

THE ODONATA OF MACAO, SOUTHERN CHINA

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Abstract – 27 spp. are listed, of which 25 (asterisked) are considered new records for this new administrative region of China. *Cercion sexlineatum* (Sel.), *Sinictinogomphus clavatus* (Fabr.) and *Anax parthenope julius* Br. were attracted to lights.

Introduction

This is the first account regarding the dragonflies and damselflies of Macao. The flora and fauna are similar to that of the Hong Kong area,

with the exception that the land area of Macao is considerably smaller, approximately 25 km², which results in fewer number of species. The land area of Hong Kong consisting of more than 1000 km² results in a greater number of habitats for insects and the number of species of Odonata exceeds 100.

An aerial net was employed to collect dragonflies and damselflies on the wing throughout the area of Macao with emphasis on the island areas of Taipa and Coloane. Sampling was car-

ried out over a period of at least 2 months with Professor G.-Q. Liang visiting Macao during June and September 1999; while other records were made at other times, i.e. in the spring before the summer monsoon (period of frequent typhoons) and then later in the fall. The dichotomous keys and colour plates found in WILSON (1995) were employed to identify local fauna and specimens whose identity was difficult to determine, were compared by one of us (L.G.Q.) with known or previously confirmed material in the Entomology Museum collection at Zhongshan University in Guangzhou, China, where voucher specimens have been deposited.

List of species

The species considered new records for Macao are asterisked (*).

Coenagrionidae

- * *Agriocnemis pygmaea* (Ramb.): Macao peninsula, 10-IX-1993, ERE leg.; – Coloane island, 2/12-VI-1999, LGQ leg. – Distribution includes India, Japan, Taiwan, Indonesia and Australia as well as Hong Kong (WILSON, 1995).
- *Cercion sexlineatum* (Sel.): attracted to high-intensity lamps at the entrance of the inner harbour in Macao, VIII/IX-1996, ERE leg. – WILSON (1996) was the first to report it from Macao, based on specimens sent him previously by one of us (ERE). Later WILSON (1997) reported it in Hong Kong, Taiwan, the Ryukyu Islands of Japan and the Hainan and Kiangsu provinces of China.
- * *Ceriagrion auranticum ryukyuanum* Asahina: Coloane island, 8-VIII-1995, J. Gomes leg.; – Macao peninsula, 10-IX-1993, ERE leg.; 2/12-VI-1999m LGQ leg. – Larvae in Hong Kong live amidst submerged aquatic weeds in ponds and marshes and a similar habitat in Macao has been recently created by the newly formed Nam Van lakes containing *Elodea* sp. of water plant on the Macao peninsula. Distribution includes Taiwan, Japan and the Hainan province of China.
- * *Ischnura senegalensis* (Ramb.): Macao peninsula and from rectangular cement water tank on forested hill near Ka-Ho vil-

lage, Coloane island, 2/12-VI-1999, ERE leg. – This commonly occurring species in South China has developed into higher populations in the Nam-Van Lakes system in Macao in recent years, when the latter were converted to freshwater from a saline environment originally in the Pearl river delta. The development of this species is believed to be rapid and bivoltine and commonly occurring in ponds, marshes and sluggish rivers in Hong Kong (WILSON, 1995). Its distribution includes India, the Philippines, Indonesia, Japan, Taiwan, Laos, Vietnam and New Guinea as well as the Hunan province of China.

Platycnemididae

- * *Copera marginipes* (Ramb.): Coloane island, 21-IX-1999, LGQ leg.; – in Seac Pai Van forestry park, 14-X-1999; – 16-X-1999 mating pair in copulation along running stream, ERE leg. – The body is whitish in colour in teneral adults and when flying they are sometimes referred to as the “ghost form” (ASAHINA, 1993). It is common in rivers and streams in Hong Kong and WILSON (1997) listed its distribution as Bangladesh, Burma, India, Indonesia, Laos, peninsular Malaysia, Nepal, Sri Lanka, Thailand, Vietnam and Taiwan. Within China it is found in the Fujian province and LIANG et al. (1989) reported it from the Guangdong province.

