

THE ODONATE FAUNAS FROM TWO HONG KONG STREAMS, WITH DETAILS OF SITE CHARACTERISTICS AND DEVELOPMENTAL THREATS*

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A large number of streams throughout the territory of Hong Kong were sampled for dragonfly larvae between 1991 and 1995. Streams in 2 locations were found to support extremely diverse and abundant populations of gomphids and macromiines. The site details and characteristics of these 2 stream localities at Sha Lo Tung and Tai Tong are described together with information on all odon. spp. found at these sites. The odon. populations of both sites are important internationally and are threatened by developmental pressures. A brief account of these threats is provided.

INTRODUCTION

Hong Kong has a land area of 1092 km² comprised of the New Territories, Hong Kong Island, Lantau Island and over 230 smaller islands. Its topography is characterised by steep granitic and volcanic mountains with no lowland rivers of any significant size. There are few permanent water bodies with the exception of man-made reservoirs. Eighty percent of the 2-2.5 metres of annual rainfall falls in the hot wet season from May to September. The mountain areas are now relatively undisturbed when compared with neighbouring Guangdong, but most have lost their original forest cover. Hong Kong is located in the eastern extremity of tropical China. The latitude of Hong Kong is 22°N. Despite cool winters, the insect fauna of Hong Kong is dominated by tropical species. The odonates are no exception and less than 6% of species recorded from the territory have Palaearctic origins.

The few sizeable lowland rivers that occur in Hong Kong are grossly polluted and support an impoverished aquatic fauna. There are many small mountain streams

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which have excellent water quality but most of the dragonfly populations are limited to specialists that can tolerate dry winter conditions and torrential wet season flows. Few stream locations exist which possess shallow-gradients and have escaped organic enrichment.

During 1991 to 1995 a number of sites with the potential to support diverse riverine odonate populations were investigated. Two sites, not previously studied for their odonate faunas, at Sha Lo Tung (Tai Po) and Tai Tong (Yuen Long) were found to support extremely rich odonate faunas. Both sites possess small, unpolluted streams with shallow gradients.

Sixty eight species have been recorded from Sha Lo Tung, during the past five years, which represents nearly 65% of the territory's odonate fauna. Fifty one species have been recorded from Tai Tong. Nine species of gomphid and three species of *Macromia*, not previously recorded from elsewhere in Hong Kong, have been found at these two sites. For a comprehensive review of the Hong Kong odonate fauna consult LAI (1971), ASAHINA (1965, 1987, 1988, 1992), HÄMÄLÄINEN (1991), MATSUKI et al. (1990), MATSUKI (1989), MATSUKI & SAITO (1995, 1996), SAITO & OGATA (1995) and WILSON (1993, 1995a, 1995b, 1996, 1997).

Tai Tong is located on the edge of a Country Park and Sha Lo Tung is a village and agricultural area surrounded by a Country Park. Unfortunately, both sites are under threat from unauthorised and proposed developments. Site descriptions and an account of these threats is provided here.

SHA LO TUNG

SITE CHARACTERISTICS

Sha Lo Tung is located in an isolated valley surrounded on all sides by the Pat Sin Leng range of low granite mountains to the north, east and south, which rise to a maximum of 639 m, and the Cloudy Hill granite mountain range to the west, which achieve a maximum height of 440 m. There are two abandoned agricultural areas in the valley floor, totalling some 80 hectares, at approximate 180 m above sea level, centred at Sha Lo Tung to the south and Ping Shan Chai to the north. All streams in the catchment drain to the Hok Tau reservoir located north of the Sha Lo Tung basin. The reservoir is approximately 100 m above sea level. The agricultural areas are surrounded by the 3,125 hectare Pat Sin Leng Country Park but are themselves excluded from the Country Park since, at the time of designation, they were farmed and supported four small, inhabited rural villages.

The Sha Lo Tung basin was originally settled by two Hakka migrant clans, the Cheungs and Leis in the late 1600s and early 1700s respectively. The population probably peaked in the late 1950s with a maximum number of residents of approximately 450. During the late 1960s rice farming became nonviable in Hong Kong and the New Territories and villagers began to leave the upland farming

communities at this time. The last villagers left their homes in 1995.

