
71	*66*	*Phragmataecia fusca* Wileman, 1911	s, w	1	24 Apr 2009
Pterophoridae - Pterophorinae					
72	*67*	*Stenoptilodes taprobanes* (Felder & Rogenhofer, 1875)	r, rd	1	16 Oct 2009
Thyrididae - Thyridinae					
73		*Glanycus insolitus* Walker, 1855	u, w	1	4 Jul 1996
Pyralidae - Galleriinae					
74	*68*	*Doloessa viridis* Zeller, 1848	c, w	2	24 Apr 2009
75	*69*	*Tirathaba irrufatella* Ragonot, 1901	s, l	2	24 Apr 2009
Pyralidae - Pyralinae					
76	*70*	*Endotricha repandalis* (Fabricius, 1794)	c, w	9	24 Apr 2009, 16 Oct 2009
77	*71*	*Endotricha theonalis* (Walker, 1859)	f, w	1	24 Apr 2009
Pyralidae - Phycitinae					
78	*72*	*Assara* sp. B	vr, rd **NR**	1	16 Oct 2009
79	*73*	*Ectomyelois ceratoniae* (Zeller, 1839)	c, w	2	24 Apr 2009
80	*74*	*Emmalocera neesimella* (Ragonot, 1901)	u, w	2	24 Apr 2009, 16 Oct 2009
81	*75*	*Etiella zinckenella* (Treitschke, 1832)	f, w	2	16 Oct 2009
82	*76*	*Guastica semilutea* Walker, 1863	c, w	2	24 Apr 2009
83	*77*	*Indomyrlaea ferreotincta* (Hampson, 1912)	s, l	2	16 Oct 2009
84	*78*	*Morosaphycita morosalis* (Sallmüller, 1880)	u, l	2	24 Apr 2009, 16 Oct 2009
85	*79*	*Phycita cavifrons* Meyrick, 1932	r, rd	1	24 Apr 2009
Crambidae - Pyraustinae					
86	*80*	*Hyalobathra opheltesalis* (Walker, 1859)	u, l	1	24 Apr 2009
87	*81*	*Isocentris filalis* (Guenée, 1854)	c, w	1	16 Oct 2009
Crambidae - Acentropinae					
88	*82*	*Agassiziella* sp. nr. *albidivisa* (Warren, 1896)	r, rd	1	16 Oct 2009
89	*83*	*Eoophyla* sp. A nr *sinensis*	u, l	5	16 Oct 2009
90	*84*	*Eristena* sp. nr. *bifurcalis* (Pryer, 1877)	r, rd	1	16 Oct 2009
91	*85*	*Paracymoriza vagalis* (Walker, [1866])	s, l	1	16 Oct 2009
92	*86*	*Parapoynx diminutalis* Snellen, 1880	u, w	32	24 Apr 2009, 16 Oct 2009
93	*87*	*Parapoynx fluctuosalis* (Zeller, 1852)	s, l	3	24 Apr 2009
Crambidae - Crambinae					
94	*88*	*Calamotropha* sp. nr. *melanosticta* (Hampson, 1895)	r, rd	1	24 Apr 2009

95	*89*	*Chilo auricilia* Dudgeon, 1905	r, rd	1	16 Oct 2009
96	*90*	*Culladia hastiferalis* (Walker, 1865)	c, w	7	24 Apr 2009
Crambidae - Schoenobiinae					
97	*91*	*Scirpophaga praelata* (Scopoli, 1763)	u, l	1	24 Apr 2009
Crambidae - Spilomelinae					
98	*92*	*Aethaloessa calidalis* (Guenée, 1854)	s, l	2	24 Apr 2009
99	*93*	*Antigastra catalaunalis* (Duponchel, 1833)	r, rd	1	16 Oct 2009
100	*94*	*Camptomastix hisbonalis* (Walker, 1859)	c, w	3	24 Apr 2009
101	*95*	*Cnaphalocrocis medinalis* (Guenée, 1854)	c, w	2	16 Oct 2009
102	*96*	*Cnaphalocrocis poeyalis* (Boisduval, 1833)	c, w	1	16 Oct 2009
103		*Diaphania indica* (Saunders, 1851)	c, w	1	Oct 2006
104		*Diasemia accalis* (Walker, 1859)	f, w	1	23 Aug 2007
105	*97*	*Diasemiopsis ramburialis* (Duponchel, 1834)	s, rd	1	24 Apr 2009
106		*Dichocrocis punctiferalis* (Guenée, 1854)	f, w	1	22 May 1993
107	*98*	*Eurrhyparodes bracteolalis* (Zeller, 1852)	s, l	1	16 Oct 2009
108	*99*	*Eurrhyparodes tricoloralis* (Zeller, 1852)	s, l	1	16 Oct 2009
109	*100*	*Filodes fulvidorsalis* (Hübner, 1832)	c, w	8	24 Apr 2009
110	*101*	*Glyphodes bicolor* (Swainson, [1821])	c, w	1	16 Oct 2009
111	*102*	*Herpetogramma licarsisalis* (Walker, 1859)	c, w	4	24 Apr 2009, 16 Oct 2009
112	*103*	*Hydriris ornatalis* (Duponchel, 1832)	c, w	7	Oct 2006, 24 Apr 2009, 16 Oct 2009
113	*104*	*Hymenia perspectalis* (Hübner, 1796)	u, w	1	24 Apr 2009
114	*105*	*Ischnurges gratiosalis* (Walker, 1859)	f, w	1	16 Oct 2009
115	*106*	*Lamprosema tampiusalis* (Walker, 1859)	c, w	4	24 Apr 2009
116	*107*	*Metoeca foedalis* (Guenée, 1854)	c, w	1	16 Oct 2009
117	*108*	*Omiodes diemenalis* (Guenée, 1854)	u, w	5	24 Apr 2009, 16 Oct 2009
118	*109*	*Palpita pajnii* Kirti & Rose, 1992	s, l	1	16 Oct 2009
119	*110*	*Pleuroptya* sp. A	r, rd	1	16 Oct 2009
120	*111*	*Prophantis adusta* Inoue, 1986	f, w	1	24 Apr 2009
121	*112*	*Psara basalis* (Walker, 1865)	u, w	2	16 Oct 2009
122	*113*	*Sameodes cancellalis* (Zeller, 1852)	f, w	1	16 Oct 2009
123	*114*	*Spoladea recurvalis* (Fabricius, 1775)	c, w	9	24 Apr 2009, 16 Oct 2009
124	*115*	*Syllepte pernitescens* (Swinhoe, 1894)	c, w	1	24 Apr 2009
125	*116*	*Symmoracma minoralis* (Snellen, 1880)	u, l	9	24 Apr 2009, 16 Oct 2009
126	*117*	*Talanga sexpunctalis* (Walker, 1874)	c, w	1	16 Oct 2009
Uraniidae - Uraniinae					
127	*118*	*Lyssa zampa* Butler, 1869	c, w	1	16 Oct 2009
Uraniidae - Microniinae					
128		*Micronia aculeata* Guenée, 1857	f, w	1	1 Sep 2008
Uraniidae - Epipleminae					
129		*Orudiza protheclaria* Walker, 1861	s, l	4	9 May 1989, 30 Jul 19889 11 Oct 1989, 15 May 2010
Geometridae - Ennominae					
130	*119*	*Ascotis selenaria* ([Denis & Schiffermüller], 1775)	c, w	1	24 Apr 2009
131	*120*	*Chiasmia emersaria* (Walker, 1861)	c, w	1	16 Oct 2009
132	*121*	*Chiasmia monticolaria* (Leech, 1897)	f, l	1	24 Apr 2009
133	*122*	*Chiasmia triangulata* (Hampson, 1891)	s, l	1	16 Oct 2009
134	*123*	*Coremecis* sp. A	s, l	2	24 Apr 2009
135	*124*	*Corymica arnearia* Walker, 1860	f, w	2	25 Nov 1989, 24 Apr 2009
136	*125*	*Dasyboarmia subpilosa* (Warren, 1894)	vc, w	4	24 Apr 2009
137	*126*	*Ectropis bhurmitra* (Walker, 1860)	c, w	4	24 Apr 2009
138	*127*	*Fascellina chromataria* Walker, 1860	vc, w	3	24 Apr 2009
139	*128*	*Fascellina plagiata* (Walker, 1866)	c, w	1	24 Apr 2009
140	*129*	*Hypomecis cineracea* (Moore, 1888)	f, l	4	24 Apr 2009, 16 Oct 2009

