AGRION

NEWSLETTER OF THE WORLDWIDE DRAGONFLY ASSOCIATION

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AGRION is the Worldwide Dragonfly Association's (WDA's) newsletter, which is normally published twice a year in January and July. Occasionally a special issue may be produced, as was the case in May 2020 when a special issue was published in response to the ongoing Covid-19 pandemic. The WDA aims to advance public education and awareness by the promotion of the study and conservation of dragonflies (Odonata) and their natural habitats in all parts of the world. *AGRION* covers all aspects of WDA's activities; it communicates facts and knowledge related to the study and conservation of dragonflies and is a forum for news and information exchange for members. *AGRION* is freely available for downloading from the WDA website at [https://worlddragonfly.org/about/agrion/]. WDA is a Registered Charity (Not-for-Profit Organization), Charity No. 1066039/0. A 'pdf' of the WDA's Constitution and byelaws can be found at its website link at [https://worlddragonfly.org/about/].

Editor's notes

Keith Wilson [kdpwilson@gmail.com]

WDA Membership

Membership signing up and renewal process is now handled by WDA directly from the WDA website [https://worlddragonfly.org/]. There are three kinds of WDA membership available, either **Regular** or single (£50/year), which is the standard category, **Family** (£75/year) or **Reduced** (£25/year). The latter is a reduced membership category for students (grade school, undergraduate, graduate, etc.) and anyone (student or not) residing in a developing nation (see UN list). For further information consult the WDA website at: [https://worlddragonfly.org/new-changes-in-2021/]. You can sign up for membership using the WDA's website [https://worlddragonfly.org/membership-account/membership-levels/] or by contacting the WDA secretary directly [wda.secretary@gmail.com]. Sponsored memberships are also available for those who cannot afford the cost due to currency restrictions or other reasons. Prior to 2021, membership options were with or without the WDA's journal (*The International Journal of Odonatology*)—in electronic form or hard copy, but as from January 2021 the IJO has only been available in electronic form and is now freely accessible through Open Access [https://worlddragonfly.org/ijo/]. For member benefits see WDA web page under Member Resources [https://worlddragonfly.org/resources/member-resources/].

WDA Membership Renewal

Automatic renewal is in place for existing members so they do not have to worry about their membership renewal. A reminder email, notifying members of their upcoming membership payment, will be sent seven days prior to the debit.

Cover. Left photo: Magnificent Emperor (*Anax immaculifrons* Rambur, 1842), Valparai, Tamil Nadu, India 25 November 2009. Photo credit: P. Jeganathan [WikimediaCommons]. Right photo: Fiery Emperor (*Anax aurantiacus* Makbun, Wongkamhaeng & Keetapithchayakul, 2022), Doi Suthep-Pui National Park, Chiang Mai, Thailand, 18 March 2019. Photo credit: Noppadon Makbun. Hitherto the blue-coloured *A. immaculifons* from eastern Mediterranean and South Asia and the bright orange *A. aurantiacus* from Southeast Asia—including Cambodia, south and southwest China (Fujian, Guangdong, Guangxi, Hainan and Hong Kong), Laos, Thailand and Vietnam—have been treated as forms of *A. immaculifrons*. Makbun et al, 2022 differentiated *A. aurantiacus* from *A. immaculifrons* based not only on the obvious differences in their colouration but also on morphological grounds in both the adults and larvae. In addition the authors determined from genetic molecular analysis that *A. aurantiacus* and *A. immaculifrons* represented distinct taxonomic units. There appears to be no known overlap in the distribution of the two species. See: Noppadon Makbun, Koraon Wongkamhaeng, Tosaphol Saetung Keetapithchayakul, 2002: *Anax aurantiacus* sp. nov., a new dragonfly from mainland Southeast Asia (Odonata: Aeshnidae) *Odonatologica* 51(3-4): 301-339 [Link]. There is a chance of seeing *Anax immaculifrons*, the largest of European dragonflies, in Cyprus at ICO2023 [see ICO2023 article on page 6].

Conference news

The International Congress of Odonatology ICO2023
The next ICO will be held in Paphos, Cyprus at the Neapolis University. The Congress was originally scheduled to be held in 2021 but, due to Covid-19 uncertainties, has now been rescheduled for 25-30 June 2023. For further information consult the WDA website [Link] or contact David Sparrow, Chair of the Organising Committee [davidrospfo@hotmail.com]. See latest ICO2023 news update article at on page 6].

European Congress on Odonatology (ECOO) 2020 postponed to 2022 due to Covid-19

After several Covid-19 related postponements the 6th European Congress on Odonatology (ECOO), organized by the Slovene Dragonfly Society, was finally held in in the city of Kamnik, Slovenia from 27-30 June 2022. Forty-four oral presentations were given and 14 posters were presented. The abstracts of these talks and posters are freely available in an ECOO 2022 publication: *Book of Abstracts* [Link]. For further information see the ECOO website [https://ecoo2016.wordpress.com/ecoo-2020/].