A number of low gradient streams, approximately 3-5 m in width, with shallow riffles and pools to 1.5 m in depth meander through the abandoned agricultural areas. The streams of interest are bounded by the following Universal Transverse Mercator Grid References:- KV 095 888 - KV 097 898, KV 094 884 - KV 098 891, KV 098 896 - KV 110 894. Substrates in these streams include gravel and cobble, many coarse and fine sandy reaches and muddy leaf strewn pools. The substrates of the steeper gradient streams, between the agricultural areas and the reservoir, are comprised mainly of gravel and cobble with several waterfalls and stretches of bare bedrock. Many of the slower flowing sections of stream in the agricultural areas are dominated by rooted submerged macrophytes and rooted macrophytes with surface leaves. Marginal vegetation is diverse. Mature woodland areas are well established in the area, including good examples of traditional *fung shui* woodland. Approximately 50% of the total stream length is forested. The mean annual rainfall for the area is approximately 2.4 m.

NEW HONG KONG RECORDS FROM SHA LO TUNG

A complete list of Odonata recorded from Sha Lo Tung is provided in Table I.

Prodasineura croconota, not previously recorded outside Taiwan, is common at Sha Lo Tung. The slight differences in colour pattern are detailed in WILSON (1995b:84-87, 89). LIEFTINCK (1984:21) suggested that *P. longjingensis* (Zhou, 1981) from Zhejiang province, China may be conspecific with *P. croconota*.

Drepanosticta hongkongensis (WILSON, 1997) has until recently been treated by ASAHINA (1965, 1987) and WILSON (1995b: 74, 81) as *D. brownelli* Tinkham, 1938. True *brownelli* from Guangdong is a separate taxon.

A single female *Polycanthagyna erythromelas* taken at Sha Lo Tung, 6-VI-1993, represents the first record for Hong Kong. A mature, dull brown, female specimen of a *Gynacantha* species, possibly *subinterrupta*, was collected at Sha Lo Tung, 11-X-1992. The females of *subinterrupta* and *G. hyalina* are extremely difficult to separate, as detailed by LIEFTINCK (1960:251-252, figs 12a & 12b). *G. subinterrupta* is known to occur in Hong Kong from a single male taken in July, 1993 (WILSON, 1995b:99, 103). Further specimens including more male material are required to confirm the status of this *G.* at Sha Lo Tung. Several adults of *G. japonica* were collected in August 1994 at Sha Lo Tung (WILSON, 1995b:96-97, 101-102).

The gomphid additions new to the Hong Kong fauna from this site, which were detailed in WILSON (1995a), include *Burmagomphus vermicularis*, not previously known from outside Thailand and Peninsular Malaysia, *Megalogomphus sommeri*, *Anisogomphus koxingai* and *G. kelloggi*. *Gomphidia kelloggi* has not previously been recorded outside the type locality at Ling Sioh, Fujian province. *Anisogomphus koxingai* and *Gomphidia kelloggi* have not been found at other sites in Hong Kong. SAITO & OGATA (1995) recorded a *Sieboldius* sp. from Sha Lo Tung in 1995; a