141	*130*	*Hyposidra infixaria* (Walker, 1860)	vc, w	1	24 Apr 2009
142	*131*	*Hyposidra talaca* (Walker, 1860)	vc, w	1	24 Apr 2009
143	*132*	*Lomographa inamata* (Walker, 1861)	c, l	1	16 Oct 2009
144	*133*	*Luxiaria phyllosaria* (Walker, 1860)	f, w	2	24 Apr 2009, 27 Mar 2010
145	*134*	*Macaria abydata* Guenée, 1857	**Intr**.; u, w	1	24 Apr 2009
146	*135*	*Obeidia tigrata* (Guenée, 1858)	c, w	1	24 Apr 2009
147	*136*	*Ophthalmitis herbidaria* (Guenée, 1858)	c, w	1	24 Apr 2009
148	*137*	*Ourapteryx clara* Butler, 1880	c, w	2	24 Apr 2009
149	*138*	*Pareumelea eugeniata* (Guenée, 1857)	c, w	1	24 Apr 2009
150	*139*	*Peratophyga venetia* Swinhoe, 1902	c, w	1	16 Oct 2009
151		*Percnia fumidaria* Leech, 1897	c, w	2	24 Aug 2007, 3 Feb 2010
152	*140*	*Plesiomorpha flaviceps* (Butler, 1881)	c, w	1	24 Apr 2009
153	*141*	*Plutodes costatus* (Butler, 1866)	vc, w	7	24 Apr 2009
154	*142*	*Pseudonadagara semicolor* (Warren, 1895)	c, w	1	24 Apr 2009
155	*143*	*Psilalcis galsworthyi* Sato, 1996	p**NT** vc, w	1	24 Apr 2009
156	*144*	*Rutellerona pseudocessaria* Holloway, 1993 [1994]	c, w	3	24 Apr 2009
157	*145*	*Scardamia auranticaria* Bremer, 1864	u, l	1	16 Oct 2009
158	*146*	*Scardamia metallaria* Guenée, 1858	u, w	2	16 Oct 2009
159	*147*	*Serratophyga xanthospilaria* (Wehrli, 1925)	c, w	1	24 Apr 2009
160	*148*	*Zanclopera falcata* Warren, 1894	c, w	1	24 Apr 2009
		Geometridae - Geometrinae			
161	*149*	*Comibaena argentataria* (Leech, 1897)	r, l	3	24 Apr 2009
162	*150*	*Comibaena cassidara* (Guenée, 1857 [1858])	u, l	1	24 Apr 2009
163	*151*	*Hemithea marina* (Butler, 1878)	c, w	1	24 Apr 2009
164	*152*	*Hemithea tritonaria* (Walker, [1863])	c, w	3	24 Apr 2009
165	*153*	*Lophophelma calaurops* (Prout, 1912)	vc, w	1	16 Oct 2009
166	*154*	*Pelagodes antiquadraria* (Inoue, 1976)	c, w	3	24 Apr 2009
167	*155*	*Pingasa ruginaria* (Guenée, 1857 [1858])	c, w	1	16 Oct 2009
168	*156*	*Thalassodes immissaria* Walker, 1861	c, w	1	16 Oct 2009
		Geometridae - Larentiinae			
169	*157*	*Bosara subrobusta* (Inoue, 1988)	u, w	3	24 Apr 2009
170	*158*	*Collix ghosha* Walker, 1862	f, rd	1	24 Apr 2009
171	*159*	*Pseudeuchlora kafebera* (Swinhoe, 1894)	c, w	1	16 Oct 2009
172	*160*	*Sigilliclystis kendricki* Galsworthy, 1999	p**NT HK**; c, w	1	16 Oct 2009
173	*161*	*Spiralisigna subpumilata* (Inoue, 1972)	f, w	2	24 Apr 2009
		Geometridae - Sterrhinae			
174	*162*	*Idaea chotaria* Swinhoe, 1886	r, rd	1	24 Apr 2009
175	*163*	*Idaea costiguttata* (Warren, 1896)	c, w	3	24 Apr 2009, 16 Oct 2009
176	*164*	*Idaea impexa* (Butler, 1879)	c, w	2	24 Apr 2009
177	*165*	*Idaea jakima* (Butler, 1878)	f, w	1	16 Oct 2009
178	*166*	*Idaea macrospila* (Prout, 1926)	c, w	1	24 Apr 2009
179	*167*	*Idaea phaeocrossa* (Prout, 1932)	f, w	1	16 Oct 2009
180	*168*	*Idaea ptyonopoda* (Hampson, 1895)	c, w	4	24 Apr 2009
181	*169*	*Idaea vacillata* (Walker, 1862)	c, w	2	24 Apr 2009, 16 Oct 2009
182	*170*	*Lophophleps triangularis* (Hampson, 1895)	c, w	2	24 Apr 2009, 16 Oct 2009
183	*171*	*Organopoda carnearia* (Walker, 1861)	f, l	1	16 Oct 2009
184	*172*	*Perixera griseata* (Warren, 1896)	f, l	2	24 Apr 2009
185	*173*	*Perixera punctata* (Warren, 1897)	s, l	1	16 Oct 2009
186	*174*	*Problepsis eucircota* Prout, 1913	r, rd	1	16 Oct 2009
187	*175*	*Scopula* sp. C	p**NT HK**;c, w	2	16 Oct 2009
188	*176*	*Somatina plynusaria* (Walker, 1862)	f, w	1	16 Oct 2009
		Lasiocampidae - Lasiocampinae			
189	*177*	*Euthrix isocyma* (Hampson, 1892)	vc, w	3	24 Apr 2009, 16 Oct 2009
190		*Metanastria gemella* de Lajonquière, 1979	u, w	1	16 Sep 2007
191		*Trabala vishnou* (Lefebre, 1827)	u, w	1 (larva)	29 Apr 2009

Sphingidae - Smerinthinae					
192	*178*	*Marumba dyras* (Walker, 1856)	vc, w	2	24 Apr 2009
Sphingidae - Sphinginae					
193		*Acherontia lachesis* (Fabricius, 1798)	f, w	3(larvae)	23 Feb 2007, 5 Jun 2008 30 Aug 2009
Sphingidae - Macroglossinae					
194		*Cephonodes hylas* (Linnaeus, 1771)	u. w	2	5 Jun 2008, 7 Oct 2008
195	*179*	*Enpinanga assamensis* (Walker, 1856)	f, w	1	24 Apr 2009
196	*180*	*Macroglossum fritzei* Rothschild & Jordan, 1903	vc, w	2	13 Sep 2007, 24 Apr 2009
197	*181*	*Macroglossum heliophila* Boisduval, [1875]	c, w	3	13 Sep 2007, 11 Aug 2008 24 Apr 2009
198	*182*	*Macroglossum insipida* Butler, 1875	s, l	1	16 Oct 2009
199	*183*	*Macroglossum pyrrhosticta* Butler, 1875	f, w	2	16 Oct 2009
200	*184*	*Theretra latreillii* Macleay, 1826	f, w	2	24 Apr 2009
Saturniidae - Saturniinae					
201		*Attacus atlas* Linnaeus, 1758	u. w	3 (larvae)	7 Aug 2009, 15 Aug 2009 30 Aug 2009
202		*Saturnia pyretorum* (Westwood, [1847])	f, w	1 (larva)	12 May 2008
Eupterotidae - Eupterotinae					
203	*185*	*Apha* sp. A (*floralis* group)	p**NT HK**; c, w	2	24 Apr 2009
Bombycidae - Bombycinae					
204	*186*	*Ocinara albicollis* (Walker, 1862)	f, w	1	16 Oct 2009
Bombycidae - Prismostictinae					
205	*187*	*Prismosticta hyalinata* Butler, 1885	u, w	5	16 Oct 2009
Notodontidae - Dudusinae					
206	*188*	*Netria viridescens* Walker, 1855	c, w	1	24 Apr 2009
Notodontidae - Biretinae					
207	*189*	*Gargetta divisa* Gaede, 1930	c, w	2	24 Apr 2009
208	*190*	*Porsica curvaria* (Hampson, 1892)	u, l	1	16 Oct 2009
Notodontidae - Stauropinae					
209	*191*	*Antiphalera exquisitor* Schintlmeister, 1989	c, w	1	16 Oct 2009
Notodontidae - Pygaerinae					
210	*192*	*Micromelalopha baibarana* Matsumura, 1929	c, w	1	24 Apr 2009
Micronoctuidae - Belluliinae					
211	*193*	*Bellulia galsworthyi* Fibiger, 2008	p**NT HK**; s, w	1	24 Apr 2009
Erebidae - Lymantriinae					
212	*330*	*Arna bipunctapex* (Hampson, 1891)	f, w	1	16 Oct 2009
213	*331*	*Artaxa* sp. C nr. *guttata* Walker	s, l	1	24 Apr 2009
214	*332*	*Artaxa* sp. nr. *lubecula* Wileman, 1910	f, w	7	24 Apr 2009
215	*333*	*Calliteara angulata* (Hampson, 1891)	u, l	1	16 Oct 2009
216	*334*	*Euproctis* sp. nr. *seitzei* Strand	u, w	3	24 Apr 2009, 16 Oct 2009
217		*Olene chekiangensis* (Collonette, 1938)	c. w	1 (larva)	19 Jul 2009
218	*335*	*Orgyia postica* (Walker, 1855)	vc, w	5	24 Apr 2009, 16 Oct 2009
219	*336*	*Perina nuda* (Fabricius, 1787)	c, w	1 (pupa)	21 Mar 2007
				3	24 Apr 2009
Erebidae - Arctiinae					
220		*Amata germana* Felder, 1862	c, w	2	20 Mar 2007, 11 Mar 2009