Protoneuridae

- * *Prodasineura autumnalis* (Fraser): Coloane island, 25-VI-1999, 23-X-1999, ERE leg. – Its habitat in both Hong Kong and in Macao appears to be in forest streams. The males habitually hover over the water near their breeding sites (WILSON, 1995). Its distribution according to ASAHINA (1987) includes Burma, the Assam area of India, Nepal, Thailand, Vietnam, peninsular Malaysia, Sumatra and Java in Indonesia as well as Hong Kong and within China the Fujian, Guangdong (LIANG et al., 1989) Hainan and Yunnan (SUI & SUN, 1984) provinces.
- * *Prodasineura nigra* Fraser: Coloane island, 28-VIII-1999, ERE leg., Seac Pai Van park; 2/12-VI-1999, ERE & LGQ leg., Ka-Ho vil-

lage. – SUI & SUN (1984) reported it from the Yunnan province of China and it is also found in Burma (Myanmar) and Nepal.

- * *Prodasineura verticalis* (Selys): Coloane island, 25-VI-1999, ERE leg., Seac Pai Van park stream. – FURTADO (1975) described its reproductive behaviour in Malaysia and it is also found in dense forests in Thailand.

Aeshnidae

- * *Anax immaculifrons* Ramb.: Macao peninsula, 10-VI-1996, ERE leg.; – Ka-Ho village, Coloane island, 10-VI-1999, ERE & LGQ leg. – Larve inhabit sluggish pools in upland streams in Hong Kong (WILSON, 1995). In Macao adults were observed ovipositing in a 2x7 m elongate cement water tank 1 m in depth on a hillside above Ka-Ho village. Distribution includes India, Sri Lanka, Vietnam and Thailand as well as the Guangdong province of China.
- * *Anax parthenope julius* Br.: Coloane island, 4-IX-1994, Cheong Chi Kong leg.; – Macao peninsula, 22/30-X-1996, 23-XI-1996, 12-X-1997, 16-X-1998, ERE leg. – Attracted to lights in the harbour of Macao. The exuviae were observed on water plants in a pond at an arboretum (Oct) in the Seac Pai Van park area of Coloane island, suggesting that this species is probably univoltine, with adults mostly on the wing in September and October. It is the most common aeshnid in Macao, frequenting marshes and lowland wet areas. Its distribution includes Taiwan, Korea, the Ryukyu Islands of Japan as well as Hong Kong.
- * *Anaciaeschna jaspidea* (Burm.): Macao peninsula, 30-VI-1996, ERE leg.; – Taipa island, X-1999, ERE leg. – It frequents marshes and lowland wet areas, appears to fly at dusk rather than during more sunlit periods, and its distribution includes Hong Kong (ASAHINA, 1988) as well as India, Taiwan, the Philippines, Japan and Papua New Guinea (WILSON, 1995).

Gomphidae

- * *Sinictinogomphus clavatus* (Fabr.): Macao peninsula near Nam Van lakes, 12-VI-1997; – Taipa island attracted to lights at the University of Macau campus, 31-V-1998, ERE leg. – It prefers ponds and reservoirs.

It is found in Hong Kong, Japan and Korea as well as the Fujian, Guangdong and Zhejiang provinces of China (WILSON, 1997).

Libellulidae

- * *Acisoma p. panorpoides* (Ramb.): Taipa island, VIII/IX-1993, ERE leg.; – Coloane island, 3/12-VI-1999, LGQ leg. – It breeds in marshes and swampy areas and the adults range throughout the territory during late summer. Distribution includes Afghanistan, Burma (Myanmar), Indonesia, India, Sri Lanka, Malaysia, Nepal, the Philippines, Thailand as well as Taiwan, Hong Kong and the Guangdong and Hunan provinces of China (WEN, 1992).
- * *Brachydiplax chalybea* Br.: Coloane island, 10-VI-1999, LGQ leg. – It was found breeding in a marshy area among lesser duckweed, *Lemma minor* and arrow-head plant, *Sagittaria sagittifolia* near a rock quarry in the Seac Pai Van area of Coloane island. Its distribution includes Hong Kong, Japan, Taiwan and Vietnam.
- * *Crocothemis servilia* (Dru.): Macao peninsula, 10-IX-1993, ERE leg. – Coloane island, 3/12-VI-1999, LGQ leg. – It is a pond loving species, locally as well as in Hong Kong, and found also in Sri Lanka, Japan, Taiwan, the Philippines and Indonesia (WILSON, 1995) as well as the Guangdong and Hunan provinces of China.
- * *Diplacodes trivialis* (Ramb.): Taipa island, 3-VIII-1990, ERE leg.; – 3/12-VI-1999, LGQ leg. – Three generations per year are believed to exist for this species (DUDGEON, 1999) that frequents marshy areas and the shallow margins of ponds and lakes in both Hong Kong and in Macao. Distribution also includes India, Indonesia, the Philippines as well as Taiwan and the Hunan province of China (ZHAO, 1985).
- * *Neurothemis t. tullia* (Dru.): Coloane island, 11-IX-1993, ERE leg. – In the area of Bangladesh its life history takes 82 days (BEGUM et al., 1990). Locally it frequents rice paddies and swampy areas and is distributed in Hong Kong (WILSON, 1995) as well as Bangladesh, Burma, India, Sri Lanka, peninsular Malaysia, Nepal,