Table I
 Odonata recorded from Sha Lo Tung, 1991-1995

Species	Author	Status in Hong Kong
<i>Philoganga vetusta</i>	Ris 1912	U
<i>Mnais mneme</i>	Ris, 1916	LC
<i>Neurobasis c. chinensis</i>	(Linnaeus, 1758)	U
<i>Rhinocypha p. perforata</i>	(Percheron, 1835)	C
<i>Euphaea decorata</i>	Selys, 1853	C
<i>Agriocnemis femina oryzae</i>	Lieftinck, 1962	C
<i>Ischnura senegalensis</i>	(Rambur, 1842)	C
<i>Onychargia atrocyana</i>	Selys, 1865	LC
<i>Ceriagrion auranticum ryukyuanum</i>	Asahina, 1967	C
<i>Coeliccia cyanomelas</i>	Ris, 1912	C
<i>Pseudagrion r. rubriceps</i>	Selys, 1976	U
<i>Copera ciliata</i>	(Selys, 1863)	C
<i>C. marginipes</i>	(Rambur, 1842)	C
<i>Prodasineura autumnalis</i>	(Fraser, 1922)	C
<i>P. ra croconota</i>	(Ris, 1914)	LC
<i>Protosticta taipokauensis</i>	Asahina & Dudgeon, 1987	LC
<i>Drepanosticta hongkongensis</i>	Wilson, 1997	LC, endemic
<i>Anax guttatus</i>	(Burmeister, 1839)	C
<i>A. parthenope julius</i>	(Brauer, 1865)	C
<i>Gynacantha</i> sp. (<i>subinterrupta</i> or <i>hyalina</i>)	Rambur, 1842	R
<i>G. japonica</i>	Bartenef, 1909	U
<i>Tetracanthagyna waterhousei</i>	MaLachlan, 1898	U
<i>Polycanthagyna erythromelas</i>	(McLachlan, 1896)	U
<i>Asiagomphus hainanensis</i>	(Chao, 1953)	LC
<i>A. septimus</i>	(Needham, 1930)	LC
<i>Burmagomphus vermicularis</i>	(Martin, 1904)	U
<i>Anisogomphus koxingai</i>	Chao, 1954	R
<i>Heliogomphus scorpio</i>	(Ris, 1912)	LC
<i>Leptogomphus elegans hongkongensis</i>	(Asahina, 1988)	LC
<i>Ophiogomphus sinicus</i>	(Chao, 1954)	LC
<i>Lamelligomphus hongkongensis</i>	Wilson, 1995	R, endemic
<i>Megalogomphus sommeri</i>	(Selys, 1954)	U
<i>Sieboldius</i> sp.		R
<i>Ictinogomphus pertinax</i>	(Selys, 1854)	C
<i>Gomphidia kelloggi</i>	Needham, 1930	R
<i>Epophthalmia elegans</i>	(Brauer, 1865)	U
<i>Macromia urania</i>	Ris, 1916	U
<i>M. katae</i>	Wilson, 1993	R, endemic
<i>M. berlandi</i>	Lieftinck, 1941	R
<i>Idionyx victor</i>	Hämäläinen, 1991	LC
<i>Macromidia ellenae</i>	Wilson, 1996	R, endemic
<i>M. rapida</i>	Martin 1907	LC
<i>Lyrithemis elegantissima</i>	Selys, 1883	LC
<i>Brachydiplax chalybea flavovittata</i>	Ris, 1911	C
<i>Orthetrum chrysis</i>	(Selys, 1891)	C

Table I (continued)

Species	Author	Status in Hong Kong
<i>O. glaucum</i>	(Brauer, 1865)	C
<i>O. luzonicum</i>	(Brauer, 1868)	C
<i>O. pruinosum neglectum</i>	(Rambur, 1842)	C
<i>O. s. sabina</i>	(Drury, 1770)	C
<i>O. t. triangulare</i>	(Selys, 1878)	U
<i>Acisoma p. panorpoides</i>	Rambur, 1842	C
<i>Brachythemis contaminata</i>	(Fabricius, 1793)	C
<i>Crocothemis s. servilia</i>	(Drury, 1770)	C
<i>Diplacodes trivialis</i>	(Rambur, 1842)	C
<i>Neurothemis t. tullia</i>	(Drury, 1773)	C
<i>N. fulvia</i>	(Drury, 1773)	C
<i>Rhodothemis rufa</i>	(Rambur, 1842)	U
<i>Pseudothemis zonata</i>	(Burmeister, 1839)	C
<i>Trithemis aurora</i>	(Burmeister, 1839)	C
<i>T. festiva</i>	(Rambur, 1842)	C
<i>Palpopleura s. sexmaculata</i>	(Fabricius, 1787)	C
<i>Rhyothemis variegata arria</i>	(Drury, 1773)	C
<i>Hydrobasileus croceus</i>	(Brauer, 1867)	U
<i>Pantala flavescens</i>	(Fabricius, 1798)	C
<i>Tramea virginia</i>	(Rambur, 1842)	C
<i>Zygonyx iris insignis</i>	(Kirby, 1900)	C
<i>Z. asahinai</i>	Matsuki & Saito, 1995	U

C = common, - LC = locally common, - U = uncommon, - R = rare

genus not previously recorded from Hong Kong.

The newly recorded Hong Kong *Macromia* species, comprising *berlandi*, *urania* and *katae*, were detailed in WILSON (1993). The type locality for *katae* is Sha Lo Tung. Sha Lo Tung is the type locality for *Macromidia ellenae* (WILSON, 1995b: 138-139, 149, 151; 1996). Sha Lo Tung is the only known site in the world supporting two species of the Oriental genus *Macromidia*.