221		*Syntomoides imaon* (Cramer, 1780)	c, w	4	16 Sep 1988, 23 Aug 2007 16 Aug 2008,19 Mar 2010
222		*Argina argus* (Kollar, 1844)	s, w	1	16 Jun 2008
223	*205*	*Barsine striata* (Bremer & Grey, 1852)	vc, w	1	16 Oct 2009
224	*206*	*Brunia antica* (Walker, 1854)	vc, w	2	24 Apr 2009
225	*207*	*Creatonotos transiens* (Walker, 1855)	c, w	23	24 Apr 2009
226	*208*	*Diduga flavicostata* (Snellen, 1878)	c, w	1	24 Apr 2009
227	*209*	*Eilema fuscodorsalis* (Matsumura, 1930)	c, w	5	24 Apr 2009, 16 Oct 2009
228	*210*	*Eugoa brunnea* Hampson, 1914	f, l	3	24 Apr 2009, 16 Oct 2009
229	*211*	*Lyclene acteola* (Swinhoe, 1903)	u, l	3	24 Apr 2009
230	*212*	*Macrobrochis gigas* (Walker, 1854)	f, w	1	24 Apr 2009
231	*213*	*Microlithosia shaowuica* Daniel, 1954	f, l	4	24 Apr 2009, 16 Oct 2009
232	*214*	*Pelosia* sp. indet. A	r, rd	1	24 Apr 2009
233	*215*	*Schistophleps bipuncta* Hampson, 1891	vc, w	3	24 Apr 2009
233	*216*	*Tigrioides immaculata* (Butler, 1880)	c, w	3	24 Apr 2009
Erebidae - Herminiinae					
235	*307*	*Adrapsa ablualis* Walker, [1859] 1858	c, w	1	16 Oct 2009
236	*308*	*Bertula abjudicalis* Walker, [1859] 1858	f, l	3	24 Apr 2009
237	*309*	*Hadennia jutalis* (Walker, [1859])	c, w	3	24 Apr 2009
238	*310*	Herminiinae genus & sp. A	r, rd	2	16 Oct 2009
239	*311*	*Hydrillodes abavalis* (Walker, [1859] 1858)	c, w	1	24 Apr 2009
240	*312*	*Hydrillodes lentalis* Guenée, 1854	c, w	1	24 Apr 2009
241	*313*	*Nodaria externalis* Guenée, 1854	c, w	9	24 Apr 2009, 16 Oct 2009
242	*314*	*Polypogon biasalis* (Walker, 1858)	f, w	3	16 Oct 2009
243	*315*	*Polypogon fractalis* (Guenée, 1854)	f, w	9	24 Apr 2009, 16 Oct 2009
244	*316*	*Progonia oileusalis* (Walker, 1858)	c, w	2	16 Oct 2009
245	*317*	*Simplicia bimarginata* Walker, [1863]	f, l	1	16 Oct 2009
246	*318*	*Simplicia niphona* (Butler, 1878)	c, w	1	24 Apr 2009
Erebidae - Aganainae					
247	*198*	*Asota caricae* (Fabricius, 1775)	c, w	5	24 Apr 2009, 16 Oct 2009
248	*199*	*Asota heliconia* (Linnaeus, 1758)	c, w	3	24 Apr 2009, 16 Oct 2009
249	*200*	*Asota plaginota* Butler, 1875	c, w	1	16 Oct 2009
Erebidae - Pangraptinae					
250	*350*	*Pangrapta plumbilineata* Wileman & West, 1929	c, w	2	24 Apr 2009
Erebidae - Hypeninae					
251		*Dichromia sagitta* (Fabricius, 1775)	u, w	1	28 May 2010
252	*319*	*Hypena conscitalis* Walker, [1866] 1865	s, rd	1	16 Oct 2009
253	*320*	*Hypena indicatalis* Walker, [1859] 1858	f, w	1	16 Oct 2009
254	*321*	*Hypena jocosalis* Walker, [1859] 1858	s, rd	1	24 Apr 2009
255	*322*	*Hypena occatus* Hampson, 1882	f, w	1	24 Apr 2009
256	*323*	*Hypenagonia* sp. A	vr, rd **NR**	1	24 Apr 2009
257	*324*	*Lysimelia alstoni* Holloway, 1979	f, w	2	16 Oct 2009
258	*325*	*Lysimelia neleusalis* Walker, [1859] 1858	f, w	1	16 Oct 2009
259	*326*	*Naarda ochreistigma* (Hampson, 1893)	f, rd	4	24 Apr 2009
260	*327*	*Rhynchina columbaris* (Butler, 1889)	r, rd	1	24 Apr 2009
Erebidae - Rivulinae					
261	*351*	*Rivula inconspicua* (Butler, 1881)	f, w	3	16 Oct 2009
262	*352*	*Rivula sasaphila* Sugi, 1982	u, l	2	24 Apr 2009
Erebidae - Scoliopteryginae					
263	*228*	*Cosmophila flava* (Fabricius, 1775)	c, w	4	16 Oct 2009
264	*233*	*Gonitis mesogona* Walker, [1858] 1857	c, w	2	24 Apr 2009
Erebidae - Calpinae					
265	*226*	*Anachrostis* sp. nr. *nigripuncta* Hampson, 1893	f, w	5	24 Apr 2009, 16 Oct 2009