Figure 1. (A) Group photo of the ECOO 2022 participants. Photo credit: Matjaž Bedjanič. (B) Front cover of the ECOO 2022 publication: *Book of Abstracts* [Link].

WDA and social media

WDA has an active social media team coordinated by Social Media Coordinator, Emily Sandal [https://worlddragonfly.org/about/social-media-team/]. Emily is a postdoctoral research associate at the Center for Biodiversity & Global Change at Yale University, USA. Her work focuses on functional traits and global distribution of dragonflies, with a particular focus on larval odonates. Other members of the Social Media Team

include Rhema Dike and Danielle Husband. Rhema is a student and research assistant at the University of Lagos in Nigeria. He studies the diversity, distribution, and taxonomy of Odonata in Southwestern Nigeria and also studies odonates as indicators of water quality. Danielle is a biology masters student at Texas Tech University. Her research focuses on west Texas odonates at undersampled and imperiled wetlands. The Social Media Team regularly posts information on Facebook, Twitter, Instagram and the WDA website about Odonata related news and research. WDA's Facebook group can be found at [https://www.facebook.com/WorldwideDragonflyAssociation], its Twitter presence at [https://twitter.com/worlddragonfly?lang=en] and Instagram at [https://www.instagram.com/worlddragonfly/].

Next issue of *AGRION*

For the next issue of *AGRION,* to be published at the beginning of July 2023, please send your contributions to Keith Wilson [kdpwilson@gmail.com] or Graham Reels [gtreels@gmail.com]. All articles, information and news items related to dragonflies or of interest to WDA members are most welcome and will be considered for publication. Please send all text and figure captions in a Word file by email. Please do not include artwork with the text but provide a separate file or files, ideally in a compressed format (e.g. 'tiff', 'jpeg' or 'gif'). Do not make up plates of multiple photos but send the original photo images as separate files.

If you have an odonate photo illustrating any rarely observed aspect of dragonfly biology, or an unusual species, or simply a stunning dragonfly shot, please submit it for consideration for publication on the front cover of *AGRION*.

***AGRION* CONTENTS**

Nominations for the WDA Board positions 2023-2025

According to the WDA Constitution a new WDA Board of Trustees shall be established at least four weeks prior to the Biennial Board of Trustees General Meeting—to be held at ICO23 in June 2023—to replace the present Board for the two-year period mid-2023 to mid-2025. Kendra Abbott, our President Elect, will take over at the Biennial Board General Meeting from Yoshi Tsubaki as the new WDA President.

The present WDA 2021-2023 Board of Trustees
President: Yoshi Tsubaki
President Elect: Kendra Abbott
Secretary and Treasurer: Peter Brown
Managing Editor: John Abbott.
Webmaster: Will Kuhn, with assistance as needed from Rhainer Guillermo.
Symposium Coordinator: Frank Suhling
Chairman Conservation & Funding: Göran Sahlén.
Editor Agrion Newsletter: Keith Wilson, with assistance from Graham Reels.
Trustee: Kehinde Kemabonta
Trustee: Christopher Beatty
Past President: Jessica Ware

All members of the present WDA Board shall retire from office together at the end of the ICO2023 Biennial General Meeting with the exception of the President Elect. They may be re-elected or re-appointed to their current positions. Frank Suhling (Symposium Coordinator), Göran Sahlén (Chairman Conservation & Funding) and Keith Wilson with assistance from Graham Reels (*Agrion* Newsletter Editors) have indicated they would prefer to step back and give up their positions to new members. The remaining Board members are currently happy to continue in their present positions. In addition to the three aforementioned Board member vacancy positions WDA also needs to appoint a new President Elect as Kendra Abbott will be assuming the role of President in June 2023 and Yoshi Tsubaki will become the new Past President.

Nominations are invited from members for all the WDA Board positions with the exception of President and Past President. Should the nominations received exceed vacancies, members will be invited to vote using ballot sheets. As indicated above new appointees are especially sought for President Elect, Symposium Coordinator, Chairman Conservation & Funding and a new *Agrion* Newsletter Editor(s). Two members need to support each nomination, and the nominee must be contacted to confirm his or her approval of the nomination. Please use the wording below to make your nomination and return before the end of April 2023. Please feel free to nominate yourself!