A single teneral male *Rhodothemis rufa* (Rambur, 1842) taken at Sha Lo Tung on 23.VI.1992 was the first record for this species from Hong Kong. The first males of *Zygonyx asahinai* MATSUKI & SAITO (1995), which was recently described from specimens collected at Tai Po Kau, Hong Kong, were taken at Sha Lo Tung (Wilson, unpub., 2 ♂, Sha Lo Tung, 27-V-1995).

GOMPHID AND MACROMIA POPULATIONS FROM SHA LO TUNG

Leptogomphus elegans hongkongensis favours gravel substrates in seepages from springs and small streams in forested hills. *Heliogomphus scorpio* adult females were observed to oviposit in slack areas amongst tree roots in shallow riffle sections. The larvae are extremely flattened and found in gravel sections of riffles sites

in woodland. *Anisogomphus koxingai* was restricted to one narrow gravel/cobble stream tributary draining Cloudy Hill. Males were observed holding territory adjacent to sunlit riffle sections. *Asiagomphus* larvae were found to be abundant in muddy leaf strewn sections of pools and stream margins. *Gomphidia kelloggi* adults males held territories in sunlit spots, at the Lo Wai village streams, every 20-50 m during May-June, selecting prominent perches adjacent to pool or riffle sections. Larvae of *G. kelloggi* appear to favour gravel and sand in the early stages progressing to sandy pools and sandy shoals as the larva matures. Larva of *Burmagomphus vermicularis* were located on muddy sandy areas in low numbers. *Megalogomphus sommeri* larvae were common throughout Sha Lo Tung basin and easily found in coarse sand and gravel. Adults were observed in woodland and occasionally males were seen at streamside perches adjacent to sandy shoals. Females can be observed ovipositing in the early morning in shallow, sandy shoals. *Ophiogomphus sinicus* is common in upland mountain streams in Hong Kong with steep gradients and boulder strewn substrates but is rare in the shallow gradient streams found at Sha Lo Tung. Only a single exuvia of *Lamelligomphus hongkongensis* was found in a small stream near Cheung Uk.

Larval populations of the three *Macromia* species at Sha Lo Tung occupy different subhabitats within a meandering pool/riffle stream system, but can nevertheless be encountered within close proximity to each other. Larvae of all three *Macromia* species were retrieved from a single pool/riffle location. *M. berlandi* larvae were found in the slow flowing reaches of the streams, on substrates of mud and sand, in pools and at depositing margins of bends. *M. urania* larvae preferred slightly faster flowing reaches with substrates mainly of sand but also including mud and leaf debris. The larvae of *Macromia katae* occupy an unusual habitat for *macromias*, occurring amongst roots and weeds in pools and stream margins. *M. katae* kept in tanks often assume a vertical position gripping rooted, submerged macrophytes. For further information on the structure and biology of these larvae see WILSON & THEISCHINGER (1996).

DEVELOPMENTAL THREATS AT SHA LO TUNG

Following an initial application in the early eighties revised proposals to build a 36 hole golf course and a substantial residential development at Sha Lo Tung were submitted to the Hong Kong Government in 1991. The development was given planning approval in principal, subject to the completion of a satisfactory Environmental Impact Assessment (EIA), despite part of the development being located in the designated Pat Sin Leng Country Park. Friends of the Earth forced a Judicial Review on the grounds that the development proposals contravened the Country Parks Ordinance. The Hong Kong Judiciary determined that the Country Parks Board had exceeded its powers in approving the project. The development proposals were immediately revised to exclude all areas designated as Country Park and

focused on the largely abandoned, Sha Lo Tung agricultural areas.