266	*227*	*Calyptra minuticornis* (Guenée, 1852)	f, w	3	24 Apr 2009, 16 Oct 2009
267	*229*	*Dierna patibulum* (Fabricius, 1794)	u, l	5	24 Apr 2009, 16 Oct 2009
268		*Eudocima homaena* Hübner, [1823] 1816	f, l	2	1 Dec 1989, 1 Nov 1991
269	*231*	*Eudocima phalonia* (Linnaeus, 1763)	f, w	1	16 Oct 2009
270	*232*	*Goniocraspedon mistura* (Swinhoe, 1891)	f, l	1	16 Oct 2009
271	*234*	*Oraesia emarginata* (Fabricius, 1794)	f, w	3	16 Oct 2009
272		*Oraesia excavata* (Butler, 1878)	f, w	1	31 Oct 1989
273		*Plusiodonta coelonota* (Kollar, 1844)	f, w	1	18 Jul 1992
		Erebidae - Hypenodinae			
274	*328*	*Luceria oculalis* (Moore, 1877)	f, w	1	16 Oct 2009
275	*329*	*Luceria striata* Galsworthy, 1997	p**VU HK**; f, w	1	24 Apr 2009
		Erebidae - Boletobiinae			
276	*264*	*Maguda suffusa* (Walker, 1863)	c, w	3	24 Apr 2009, 16 Oct 2009
		Erebidae - Aventiinae			
277	*217*	*Cerynea contentaria* (Walker, 1861)	c, w	2	16 Oct 2009
278	*218*	*Cerynea discontenta* Galsworthy, 1998	p**NT HK**; f, w	5	24 Apr 2009, 16 Oct 2009
279	*219*	*Cerynea ustula* (Hampson, 1898)	c, w	4	24 Apr 2009
280	*220*	*Lasperyria ruficeps* (Walker, 1864)	vc, w	6	24 Apr 2009, 16 Oct 2009
281	*221*	*Corgatha trichogyia* Hampson, 1907	f, w	1	24 Apr 2009
282	*195*	*Enispa elataria* (Walker, 1861)	c, w	3	16 Oct 2009
283	*222*	*Metaemene atriguttata* (Walker, 1862)	f, w	2	24 Apr 2009, 16 Oct 2009
284	*223*	*Ataboruza semilux* (Walker, 1865)	s, l	1	16 Oct 2009
		Erebidae - Araeopteroninae			
285	*203*	*Araeopteron amoenum* Inoue, 1958	r, rd	1	16 Oct 2009
286	*204*	Araeopteroninae sp. A	r, rd	1	24 Apr 2009
		Erebidae - Eublemminae			
287	*287*	*Eublemma albostriata* Wileman & West, 1929	f, l	1	24 Apr 2009
288	*288*	*Eublemma baccalix* (Swinhoe, 1886)	f, l	1	24 Apr 2009
289	*289*	*Eublemma ragusana* (Freyer, 1845)	c, w	6	24 Apr 2009
		Erebidae - Anobinae			
290	*250*	*Crithote horridipes* Walker, 1864	c, w	3	24 Apr 2009
291	*269*	*Plecoptera luteiceps* (Walker, 1865)	c, w	1	24 Apr 2009
292	*276*	*Tephriopis divulsa* (Walker, 1865)	c, w	2	12 Aug 2006, 16 Oct 2009
		Erebidae - Erebinae			
293	*235*	*Arsacia rectalis* (Walker, 1863)	c, w	1	16 Oct 2009
294	*236*	*Bastilla absentimacula* (Guenée, 1852)	c, l	1	24 Apr 2009
295	*237*	*Bastilla analis* (Guenée, 1852)	f, l	2	16 Oct 2009
296	*238*	*Bastilla crameri* (Moore, [1885] 1884-1887)	u, l	2	23 Aug 2007, 24 Apr 2009
297	*239*	*Bastilla maturata* (Walker, 1858)	f, w	1	24 Apr 2009
298	*240*	*Bastilla maturescens* (Walker, 1858)	u, l	3	24 Apr 2009, 16 Oct 2009
299	*241*	*Bastilla simillima* (Guenée, 1852)	u, l	4	24 Apr 2009, 16 Oct 2009
300	*247*	*Calesia haemorrhoa* Guenée, 1852	r, rd	2	16 Oct 2009
301	*248*	*Chalciope mygdon* (Cramer, 1777)	f, w	3	16 Oct 2009
302	*251*	*Dysgonia stuposa* (Fabricius, 1794)	f, w	2	Oct 2006, 16 Oct 2009
303	*253*	*Ericeia elongata* Prout, 1929	c, w	1	16 Oct 2009
304	*254*	*Ericeia inangulata* (Guenée, 1852)	u, l	5	24 Apr 2009, 16 Oct 2009
305	*255*	*Ericeia subcinerea* (Snellen, 1880)	vc, w	3	24 Apr 2009, 16 Oct 2009
306	*259*	*Hypopyra contractipennis* (Joannis, 1912)	f, l	1	16 Oct 2009
307	*260*	*Hypopyra vespertilio* (Fabricius, 1787)	c, w	2	24 Apr 2009
308	*267*	*Ophiusa tirhaca* (Cramer, 1780)	u, l	1	24 Apr 2009
309	*268*	*Oxyodes scrobiculata* (Fabricius, 1775)	c, w	3	12 Aug 2007, 24 Apr 2009
310	*279*	*Erebus ephesperis* (Hübner, [1823] 1816)	c, w	1	24 Apr 2009
311	*280*	*Mocis frugalis* (Fabricius, 1775)	c, w	1	16 Oct 2009

312	*281*	*Mocis undata* (Fabricius, 1775)	c, w	6	24 Apr 2009, 16 Oct 2009
313	*282*	*Pantydia metaspila* (Walker, [1858] 1857)	r, rd	1	24 Apr 2009
314	*283*	*Rema costimacula* (Guenée, 1852)	vc, w	4	24 Apr 2009, 16 Oct 2009
315	*284*	*Rhesala imparata* Walker, 1858	c, w	1	16 Oct 2009
316		*Spirama retorta* (Clerck, 1759)	u, w	1	20 Jun 2008
317		*Tinolius hypsana* Swinhoe, 1889	u, l	2	26 Mar 1989, 1 Jun 2010
				2 (larva)	12 May 2008, 4 Aug 2008
Erebidae - unplaced to subfamily					
318	*242*	*Blasticorhinus enervis* (Swinhoe, 1890)	f, w	3	24 Apr 2009, 16 Oct 2009
319	*243*	*Blasticorhinus rivulosa* (Walker, 1865)	f, w	1	24 Apr 2009
320	*244*	*Bocula diffisa* (Swinhoe, 1890)	u, w	2	24 Apr 2009, 16 Oct 2009
321	*245*	*Bocula marginata* (Moore, 1882)	c, w	3	24 Apr 2009, 16 Oct 2009
322	*246*	*Britha pactalis* (Walker, [1859] 1858)	u, l	2	24 Apr 2009, 16 Oct 2009
323	*249*	*Chorsia albiscripta* (Hampson, 1897)	c, w	1	16 Oct 2009
324	*270*	*Chorsia perversa* (Walker, 1863)	r, rd	8	24 Apr 2009, 16 Oct 2009
325		*Egnasia seclusalis* (Walker, [1866] 1865)	c, w	1	9 Aug 2009
326	*252*	*Ercheia cyllaria* (Cramer, 1779)	c, w	4	24 Apr 2009, 16 Oct 2009
327	*256*	*Erygia apicalis* Guenée, 1852	c, w	3	24 Apr 2009
328	*257*	*Gesonia obeiditalis* Walker, [1859] 1858	c, w	1	16 Oct 2009
329	*258*	*Hepatica irrorata* (Wileman & South, 1917)	s, rd	1	16 Oct 2009
330	*261*	*Ischyja manlia* (Cramer, 1766)	c, w	2	24 Apr 2009, 16 Oct 2009
331	*262*	*Lophathrum comprimens* (Walker, 1858)	c, w	4	24 Apr 2009, 16 Oct 2009
332	*263*	*Loxioda similis* (Moore, 1882)	f, w	1	16 Oct 2009
333	*265*	*Mecodina agrestis* (Swinhoe, 1890)	f, l	1	24 Apr 2009
334	*266*	*Mecodina diastriga* Hampson, 1926	s, l	1	24 Apr 2009
335	*271*	*Saroba pustulifera* Walker, 1865	c, w	3	24 Apr 2009, 16 Oct 2009
336	*272*	*Sarobides inconclusa* (Walker, [1863] 1864)	f, l	1	16 Oct 2009
337	*273*	*Sympis rufibasis* Guenée, 1852	c, w	3	24 Apr 2009, 16 Oct 2009
338	*274*	*Tamba apicata* (Hampson, 1902)	c, l	1	24 Apr 2009
339	*275*	*Taviodes fulvescens* Hampson, 1926	s, rd	1	16 Oct 2009
340	*277*	*Ugia purpurea* Galsworthy, 1997	p**NT HK**; vc, w	5	24 Apr 2009, 16 Oct 2009
Euteliidae - Euteliinae					
341	*295*	*Anuga multiplicans* (Walker, 1858)	f, w	1	24 Apr 2009
Nolidae - Nolinae					
342	*337*	*Barasa acronyctoides* Walker, 1862	f, w	1	24 Apr 2009
343	*340*	*Manoba brunellus* (Hampson, 1893)	c, w	3	16 Oct 2009
344	*341*	*Melanographia flexilineata* (Hampson, 1898)	c, w	1	16 Oct 2009
345	*343*	*Nola marginata* Hampson, 1895	f, w	1	24 Apr 2009
346	*344*	*Nola pumila* Snellen, 1875	c, w	4	24 Apr 2009
347	*345*	*Nola* sp. C nr. *cretacea*	f, w	2	24 Apr 2009, 16 Oct 2009
348	*346*	Nolini sp. indet. #1	dd	1	24 Apr 2009
Nolidae - Chloephorinae					
349		*Carea varipes* Walker, [1857] 1856	c, w	1	9 Aug 2009
350	*338*	*Garella ruficirra* (Hampson, 1905)	u, rd	1	24 Apr 2009
351	*339*	*Giaura multipunctata* Swinhoe, 1919	c, l	1	16 Oct 2009
352		*Labanda semipars* (Walker, 1858)	s, l	1	10 Apr 1989
353	*347*	*Paracrama dulcissima* (Walker, [1863] 1864)	c, w	1	24 Apr 2009
Nolidae - Westermanniinae					
354	*342*	*Negeta signata* (Walker, [1863] 1864)	c, w	1	24 Apr 2009
Nolidae - unplaced to subfamily					
355	*348*	*Selepa celtis* Moore, 1858	f, w	1	16 Oct 2009
356	*349*	*Selepa discigera* (Walker, [1863] 1864)	u, l	1	24 Apr 2009