Thailand and Taiwan.

- * *Orthetrum melania* Sel.: Taipa and Coloane islands, 7-IX-1993, ERE leg.; – 3/12-VI-1999, LGQ leg. – A pond or slow stream inhabitant, its distribution includes Japan, Korea and Taiwan (WILSON, 1997) as well as Hong Kong and the Guangdong province of China (LIANG et al., 1989).
- * *Orthetrum pruinosum neglectum* Ramb.: Coloane island, near a slow moving stream running through the village of Ka-Ho, 3/12-VI-1999, LGQ leg. – In Hong Kong it inhabits ponds, irrigation conduits and slow streams (WILSON, 1995) and in South Asia its development from egg to adult required 155 days (KUMAR, 1970). Its distribution includes India, Bangladesh, Burma, Nepal, peninsular Malaysia and Singapore, Thailand, Laos, Vietnam, Indonesia, Japan and Taiwan. ZHAO (1985) reported it in the Hainan province of China and WEN (1992) lists the Fujian, Guangdong, Hunan and Yunnan provinces of China.
- * *Orthetrum s. sabina* (Dru.): Taipa island and Macao peninsula, 4/10-IX-1993, 28-IX-1996, ERE leg.; – Coloane island, 2/12-VI-1999, LGQ leg. – It breeds in slow-moving streams and stagnant ponds (WANG & HEPPNER, 1997) and preys upon other species of dragonflies. On 19-X-1999 it was observed feeding on *Diplacodes trivialis*, that had been captured along a forest trail in the Seac Pai Van park. It is widespread in Macao, observed on the wing throughout the Special Administrative District during the summer months. Its distribution also includes India, Borneo and Java in Indonesia, Japan, the Pacific islands of Samoa, Fiji and Marshall Islands. WANG & HEPPNER (1997) reported it from Taiwan and ZHAO (1985) from the Hainan province of China.
- *Pantala flavescens* Fabr.: Macao peninsula, 4-IX-1993, 8-X-1995, ERE leg. – Taipa and Coloane islands, 12-VI-1999, LGQ leg. – This circumtropical and subtropical species is the most commonly observed dragonfly in Hong Kong and in Macao and is on the wing at almost any time of the year. Development from egg to adult requires about 72 days in South Asia. Huge congregations are often in evidence before a violent storm or typhoon and they are often in evidence over a period of several days following the storm during the monsoon season.
- * *Pseudothemis zonata* Burm.: Taipa island, 9-VII-1999, LGQ leg. – It is found in reservoirs, sluggish streams and marshes in Hong Kong and its distribution includes Japan, Korea, Vietnam, Taiwan and WEN (1992) reported it from the Fujian, Hunan, and Jiangsu provinces of China and LIANG et al. (1989) included the Guangdong province.
- * *Rhyothemis variegata* (L.): Taipa island, 7-IX-1993, ERE leg.; – Coloane island, 18-IX-1995, J. Gomes leg. – Breeding sites in Macao and in Hong Kong include marshes and ponds and its distribution includes Vietnam, Taiwan and the Guangdong province of China.
- * *Tramea virginia* (Ramb.): Coloane island, along a slow moving stream at Ka-Ho village, 2/12-VI-1999, LGQ leg. – Its habitat includes ponds as well as lakes in Hong Kong and distribution according to WILSON (1995) includes Bangladesh, Burma, Indonesia, India, Nepal, Thailand and Vietnam north to the Ryukyu Islands of Japan.
- * *Trithemis aurora* Burm.: Coloane island, 11-IX-1993 ERE leg., 2/12-VI-1999, LGQ leg. – It was found breeding in a freshwater marsh containing lesser duckweed and arrowhead plants near a stone quarry at Seac Pai Van. Distribution also includes Burma, India, Laos, Sri Lanka, peninsular Malaysia, the Philippines, Thailand, Vietnam and Taiwan north to the Ryukyu islands of Japan. Within China it is found in the Guangdong and Hainan provinces including Hong Kong.
- * *Trithemis festiva* (Ramb.): Coloane island, 5-XI-1999, ERE leg. – It was found breeding in a man-made water impoundment, consisting of a dam with spillway over a small forest stream at the N end of the Seac Pai Van forestry park on Coloane island. WILSON (1995) reported it common in pool areas of swift flowing streams in Hong