The golf course development was initially reduced to a single nine hole course but the substantial residential proposals remained largely unchanged. The Water Supplies Department objected to the proposed use of pesticides, for golf course management, since the area is located in a water supply catchment. Consequently the golf course proposals have now been completely dropped by the developer. The new proposals are now limited to the construction of village housing, for reprovisioning purposes, and an extensive luxury low rise housing development. An environmental impact assessment (EIA) for the revised proposals was completed by AXIS Environmental Consultants Ltd. in 1995 and further revised in early 1996. If approved the development would provide accommodation for a population in excess of 1000. An appraisal of the potential impacts of development on odonate populations has been included in the EIA. The studies have been submitted to Government and are currently being considered by an EIA Steering Group, whose members include various Government Departments and is chaired by the Environmental Protection Department. The recommendations of the EIA Steering Group will be crucial for the fate of Sha Lo Tung and its diverse odonate community. The final decision on the current proposals is likely to be made by the Secretary for Planning, Environment and Lands.

The key issues for the EIA include the scale of development, use of pesticides, sediment loadings to streams from construction runoff, surface runoff from housing and roads, sewage treatment and the physical disturbance, loss and fragmentation of the shrub and woodland habitats in the vicinity of the stream channels. Any alteration of stream channel alignment, through road construction and culverting, could have a dramatic impact on the present distribution of substrates. Further potential deleterious impacts include loss of riparian woodland, drainage improvements and disturbance to the abandoned rice paddies, which could significantly alter the annual flow regime. Gradual change in substrate distribution may not be critical to odonate populations but sudden alterations and reduction in base flows could have a serious impact. The smothering of stream substrates and filling of pools from sediment runoff during the construction of the relatively large scale developments proposed represent serious threats to the odonate communities.

The majority of village house owners at Sha Lo Tung have an agreement with the developer to receive new village houses if development approval is granted. In the spring of 1995 a number of villagers, frustrated at the lack of progress by the developer, took direct action by bulldozing areas of abandoned agricultural land. The action, which was considered to be within the law, caused considerable sedimentation of one important section of stream watercourse and a number of pools were filled with coarse sand as a direct consequence. No additional action has been taken by the villagers up until June 1996. The villagers are awaiting the outcome of

the latest developer's submission (third revised EIA) to Government.

TAI TONG

SITE CHARACTERISTICS

The Tai Tong site is located just inside the northern boundary of the 5,330 hectare Tai Lam Country Park. The lower portion of the site is comprised of a 1 km stretch of lowland stream located at approximately 40 m above sea level at the foot of a range of low granite mountains with a maximum height of 507 m. The stream is 3-6 m wide and less than 50 cm deep with a shallow gradient and a substrate comprised predominantly of coarse granitic sand with margins of muddy sand and occasional reaches of cobble. The stream channel is bordered by low trees and scrub. In the stream marginal vegetation is dominated by grasses and rooted submerged macrophytes are absent. The Universal Transverse Mercator Grid References for the upstream and downstream boundaries of the lower section are JV 936 811 to JV 936 805. The upper portion of the site, located above a large waterfall in secondary woodland, is also approximately 1 km in length with a shallow gradient. The surrounding mountainous catchment is largely denuded of its original forest vegetation and is subjected to heavy erosion during the rainy season from April to October. Mean annual rainfall is 2.0 m.

NEW HONG KONG RECORDS FROM TAI TONG

A complete list of odonata recorded from Tai Tong is provided in Table II.

A female *Gynacantha* taken from Tai Tong on 24-V-1992 (WILSON, 1995b: 98, 103, 105) may be *hyalina* but, as stated earlier, it not possible to separate this species from *subinterrupta* at the present time. It is recorded here as *Gynacantha* sp.

The gomphids newly recorded from Hong Kong at this site comprise *Burmagomphus vermicularis* and *Megalogomphus*, which were also recorded at Sha Lo Tung, and *Paragomphus capricornis*, *Sinictinogomphus clavatus* and *Lamelligomphus hongkongensis*. The type locality for the latter species is Tai Tong WILSON (1995a). *Macromia urania* was recorded from Hong Kong for the first time at this site in 1992 (WILSON, 1993).