Noctuidae - Plusiinae					
357		*Chrysodeixis eriosoma* (Doubleday, 1843)	c, w	1	15 May 2004
Noctuidae - Bagisarinae					
358	*290*	*Amyna axis* (Guenée, 1852)	f, w	2	16 Oct 2009
359	*291*	*Amyna punctum* (Fabricius, 1794)	f, w	3	24 Apr 2009, 16 Oct 2009
360	*224*	*Chasmina fasciculosa* (Walker, 1858)	u, l	1	24 Apr 2009
361	*225*	*Ramadasa pavo* (Walker, 1856)	r, rd	1	24 Apr 2009
362		*Xanthodes transversa* Guenée, 1852	f, w	3 (larvae)	12 May 2008, 5 Sep 2009 21 Sep 2009
Noctuidae - Eustrotiinae					
363	*292*	*Maliattha separata* Walker, 1863	f, w	2	16 Oct 2009
364	*293*	*Maliattha signifera* (Walker, [1858] 1857)	c, w	1	24 Apr 2009
Noctuidae - Acontiinae					
365	*194*	Acontiinae genus & sp. B	**HK** r, rd	3	24 Apr 2009
366	*230*	*Ecpatia longinqua* (Swinhoe, 1890)	c, w	6	20 Jun 1992, 16 Oct 2009
Noctuidae - Acronictinae					
367	*196*	*Belciana scorpio* Galsworthy, 1997	p**VU HK**; f, l	2	24 Apr 2009
368	*197*	*Tycracrona obliqua* Moore, 1882	f, l	1	16 Oct 2009
Noctuidae - Agaristinae					
369		*Episteme lectrix* (Linnaeus, 1764)	u, w	1	16 Sep 1988
370	*201*	*Mimeusemia postica* (Walker, 1862)	c, w	1	24 Apr 2009
371	*202*	*Sarbanissa albifascia* (Walker, 1865)	u, w	1	24 Apr 2009
Noctuidae - Condicinae					
372	*278*	*Condica conducta* (Walker, [1857] 1856)	c, w	16	24 Apr 2009, 16 Oct 2009
Noctuidae - Eriopinae					
373	*285*	*Callopistria apicalis* (Walker, 1855)	c, w	1	16 Oct 2009
374	*286*	*Callopistria exotica* (Guenée, 1852)	c, w	5	24 Apr 2009, 16 Oct 2009
Noctuidae - Noctuinae					
375	*294*	*Pseudeustrotia semialba* (Hampson, 1894)	c, w	2	24 Apr 2009
376	*304*	*Spodoptera litura* (Fabricius, 1775)	c, w	6	1 Aug 2008, 16 Oct 2009
377	*296*	*Athetis bremusa* (Swinhoe, 1885)	c, w	1	16 Oct 2009
378	*297*	*Athetis cognata* (Moore, 1882)	c, w	5	16 Oct 2009
379	*298*	*Athetis hongkongensis* Galsworthy, 1997	p**NT HK**; c, w	2	24 Apr 2009
380	*299*	*Athetis obtusa* (Hampson, 1891)	u, w	4	24 Apr 2009
381	*300*	*Athetis ochracea* (Hampson, 1894)	u, l	1	16 Oct 2009
382	*301*	*Athetis thoracica* (Moore, [1885] 1884-1887)	f, w	2	16 Oct 2009
383		*Paradiopa postfusca* (Hampson, 1893)	c, w	1	18 Jul 1992
384	*305*	*Tiracola aureata* Holloway, 1989	c, w	2	24 Jul 1992, 16 Oct 2009
385	*306*	*Trachea auriplena* (Walker, 1857)	f, w	1	24 Apr 2009
386	*302*	*Mythimna moorei* (Swinhoe, 1902)	s, l	1	16 Oct 2009
387	*303*	*Mythimna reversa* (Moore, [1885] 1884-1887)	c, w	6	16 Oct 2009

Notes on *Vespa analis* and *Vespa mandarinia* (Hymenoptera, Vespidae) in Hong Kong, and a key to all *Vespa* species known from the SAR

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Abstract

A brief summary of two uncommon hornet species in Hong Kong, *Vespa analis* and *Vespa mandarinia*, is provided,with notes on their biology in other regions. A key to all species of *Vespa* occurring in Hong Kong is also given.

Key words: Hymenoptera, Vespidae, Vespinae, *Vespa*, *analis*, *mandarinia*, hornet, wasp

Introduction

Vespa analis Fabricius, 1775 and *Vespa mandarinia* Smith, 1852 are hornet species with fairly wide distributions throughout East Asia. Both species are present in Hong Kong, which lies within their distributional range, although they are uncommon and rarely seen. This paper presents some background information regarding both species, with notes on their distribution and previous records within Hong Kong, as well as on their biology from what is known about them in other parts of their range.

Identification

Eight species of *Vespa* (hornets) are present in Hong Kong, of which six are common and regularly seen. The two uncommon species covered in this paper can easily be identified by the following characteristics: they are medium-sized to very large species with the last abdominal segment completely orange-yellow. The last abdominal segment of all other local species is always either completely dark or partly reddish, except for *Vespa bicolor* Fabricius, 1787, which however is a small and very distinct species that cannot be mistaken for anything else. A key to the eight known *Vespa* species in Hong Kong is given here. This key is based on both structural and colour characteristics, and is intended mainly for use within Hong Kong, as individuals of some species exhibit considerable differences in colour in other regions. Measurements are taken from specimens in my personal collection.

1. a. Ground colour, including entire abdomen, light yellow. Small species (queens 25mm, workers generally under 20mm) - ***Vespa bicolor*** Fabricius, 1787.
b. Ground colour not entirely yellow. **- 2**

2(1). a. Head entirely yellow or orange. - **3**
b. Head either completely or partly (vertex, frons, part of gena) dark brown or black. - **4**

3(2). a. Head strongly widened, with gena enlarged behind the eyes and at least 1.8x as wide as the eye in the female
or 1.3x in the male from a lateral view. - **5**
b. Head not strongly widened, with gena being equal to or narrower than the eye when viewed laterally. - **6**

4(2). a. Frons, vertex black. Clypeus, mandibles and lower part of gena predominantly orange. Thorax fully black. Ground colour of abdomen black with metallic gold sheen. Last abdominal segment partly reddish. Small to medium-sized (queens to 28mm, workers generally under 24mm) - ***Vespa velutina*** Lepeletier, 1836.
b. Head reddish brown. Abdomen black apart from a distinct yellow band. - **7**

5(3). a. Sixth abdominal segment entirely yellow. Abdomen with orange or yellow bands which may vary greatly in width between individuals and populations. Very large species (queens may reach or exceed 45mm, workers between 25mm and 40mm).- ***Vespa mandarinia*** Smith, 1852.
b. Sixth abdominal segment black. Abdomen largely black, apart from first two segments coloured with bands of orange, yellow and black. Very large species (queens to 46mm, workers between 23mm and 39mm). - ***Vespa soror*** du Buysson, 1905.

6(3). a. Sixth abdominal segment entirely yellow. Abdomen dark brown with yellow or orange bands which may vary greatly in width. A rather blunt, triangular tooth present on the anterior margin of the clypeus. Generally medium-sized species (22mm to 30mm), although some individuals may attain larger sizes. - ***Vespa analis*** Fabricius, 1775
b. Sixth abdominal segment black. Abdomen largely black, apart from first two segments coloured with bands of orange-brown, yellow and black, and sometimes a thin yellow band at the posterior margin of the second tergite. Large species (22mm to 35mm) - ***Vespa ducalis*** Smith, 1852.

7(4). a. Yellow band on abdomen comprising of only second tergite largely yellow. Larger species (20mm to 34mm). - ***Vespa tropica*** (Linnaeus, 1758).

b. Yellow band on abdomen comprising of both first and second terga largely yellow. Smaller species . - ***Vespa affinis*** (Linnaeus, 1764), (workers generally under 24mm, queens up to 30mm).

Vespa analis and *V. mandarinia* are fairly similar in appearance, and a large individual of *V. analis* or a small individual of *V. mandarinia* might be confused with the other species at a glance while flying past, but both are easily separable by structural attributes, the most obvious of which would be the strongly enlarged head of *V. mandarinia*, with the gena proportionately wider in comparison to the eye in side profile (at least 1.8x in the female). *V. analis*, on the other hand, is the only *Vespa* species known to have a median tooth on the anterior margin of the clypeus.