Nomination for WDA Board of Trustees 2023-2025

I, _____ (proposer's name) _____(WDA mem. no.) wish to nominate the following member for the office of _____OR as a member of the Board of Trustees:

Name of nominee:_____

Address:_____

_____

Signatures of nominator and seconder

_____ _____

Nominator (WDA no. _____) Name of seconder _____ (WDA no. _____)

To be returned on or before 30 April 2023 to WDA Secretary, Peter Brown, Hill House, Flag Hill, Great Bentley, Colchester CO7 8RE [wda.secretary@gmail.com].

International Congress on Odonatology, 25 - 30 June 2023

ICO 2023, Paphos, Cyprus

David and Ros Sparrow [davidrospfo@hotmail.com]

The International Congress on Odonatology 2023 (ICO2023) will be held in Neapolis University, Paphos, Cyprus from 25th to 30th June, 2023. One very big advantage of the university is that it has reasonably priced on-site accommodation in recently renovated en-suite rooms, each with a balcony. Paphos International Airport is just 15 km away by road and there is a bus service from the airport that stops immediately outside the university that costs just €1.50! Registration for the congress is now open on the WDA website and the early-bird reduced fees for the congress (available until 31st March) are GBP 165 for students and GBP 310 for full-paying delegates.

The congress will open for delegates to check-in at 3:00 pm on Sunday 25th June and there will be a welcome cocktail reception from 6.00 pm – 8.00 pm in the evening. Congress sessions will be held on Monday 26th to Wednesday 28th June and on Friday 30th June. Morning and afternoon refreshments and lunch will be provided and included in the congress fees. On Thursday 29th June there will be a mid-congress field trip (also included in the congress fees) when we will split into smaller groups and visit sites on the nearby Ezousa and Diarizos rivers. We will then take a late lunch at a trout farm restaurant, escaping the heat at 1300 m asl. The congress will end with an optional congress dinner at a cost of GBP 35.

Following the congress there will be an optional 3-day post congress field trip, which will explore sites from our Paphos base.

Apart from the congress, another reason for visiting Paphos is to explore the many archaeological sites in the area, including the Paphos UNESCO World Heritage Site, featuring Roman-era mosaics and monumental rock-cut tombs. In fact delegates might wish to extend their visit by a few days before or after the congress when accommodation at the university is available.

Finally and importantly: Paphos is a popular holiday destination; hotels and flights tend to book up fast and get more expensive with time, so delegates are advised to book both flights and accommodation as early as possible.

Photo captions. (A) Neapolis University. (B) Magnificent Emperor (*Anax immaculifrons*), Choli, Cyprus, 21 August, 2016. Europe's largest dragonfly is restricted within Europe to Cyprus and the Greek Islands of Rhodes, Karpathos and Ikaria. (C) Persian Bluetail (*Ischnura intermedia*), R. Diarizos, Cyprus, 14 May 2016. Cyprus is the only place in Europe where *I. intermedia* is known to occur.

Obituary
Dr Kazunori Higashi (1 September 1935 - 18 February 2021)
A pioneer in introducing mathematical analysis to dragonfly ecology

Hidenori Ubukata [hidenori.ubukata{at}gmail.com]

Dr Kazunori Higashi (Professor Emeritus, Saga University; Fig. 1), a member of the Worldwide Dragonfly Association (WDA) and the first representative of the Japanese Group of WDA, passed away on February 18, 2021. I would like to offer my heartfelt condolences, look back on his achievements in ecological research of Odonata, and in the conservation of dragonflies and their habitats in global and local platforms, and portray his personality.

Figure 1. Dr Kazunori Higashi (1935-2021).

Dr Higashi was born on September 1, 1935 in Nagasaki Prefecture, Japan. In his childhood, he enjoyed observing insects, and was interested to see that an imagine of *Orthetrum albistylum*, which had had its wing slightly torn off by him, returned to the same place after a while. He wrote his bachelor thesis, on the ecology of *Crocothemis servilia*, at Yokohama City University, and continued his study on the ecology of dragonflies after entering the Graduate School of Science at Kyushu University. He was then employed as a professor's assistant at the Faculty of Science in 1966, and worked hard as a member of the staff of the Course of Animal Ecology while teaching younger students. In 1978, he was awarded the degree of Doctor of Science (Kyushu University) his dissertation being titled "Territoriality and its functions in Odonata". He became an Associate Professor at Saga University in 1980 and was promoted to Professor in 1986. He retired in 2001 and was awarded the title of Professor Emeritus. For 21 years at Saga University, he continued his lifework of researching the ecology of dragonflies, and provided guidance to many students and graduate students.