GOMPHID AND MACROMIA POPULATIONS AT TAI TONG

This site's invertebrate fauna was dominated by the gomphid, *Paragomphus capricornis* with larval densities in excess of 50 individuals per square metre. The larvae were located close to the substrate surface of coarse quartz sand. The adults appeared on the wing in early spring with peak emergence in May-June. Unlike

Table II
Odonata recorded from Tai Tong, 1991-1995

Species	Author	Status in Hong Kong
<i>Neurobasis chinensis chinensis</i>	(Linnaeus, 1758)	U
<i>Mnais mneme</i>	Ris, 1916	LC
<i>Rhinocypha perforata perforata</i>	(Percheron, 1835)	C
<i>Euphaea decorata</i>	Selys, 1853	C
<i>Agriocnemis femina oryzae</i>	Lieftinck, 1962	C
<i>Ischnura senegalensis</i>	(Rambur, 1842)	C
<i>Cercion calamorum dyeri</i>	(Fraser, 1919)	R
<i>Ceriagrion auranticum ryukyuanum</i>	Asahina, 1967	C
<i>Pseudagrion spencei</i>	Fraser, 1922	R
<i>Pseudagrion rubriceps rubriceps</i>	Selys, 1976	U
<i>Coeliccia cyanomelas</i>	Ris, 1912	C
<i>Copera ciliata</i>	(Selys, 1863)	C
<i>Copera marginipes</i>	(Rambur, 1842)	C
<i>Prodasineura autumnalis</i>	(Fraser, 1922)	C
<i>Anax guttatus</i>	(Burmeister, 1839)	C
<i>Anax parthenope julius</i>	(Brauer, 1865)	C
<i>Anax immaculifrons</i>	Rambur, 1842	U
<i>Gynacantha</i> sp. (<i>subinterrupta</i> or <i>hyalina</i>)		R
<i>Asiagomphus septimus</i>	(Needham, 1930)	LC
<i>Burmagomphus vermicularis</i>	(Martin, 1904)	U
<i>Lamelligomphus hongkongensis</i>	Wilson, 1995	R, endemic
<i>Megalogomphus sommeri</i>	(Selys, 1954)	U
<i>Paragomphus capricornis</i>	(Förster, 1914)	R
<i>Ictinogomphus pertinax</i>	(Hagen, 1854)	C
<i>Sinictinogomphus clavatus</i>	(Fabricius, 1775)	U
<i>Epophthalmia elegans</i>	(Brauer, 1865)	U
<i>Macromia urania</i>	Ris, 1916	U
<i>Brachydiplax chalybea flavovittata</i>	Ris, 1911	C
<i>Nannophya pygmaea</i>	Rambur, 1842	U
<i>Orthetrum chrysis</i>	(Selys, 1891)	C
<i>Orthetrum glaucum</i>	(Brauer, 1865)	C
<i>Orthetrum luzonicum</i>	(Brauer, 1868)	C
<i>Orthetrum pruinosum neglectum</i>	(Rambur, 1842)	C
<i>Orthetrum sabina sabina</i>	(Drury, 1770)	C
<i>Acisoma panorpoides panorpoides</i>	Rambur, 1842	C
<i>Brachythemis contaminata</i>	(Fabricius, 1793)	C
<i>Crocothemis servilia servilia</i>	(Drury, 1770)	C
<i>Diplacodes trivialis</i>	(Rambur, 1842)	C
<i>Neurothemis tullia tullia</i>	(Drury, 1773)	C
<i>Neurothemis fulvia</i>	(Drury, 1773)	C
<i>Pseudothemis zonata</i>	(Burmeister, 1839)	C
<i>Trithemis aurora</i>	(Burmeister, 1839)	C
<i>Trithemis festiva</i>	(Rambur, 1842)	C
<i>Palpopleura sexmaculata sexmaculata</i>	(Fabricius, 1787)	C
<i>Rhyothemis variegata arria</i>	(Drury, 1773)	C

Table II, continued

Species	Author	Status in Hong Kong
<i>Hydrobasileus croceus</i>	(Brauer, 1867)	U
<i>Pantala flavescens</i>	(Fabricius, 1798)	C
<i>Tramea virginia</i>	(Rambur, 1842)	C
<i>Tholymis tillarga</i>	(Fabricius, 1798)	C
<i>Zyxomma petiolatum</i>	Rambur, 1842	C
<i>Zygonyx iris insignis</i>	(Kirby, 1900)	C

C = Common, LC = Locally common, U = Uncommon, R = Rare

most Hong Kong riverine gomphids, which are spring emergers, *P. capricornis* was observed to have an additional emergence period in late summer during October. From a preliminary examination of the stream invertebrate fauna it would appear that during late autumn and winter the *Paragomphus* larvae constitute the major component of the biomass. The main food item is likely to be chironomids which were found in low numbers. *Paragomphus* larvae, which are extremely active, were found on the substrate surface or at shallow depth in the top few millimetres. No *Paragomphus* larva were found in the upper, wooded section.