Notes on *Vespa analis*

Vespa analis is widely distributed throughout East and Southeast Asia, with the southernmost limit of its range being Indonesia and extending all the way to Eastern Russia and India (Archer 1998; Carpenter and Kojima 1997). In Hong Kong, there appear to be two distinct colour forms (pers. obs.). The more commonly seen form is reddish brown with a yellow head. The pronotum is often reddish, but sometimes the same ground colour as the rest of the thorax. The abdomen is brown with a strong red tinge, the apical margin of each segment having an orange-yellow band which may vary considerably in width between individuals. This form can somewhat resemble the common Chinese-Japanese colour form of *V. mandarinia* in appearance. In the other colour form, which appears to be exceedingly rare, the ground colour is an even darker brown with hardly any reddish tinge, and with the yellow bands being merely thin lines. This species is extremely variable in size, with most individuals in Hong Kong being approximately 22mm to 30mm (pers. obs.). Some individuals may be much larger, although this is more common with individuals from Southeast Asian regions such as Singapore (pers. obs.). There is not much difference in size between queens and late workers in mature colonies.

Vespa analis appears uncommon in Hong Kong, although it does not appear to have a very limited local distribution. I have seen it mainly in the New Territories, namely in many parts of Sai Kung, Ma On Shan, Tai Po, Fanling, Sheung Shui, Yuen Long and Tuen Mun. I have also seen individuals in Aberdeen Country Park, Victoria Peak and Lamma Island. A majority (70%; n = ?) of these records were of the more common colour form, with the darker colour form, which is identical to that formerly described as subspecies "*Vespa analis nigrans*" found in various parts of continental Asia including Peninsular Malaysia and Vietnam (Martin 1995; Nguyen et al 2006; Vecht 1957), being very rare and limited to Sai Kung and the Northern New Territories.

I have yet to personally see a nest of *V. analis* in Hong Kong. However, I have seen photos by local photographers of abandoned nests located among dense clusters of small trees in country parks or, in one case, a cave, which appear to be of this species. *V. analis* nests somewhat resemble nests of *Vespa affinis* (Linnaeus, 1764) but do not generally reach such large sizes. In addition, the markings on the envelope are quite distinctive, the circular patterns being generally very large and highly contrasting in colour. The envelope is typical of an aerial-nesting hornet, being complete and covering the nest completely except for a single entrance situated laterally on one side of the envelope. Nests and colonies in subtropical Hong Kong would probably be smaller than their counterparts in tropical equatorial regions but larger than those in temperate regions; they could possibly reach a maximum of 40cm in vertical length and 30cm wide, and colonies would probably comprise of up to 200 wasps or fewer at their peak. Although the exact colony cycle in Hong Kong is unknown, it can be expected to be fairly long, as new queens often appear during March or April, and I have seen workers attempting to catch prey such as butterflies as late as early January.

In March to April, new queens can generally be seen feeding on nectar from flowers of *Litchi chinensis* (lychee) and *Dimocarpus longan* (longan). In summer, workers feed on flowers and rotting fruit of *Musa sp.* (banana). Towards September to January, the workers and possibly males and new queens frequent various species of *Camellia*. In terms of prey choice, this species is a generalist predator, which will capture any smaller insects, especially flying ones near flowers. I have observed it catching honeybees and butterflies in Hong Kong, and have witnessed individuals in Singapore capture dragonflies as well.

Vespa analis is, as mentioned above, by no means restricted in its distribution in Hong Kong, although it appears to be more abundant in country parks and rural areas. However, a small number of sightings have been made in urban parks, mainly in Fanling, Sheung Shui and Yuen Long. It appears to be more common at higher altitudes, with most sightings so far having been made at elevations between 100m and 700m. There appears to be a small but thriving population of this species locally, and it might not actually be as rare as it appears to be. One reason for its apparent rarity and difficulty in finding nests is its exceedingly shy nature, which is apparent in its flight pattern (pers. obs.).. Workers of this species generally fly close to dense vegetation, often cutting in and out, therefore trying to follow a foraging worker can be extremely difficult. In fact, a large insect with the abdomen sporting a yellow tip disappearing into the foliage of a tree or bush is often all that is seen of this species. Even at flowers of fruit trees or *Camellia* trees, it will fly back into the canopy to access flowers at another side of the tree, rather than flying around on the outside. This species is also alert and difficult to approach - it will flee at the slightest disturbance. The only time it is more approachable is when feeding on banana flowers or rotting fruits in summer.

In Singapore, *V. analis* is extremely abundant and will even

nest in urban areas (pers. obs.). However, the nests are not always easy to find. I have, on several occasions, followed a distinct flight path leading into a tree or cluster of shrubs, thinking the nest would definitely be within, only to find out that the said tree or bushes turned out to be merely a 'transit point' - the wasps would then fly out from the foliage at an angle to their original flight path, in another direction. The actual nest was often located in another tree, not necessarily within view of the transit point, and in fact one colony I observed used two such transit points before returning to the nest, which was about 60m and 20m away from the first and second clusters of shrubs respectively. This strange behaviour seems to function well in helping nests escape detection from natural predators. Indeed, even in urban areas with high human traffic many nests go unnoticed and complete their colony cycle without being discovered due to the species' secretive nature. The flight manner of *V. analis* in Hong Kong appears identical to their counterparts in Singapore (pers. obs.). Due to the fact that *V. analis* is much rarer locally as compared to in Singapore and is more confined to rural areas and country parks, nests in Hong Kong would prove very difficult to locate.

In contrast to its shy, secretive habits, *V. analis* is highly aggressive and territorial around sources of food such as flowers and fruit. Individuals often attack and chase other hornets, preventing them from landing and feeding. Even smaller-sized individuals often dominate larger individuals of *V. ducalis* and *V. tropica*. It is probable that only *V. soror* and *V. mandarinia* are more aggressive and dominate *V. analis* at such sources of food. In addition, *V. analis* is also said to be the species most likely to successfully repel or kill *V. mandarinia* in defense of their nest in Japan (Matsuura and Sakagami 1973). However, *V. analis* is known to be a fairly placid and unaggressive species in regards to colony defence (Matsuura 1973a; Vecht 1957; Starr 1992; personal observations). Workers generally pay no attention to people moving near the nest, and only attack if the nest is actually disturbed. The number of attacking workers is usually fairly small and the distance over which the attacking wasps give chase usually not very far. Still, it is wise to avoid disturbing nests of any social wasp.

Notes on *Vespa mandarinia*

Vespa mandarinia is also widely distributed throughout East Asia and shares much of its range with *Vespa analis*. Indeed, the Chinese name for *V. analis* translates roughly to "mimic of *V. mandarinia*" (Li 1985; Yamane and Wang 1996). This is largely due to the fact that *V. analis* in any given region often somewhat resembles the colour form of *V. mandarinia* in the same locality.

Vespa mandarinia is fairly well-studied in Japan (Archer 1995; Matsuura and Sakagami 1973; Yamane and Makino 1977) and is one of the best-known hornets due to it being the largest known hornet species and the harm it poses to beekeepers. Although single individuals will hunt any smaller insect they can overpower, the species is best known for its ability to launch coordinated attacks on nests of honeybees and other social wasps. This usually takes place late in the season, prior to the emergence of reproductives (males and new queens), and can probably be attributed to a greatly increased need for nutrition for the large number of larvae which will become reproductives, the only ones intended to survive and carry on the next generation. The attacking process can be divided into three stages, namely the hunting phase, slaughter phase and occupation phase (Matsuura and Sakagami 1973). *V. mandarinia* was previously thought to be the only species to do this, but in Hong Kong the closely related *V. soror* commonly does this too and is a considerable menace to the beekeeping industry locally (Lee, 2009).