Kong and the New Territories. Its distribution also includes northern India, Cambodia, peninsular Malaysia, Nepal, Thailand, Vietnam, Laos, Borneo in Indonesia, the Philippines and Taiwan. In China it has been reported from Guangxi and Guangdong provinces (LIANG et al., 1999) and from Hainan island (ZHAO, 1985).

- * *Zygonix iris insignis* (Kirby): Taipa island, 9-VI-1999, LGQ leg. – Coloane island, 4-VIII-1997, J. Machon leg. – It is a stream inhabitant, and has a single annual generation in Hong Kong (DUDGEON & WAT, 1986). Distribution includes Hainan province and the Guangdong province of China (LIANG et al., 1989).

Discussion

Natural odonate habitats in Macao include (1) fast-flowing small forest streams on Coloane island, inhabited by *Copera marginipes*, *Prodasineura autumnalis*, *P. nigra* and *P. verticalis*; – (2) slow-moving streams in lowland areas near sea-level, with *Orthetrum pruinosum*, *Tramea virginia* and *Zygonix iris insignis*; – (3) ponds and marshy areas, containing *Anax parthenope*, *Pantala flavescens*, *Crocothemis servilia* and *Ischnura senegalensis*; – and (4) smaller man-made water holding containers, with *Orthetrum* spp. and *Anax immaculifrons*. The larger reservoir areas are not good habitats due to their steep sides in which few aquatic plants are able to gain a foothold, particularly when water levels drastically fluctuate.

Diurnal Lepidoptera are often illustrated with dragonflies as part of the food-web in temperate regions, but in Macao, KERSHAW (1905) noted that Odonata seldom fed upon butterflies. He reported one instance of either a gomphid or aeshnid species feeding upon a resting *Danaus* sp. during a colder period of the year when the latter were inactive. We have noted fewer insects on the wing during the late December through February in southern China when danaiid butterflies may congregate on vegetation along forest trails, waiting for higher temperatures. KERSHAW (1905) observed territorial behaviour in which *Graphium* sp. (Papilionidae) chased dragonflies and *Neptis* sp. (Nymphalidae) disturbing those Odonata known to gather in large numbers

or swarms. He was most likely observing *Pantala flavescens*, the only species in southern China the authors are aware of congregating in large numbers. They can be often seen flying back and forth over the same small area of ground which is not necessarily associated with water.

KERSHAW (loc. cit.) also observed dragonflies predated on other species of their own kind. In our study the larger sized *Orthetrum sabina* in late October was observed catching the smaller *Diplacodes trivialis* along a forest trail in Seac Pai Van park. The latter species often travels far from water and is noted on forest paths in both Hong Kong and Macao. WILSON (1995) also reported *O. sabina* feeding upon a medium-sized *Brachydiplax chalybea* in neighbouring Hong Kong.

Even though DUDGEON (1999) concluded that forest-stream Odonata are generalist feeders and no group of specific prey could be defined, we believe that in Macao, where streams are less common and small ponds and man-made water containers commonplace, aquatic Diptera constitute an important food source, since stoneflies and mayflies are largely absent. Only one species of mayfly, of the genus *Cloeon*, has recently been collected (M. Hubbard, pers. comm.). Observations of aquatic life, made in a hillside cement cistern (3.0x1.0x0.5 m depth) on Big Taipa hill, revealed *Orthetrum* larvae living beneath an algal mat amongst at least 2 culicid species, *Culex jacksoni* during winter and *C. bitaeniorhynchus* and *Uranotaenia annandalei* in summer, along with carnivorous dytiscid beetles, *Platynectes dissimilis* and a hydrophilid, *Amphiops globus* (JÄCH & EASTON, 1998). Culicid adults are most likely an important food of adult Odonata in Macao, considering the large populations of mosquitoes reported in this small geographic area.

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