Late instar *Megalogomphus sommeri* larvae were found in relatively low numbers compared with the numbers of *Paragomphus*. At each sampling, cohorts of *Megalogomphus* larvae at all stages of development from a few millimetres to the final instar size of 44-48.5 mm were found, indicating the larval stage of this species may last several years. *Burmagomphus vermicularis* larvae were found in low numbers in the deeper, muddier sections of the stream. The larvae of *Lamelligomphus hongkongensis* were found in the cobble/gravel areas of the lower stream section. Sixteen final instar larvae were retrieved from a single location 2m x 1m, 22.V.1993. Adults were rarely observed. *Asiagomphus* larvae are present in low numbers at Tai Tong. A female *A. septimus* was taken in spring 1995.

Macromia urania larva were present in fairly high numbers during 1992-1993 and were always found on the surface of mud and sand substrate immediately adjacent to the stream border.

DEVELOPMENTAL THREATS AT TAI TONG

Under the Country Parks Ordinance development proposals are required to be compatible with conservation and recreation within a country park area. Prior to 1992 a developer had recently commenced the planting and establishment of an unauthorised orchard of lychees in the immediate vicinity of the site within the country park. In early 1993 further planting of lychee and mango trees, the construction of a new commercial fishing pond, erection of a number of small buildings and the establishment of a number of temporary residences were undertaken

adjacent to the lower section of stream channel. Further damage to the lower stream was caused in October 1992 through the removal of gravel from the stream for use as an aggregate material for construction purposes and interference with the stream's flow regime through abstraction. The District Lands Officer, with responsibilities for planning and development in the Yuen Long area, undertook enforcement action in June 1993 to initiate removal of unauthorised building developments and prevent further damage to the site. However during 1994 further unauthorised development took place within the site. In 1995 direct action was taken by Government to control the developer's activities in the Country Park. The action included the felling of six hundred fruit trees and issue of further warnings.

A survey undertaken in 1995 indicated that *Macromia urania* and *Paragomphus capricornis* populations had suffered significant reductions. No *Macromia urania* larva and very few *P. capricornis* larva or adults were observed in the lower section although *urania* larva remained common in the upper section. Although damaged, the site should recover its former odonate populations, provided the unauthorised developments and water abstraction are controlled successfully. Intensive management of the remaining orchard, using pesticides, and continued unauthorised development activities remain potential threats to the site.

CONSERVATION MEASURES

In 1995 there were 21 country parks and 14 special areas, covering over 40 per cent of the land area of Hong Kong. The Country Parks Ordinance (Cap. 208) provides a legal framework for the designation, development and management of Country Parks in Hong Kong. Country Park status affords protection from inappropriate development but many rural agricultural villages are located within country parks and these villages and their associated agricultural land are excised from country park areas. The streams and agricultural lands of the Sha Lo Tung basin are not protected by country park status.

Fifty sites have been designated as sites of special scientific interest (SSSI) in Hong Kong. There are no sites currently designated as SSSI, wholly or in part, for their odonate faunas. The World Wide Fund for Nature Hong Kong has recommended to the Agriculture and Fisheries Department of the Hong Kong Government, in early 1993, that the sites at Tai Tong and Sha Lo Tung should be designated as SSSIs due to their exceptional flora and fauna. The proposals have been supported by the Department of Ecology and Biodiversity, Hong Kong University. The odonate populations of Tai Tong and Sha Lo Tung are of local, regional and international importance. Designation as SSSIs would recognise the international status of these sites and provide some protection from inappropriate development. However, even with SSSI designation, these sensitive stream sites would remain at risk from village housing re-provision and resumption of agricultural activities, utilising modern technological practices. At present there are no statutory conserva-

tion measures which could be implemented to provide adequate protection for privately owned sites, such as those at Tai Tong and Sha Lo Tung, located inside Country Parks or surrounded by Country Park. In the absence of comprehensive legislation to protect sites designated as SSSI and without Government intervention, involving direct compensation through land exchange or compulsory purchase, the sites at Sha Lo Tung and Tai Tong will remain at risk.

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