The colony cycle of *V. mandarinia* in Hong Kong is not known, but can be assumed to be fairly long, since its colony cycle in temperate Japan is known to be quite long as well (Archer 1995). Colony cycles of most *Vespa* species are longer in the tropics than in the subtropics, and in turn longer in subtropical regions compared to temperate regions. The species usually nests underground and sometimes in tree hollows or very rarely, within buildings in rural areas (Matsuura and Koike 2002). The nest is fairly large, usually comprising four to seven combs, although larger nests with more combs have been reported in Taiwan (Yamane and Wang 1996), so it is definitely possible that nests and colonies in subtropical Hong Kong can reach larger sizes than in temperate regions. The envelope is incomplete, covering the sides of the nest but leaving the bottom exposed - this is typical of many ground-dwelling hornets (Matsuura 1973b). The cavity is enlarged by the wasps as the nest grows, and the workers spend a lot of time excavating earth, compacting it into small pellets and depositing these pellets outside the nest entrance, rather than flying off and dropping them some distance from the nest, as some other *Vespa* species do (Matsuura 1991; Matsuura and Sakagami 1973). *V. mandarinia* was once thought to be the only hornet to exhibit this excavation behaviour (Matsuura 1991), although the closely related *V. soror* also does so, and *V. tropica* as well (pers. obs.). The presence of excavated soil pellets is often how nests are discovered (Matsuura and Sakagami 1973). The workers are aggressively territorial, and will fly out to investigate and warn off any moving object near the nest, therefore it is strongly recommended that one maintain a safe distance of more than three metres should a nest be encountered. All these aspects of its biology also apply to *V. soror*; the two species are clearly extremely similar in biology.

Vespa mandarinia has previously been recorded from Hong Kong (Carpenter and Kojima 1997; Vecht 1959), and a series collected from various localities in China in the Muséum National d'Histoire Naturelle (National Museum of Natural History, Paris) collection apparently includes specimens from Hong Kong (Vecht 1959). As quoted directly from Vecht: "A series from various localities (Se-Tchouen, Ta-Tsien-Lou, Siao-Lou, Hongkong, Kiangsi, Shanghai and Kouy-Tcheou, region de PinFa) (MP)". Vecht also noted that the Chinese specimens were somewhat variable in colour, but generally had the dark bands on the abdomen thinner

than specimens from Japan, and with the pronotum more constantly ferruginous. So far, the individuals observed by the author in Hong Kong generally agree with this statement in having the dark bands thinner than specimens from Japan (i.e., the yellow bands consequently wider in proportion to the black bands), although I have not had access to a large enough sample of specimens to confirm this definitively.

Vespa mandarinia appears extremely rare in Hong Kong. Its distribution in Hong Kong appears generally confined to the outlying islands, although some beekeepers in Fanling and Yuen Long have related incidents of this species attacking their hives to the author; however, they noted that these incidents took place many years back and that *V. mandarinia* have not been seen in their apiaries for a long time. I have only three confirmed personal records of this species locally. The first of these was an enormous individual, probably a new queen, feeding on banana flowers in Pui O, Lantau Island, on May 1996. No collecting equipment or holding containers were at hand and thus the individual was not collected. The second was found dead on Lamma Island in April 2008 by the author along with Christophe Barthelemy and Chan Kam Wah. It was a rather small individual, possibly one of the earliest workers to emerge. The third confirmed sighting occured on Lantau Island near Ngong Ping, where an individual clearly belonging to this species was observed in flight. Several other sightings which could apparently be of this species but could not be confirmed positively have been made by the author and Chan Kam Wah on Lantau Island, Lamma Island and Tung Ping Chau. Paul Aston also related cases of large hornets attacking nests of *Polistes olivaceus* and *Parapolybia varia* in Mui Wo, Lantau. He noted two of the largest species, one of which could be clearly identified as *V. soror*, while the other, which he described as even larger and stockier with distinct banding, clearly fitted the description of *V. mandarinia*. Besides the Chinese-Japanese colour form, a beekeeper in Fanling related an incident in which a single large hornet captured bees from a hive entrance; his description fitted the "Western colour form" (which is often referred to as *V. magnifica* or *V. mandarinia magnifica* in older publications) of the species; this form can be found in Western China as well as Northern Thailand and North Vietnam. While it is not impossible that two colour forms would co-exist locally, as is seen with *V. analis*, I have not seen the wasp in question and cannot rule out the possibility of it being a large individual of the darker colour form of *V. analis*, which closely resembles the Western colour form of *V. mandarinia*. Therefore the presence of this second colour form in Hong Kong cannot be confirmed at this point.

Conclusion

From my limited personal observations, although large individuals of *V. analis* may be mistaken for small individuals of *V. mandarinia*, the flight pattern of the two species differs considerably, with the latter often flying boldly and in the open. On the one occasion I approached an individual at banana flowers, it circled boldly upon being disturbed and did not flee quickly as *V. analis* usually does. Furthermore, even small individuals *of V. mandarinia* are proportionately more robust and stocky in shape and this is another factor which may help in distinguishing the two species. In short, both species can be distinguished fairly accurately from each other even at a distance.

The apparent rarity of *V. mandarinia* in Hong Kong is somewhat unexpected, considering that this species has fairly large colonies, a long colony cycle and the fact that workers covers substantial distances in their search for the great amount of food needed to sustain the colony. One would naturally assume that the individual wasps, at least, would be more visible. However, this is apparently not uncommon over parts of its range. *V. mandarinia* and *V. soror* do not have much geographical overlap, but in many places where they do, *V. soror* is often the more common species with *V. mandarinia* being very scarce and limited in distribution. This is so in Vietnam (Nguyen and Carpenter 2002; Nguyen et al 2006) and also in China's Guangdong Province (personal communication with several professional hornet hunters who capture entire nests for the brood which are often eaten in rural parts of China). Clearly, more research into *V. mandarinia* in Hong Kong will be required to learn more about its biology locally.

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References

Archer, M.E. 1995. Taxonomy, distribution and bionomics of the *Vespa mandarinia* group (Hymenoptera, Vespinae). *Entomologist's Monthly Magazine* 131: 47-53.

Archer, M.E. 1998. Taxonomy, distribution and nesting biology of *Vespa analis* F. (Hym., Vespidae). *Entomologist's Monthly Magazine* 134: 215-222.

Barthelemy, C. 2008. A provisional identification guide to the social Vespids of Hong Kong (Hymenoptera: Vespidae). (Downloadable at http://www.insectahk.com/book_page.html).

Carpenter, J.M. and Kojima, J. 1997. Checklist of the species in the subfamily Vespinae (Insecta: Hymenoptera: Vespidae). *Natural History Bulletin*, Ibaraki University, 1: 51-92.

Lee, J.X.Q. 2009. *Potentially dangerous bees and wasps of Hong Kong*. Hong Kong Entomological Society Popular Entomology Book Series #2.

Li, T.S. 1985. *Economic Insect Fauna of China*, Fasc 30 - Hymenoptera, Vespoidea. Science Press, Beijing, China. [In Chinese].

Matsuura, M. 1973a. Nesting habits of several species of the genus Vespa in Formosa. *Kontyû* 41 (3): 286-293.

Matsuura, M. 1973b. Nesting sites of the Japanese Vespa species. *Kontyû* 39 (1): 43-54.

Matsuura, M. 1991. Vespa and Provespa. In: *The Social Biology of Wasps*, (Ross, K.G. and Matthews, R.W. eds.). Cornell University Press.

Matsuura, M. and Koike, K. 2002. Studies on the ecology of social wasps and bees in urban environments 1. Records on aerial nests of the giant hornet, *Vespa mandarinia japonica* (Hymenoptera: Vespidae) within human buildings. *Med. Entomol. Zool.* 53(3): 183-186.

Matsuura, M. and Sakagami, S. 1973. A bionomic sketch of the giant hornet, *Vespa mandarinia*, a serious pest for Japanese apiculture. *Journal of the Faculty of Science*, Hokkaido University Series VI. Zoology, 19(1): 12-162.

Martin, S.J. 1995. Hornets (Hymenoptera: Vespinae) of Malaysia. *Malayan Nature Journal* 49: 71-82.

Nguyen, T.P.L. and Carpenter, J.M. 2002. Vespidae of Vietnam (Insecta: Hymenoptera) 1. Vespinae. *Journal of the New York Entomological Society* 110(2): 199-211.

Nguyen, T.P.L., Saito, F., Kojima, J. and Carpenter, J.M. 2006. Vespidae of Viet Nam (Insecta: Hymenoptera) 2. Taxonomic notes on Vespinae. *Zoological Science* 23: 95-104.

Starr, C.K. 1992. The social wasps (Hymenoptera: Vespidae) of Taiwan. *Bulletin of the National Museum of Natural Science*, Taichung 3: 93-138.

Vecht, J. van der 1957. The Vespinae of the Indo-Malayan and Papuan areas (Hymenoptera, Vespidae). *Zool. Verh*. (Leiden) 34: 1-83.

Vecht, J. van der 1959. Notes on Oriental Vespinae, including some species from China and Japan (Hymenoptera, Vespidae). *Zool. Meded*. 36: 205-232.

Yamane, Sk. and Makino, S. 1997. Bionomics of Vespa analis insularis and V. mandarinia latilineata in Hokkaido, Northern Japan, with notes on Vespine embryo nests (Hymenoptera: Vespidae). *Insecta Matsumurana*, New Series 12.

Yamane, Sk. and Wang, H.Y. 1996. *Guide Book to Insects in Taiwan (16) - Hornets, Paper Wasps and Potter Wasps*. Shu Shin Publications, Taiwan.

Figure 1. A worker of *V. analis* on flower of *Musa* sp. (banana)

Figure 2. Another worker of *V. analis*

Figure 3. An individual of the dark colour form of *V. analis*

Figure 4. Frontal closeup of *V. analis*, showing the distinctive feature on the clypeus

Figure 5. Typical nest of *V. analis* in Singapore

Figure 6. Habitus of a worker *V. mandarinia*

Fig. 6a Lateral view

Fig. 6b Dorsal view

Fig. 6c Frontal view

Short Communication

Biological notes on *Challia hongkongensis* Ho & Nishikawa (Dermaptera: Pygidicranidae: Challinae)

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Abstract
The biology of *Challia hongkongensis* is described including the systematics, feeding habit and forceps function.

Key words: Dermaptera, *Challia hongkongensis*, Hong Kong, feeding habit

Introduction

The diet of earwigs varies from omnivorous, to purely carnivorous or herbivorous (Chen & Ma, 2004). Some species are regarded as agricultural pests (Zhang, 1996); some on the other hand are beneficial in controlling pests (Zeng et al, 2004). Locally, no observations of earwigs' feeding habits have previously been reported. The author observed a female *Challia hongkongensis* Ho & Nishikawa eat a nymph of the same species – the first report of this species' feeding behaviour.

Taxonomy and habitat of *Challia hongkongensis* Ho & Nishikawa, 2009

The genus *Challia* Burr, 1904 totally contains eight species restricted to the Oriental region. In the past, *Challia* was regarded as a Palaearctic genus (Moon & Kim, 1985). Nevertheless, two additional species were found in Vietnam (Anisyutkin, 1994; Anisyutkin & Gorokhov, 1998a and 1998b) and extended this genus from the Palaearctic further to South-East Asia. *Challia hongkongensis* Ho & Nishikawa, 2009 has recently been described from Hong Kong and is the third species represented in China (Nishikawa, 2006; Ho & Nishikawa, 2009). The allied species is *Challia gigantia* Nishikawa, 2006 but this differs in structure of the forceps and the male genitalia.

Challia hongkongensis is not a widely distributed species and is restricted to montane forest in Hong Kong.

From April to August, adults can be found actively hunting on rocks or leaves. It is a fast-moving insect that hunts at night. When disturbed, individuals move quickly to hide themselves under rocks or leaf litter. The habitat is confined to montane forest above 400 metres above sea level.

Eating habit and forceps function

On 21 August 2009, at Tai Tung Shan, north Lantau Island, around 700m above sea level, at midnight, a hunting female was observed eating a nymph of the same species. The author did not observe the hunting process but only saw the outcome (Figure 1). The adult female held the prey by its dentate forceps and bent the forceps toward its mouthparts to eat the prey (Fig. 2). Although the abdomen of the nymph was eaten, it was still alive and its head and antennae were moving. This probably proves that *Challia hongkongensis* uses its dentate forceps to hunt prey in the wild. In addition, *C. hongkongensis* is also considered to feed herbivorously based on a female observed at Kowloon Peak (Fig. 3), which possibly ate plant seeds or fruits.

From the above observations of this small nocturnal earwig, the species has varied diet including small insects and plant fruits. *C. hongkongensis* is considered to be an omnivorous earwig species.

In most earwigs, the inner margins of the forceps have sharp denticles. Their usage is related to the hunting and feeding habit. The inner denticles of the forceps of female and male *C. hongkongensis* are quite different in dentation and morphological structure (Figs. 4 and 5). In females, the forceps are almost straight and parallel-sided. The apices are curved inward and pointed. Each inner arm has 10 to 15 sharp teeth. The posterior teeth are longer than the anterior (basal) teeth. In males, the basal two thirds of the arms are curved outward while the posterior third of the forceps are almost parallel-sided. The curved part is smooth without any teeth. The posterior part is sparsely armed with four to six teeth. The teeth of the male forceps are as sharp as the female's, but slightly shorter. Generally, the teeth of the female forceps are denser than those of the male.

It is believed that earwigs use their forceps to kill and hunt their prey directly (Zeng et al, 2004). Keeping their "hunting weapon" (forceps) clean is important (Fig. 3). Furthermore, the function of long and sharp teeth can be considered as to hold and keep the prey. Based on the forcep structure of *Challia hongkongensis* and other allied members in the genus, the dentate inner arms provide evidence of their hunting method and eating habit in the wild. Although the teeth of the male forceps are weaker than in the female, they are believed to be strong enough to kill and hold prey, in addition to having an important function as display devices (Briceno and Eberhard, 1995). Therefore, the sexually dimorphic morphology of the forceps in *C. hongkongensis* is significant.

Conclusion

Challia hongkongensis is a localised earwig and is only known from Hong Kong. Its ecology needs further detailed study especially on its unknown parental behaviour and life cycle.

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References

Anisyutkin, L.N. 1994. A new species of the genus *Challia* Burr from Vietnam (Dermaptera, Pygidicranidae). *Proceedings of the Zoological Institute, RAS*, 257: 72-76. (In Russian).

Anisyutkin, L.N. and Gorokhov, A.V. 1998a. The second species of the genus *Challia* (Dermaptera, Pygidicranidae) from Vietnam. *Zoologicheskii Zhurnal*, **77**(2): 610-612. (In Russian).

Anisyutkin, L.N. and Gorokhov, A.V. 1998b. The second species of the genus *Challia* (Dermaptera, Pygidicranidae) from Vietnam. *Entomological Review*, **78**(4): 534-536. (English translation of Anisyutkin & Gorokhov 1998).

Briceno, D.R. and Eberhard, W.G. 1995. The functional morphology of male cerci and associated characters in 13 species of tropical earwigs (Dermaptera: Forficulidae, Labiidae, Carcinophoridae, Pygidicranidae). *Smithsonian Contributions to Zoology*, 555: 1-63.

Chen, Y.G. and Wang, Z.L. 2006. A new apple pest - earwig. *Northwest Horticulture*, 6: 25. [in Chinese]

Chen, Y.X. and Ma, W.Z. 2004. *Dermaptera. Fauna Sinica, Insecta vol.35*. Science Press, China. 420pp.

Ho, G.W.C. and Nishikawa, M. 2009. A new species of genus *Challia* Burr (Dermaptera: Pygidicranidae: Challinae) from Hong Kong and a new record of *Challia fletcheri* Burr from north Guangdong, China. *Japanese Journal of Systematic Entomology*, 2009: 367-374.

Moon, T.Y. and Kim, C.W. 1985. A review of the Far-east Palaearctic genus *Challia* Burr, including a new species *Challia kyusani* sp. nov. (Challinae: Dermaptera). Korean Journal of Entomology, 15: 55-60.

Nishikawa, M. 2006. Notes on the Challinae (Dermaptera: Pygidicranidae), with Descriptions of three new species from China, Korea and Japan. *Japanese Journal of Systematic Entomology*, 12(1): 17-31.

Zhang, Z.X. 1996. A new corn pest – *Ladiidae* sp. *Plant Protection Technology and Extension*, 16(2): 35. [In Chinese].

Zeng, L., Zhang, Z.H., Lu, Y.Y. & Zhang, W.Q. 2004. Response function of the earwig *Chaetospania* sp. on the banana moth *Opogona sacchari* (Bojer). *Journal of Huazhong Agricultural University*, 23(2): 218-221. [In Chinese].

Figure 1. Female *C. hongkongensis* holding prey by forceps

Figure 2. *C. hongkongensis* nymph as prey of adult female

Figure 3. Female *C. hongkongensis* cleaning its forceps; possible fruit diet

Figure 4. Male forceps

Figure 5. Female forceps


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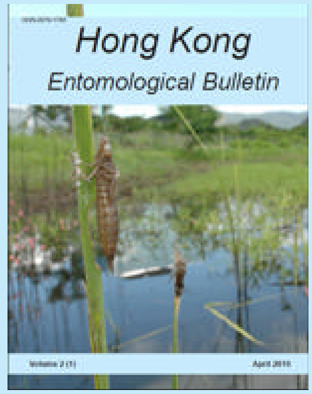
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