He actively participated in the activities of academic societies, and was in charge of peer review of submitted papers mainly related to ecology as an editorial board member of the Japanese Society for Odonatology. He served as an Auditor of the Organizing Committee of the International Symposium of Odonatology held in Osaka in 1993. He also served as the first Representative of the Japanese Group of the Worldwide Dragonfly Association, which was launched in 2001, and supported the early development of WDA from Japan where more than 200 odonate species and numerous amateur odonatologists live. In his homeland of Saga Prefecture, Dr Higashi led the activities of the Saga Dragonfly Study Group and the Saga Nature Study Society, and put his efforts into preserving the habitats of the dragonflies and providing guidance at dragonfly observation events. In 1993, he invited Prof. Philip S. Corbet to give a lecture for children at the "International Dragonfly Class", one of the 5th anniversary events of "Dragonfly Kingdom Saga" (Fig. 2). After returning to Scotland, Prof. Corbet sent a thank you letter to Dr and Mrs Higashi, which was filled with gratitude for their thoughtfulness. He also made efforts to develop human resources for people who like dragonflies.

Figure 2. Dr K. Higashi (left) in discussion with Prof. Philip S. Corbet (right) during the event of the "International Dragonfly Class" held in Saga city, Japan in 1993.

Dr Higashi is the author of three books (all written in Japanese) and was also one of the translation co-supervisors of the Japanese version

of Prof. Corbet`s 1999 book *Dragonflies: Behaviour and Ecology of Odonata*. Among them, *Research Methods for Animal Interactions I - Intraspecies Relations* was co-authored with Dr Kazuhiro Eguchi. Dr Higashi was in charge of four chapters covering topics such as general research methods, especially statistical analyses and simulation, which can be applied to all animals, not just dragonflies.

Dr Higashi, Dr Yoshitaka Tsubaki and I co-authored *Mating Systems and Social Structures of Dragonflies*. He authored two chapters, "Post-mating reproductive strategies" and "Adaptive evolution of female reproductive strategies and oviposition patterns", and co-authored the chapter "Coexistence of different reproductive strategies and intraspecific polymorphism" with me. Not only did he write the book, but he also took the lead in putting together the entire book into a single co-authored work.

When I conveyed the concept of the Japanese translation project of P. S. Corbet's great book *Dragonflies: Behaviour and Ecology of Odonata* published in 1999 for the professional and amateur dragonfly researchers in Japan, and sounded out the feasibility to several Japanese insect biologists, Dr Higashi showed his approval from an early stage and strongly supported the advancement of the project. Once the translator team was prepared and the funding was in sight, the project team found a publisher willing to publish the translated book. Then the translation task began. Dr Higashi was responsible for translating Chapter 9, "The Adult: Foraging" (co-translated with Mr Naoya Ishizawa) and was translation co-supervisor for the entire book (in addition to Dr Yoshitaka Tsubaki, myself, and Dr Tetsuyuki Uéda). In addition to the improvement of the quality of the work, he also contributed to the harmony and stability of the translator group during the long-term supervision of the translation work, which spanned seven years. The Japanese translation of the book, titled *Dragonfly Natural History: Diversity of Behavior and Ecology*, published by Kaiyusha in 2007, is a large volume of 858 pages. One of the photos chosen to be printed on the back cover was a male of *Nannophya pygmaea* that was taken by Dr Higashi's wife, Mrs Hiroko Higashi. By the way, the reference list at the end of this book listed 11 articles written by him as the first author, and he was cited in more than 30 places in the text. When Prof. Corbet published the original book (1999), Dr Higashi was entrusted with reading the manuscript of Chapter 9, "The Adult: Foraging", and it meant that he was a world-level authority in this field.

Dr Higashi's maiden paper (1969) dealt with the territoriality and population dispersal of *Crocothemis servilia*. On the campus of Kyushu University, where ponds and paddy fields are scattered, he painted individual identification marks on more than 600 adults per year. This research tracked long-term changes in space utilization and the presence/absence of territory occupants, and analyzed the results. It paved the way from the qualitative observation method, which had been generally adopted until then, to aforethought and quantitative research.

In a 1973 paper, Dr Higashi proposed and practiced a method multiplying the "number of flights in feeding mode" of dragonflies, "success rate (judging by the movement of mouthparts)" and "average individual weight of small insects in flight (using a flypaper ribbon)" together. He set up many perching rods to investigate the frequency of dragonfly flights, and devised and tried an automatic recording device with a microswitch attached to a small perching rod. Thus, the amount of food intake of *Sympetrum frequens* and *Calopteryx cornelia* was estimated.

Dr Higashi's work was further developed to study the diurnal changes in the dry weight of gastric contents and faeces of *S. frequens*. He also executed computer simulations in which the product of the measured number of flight times and the capture rate (daily change involved) was multiplied by the average weight of randomly selected prey insect groups and was multiplied again by the "depletion rate of gastric contents" to calculate the "hourly gastric contents". He then compared the calculated values with the actual measurement values and revealed that the simulation showed relatively good agreement under a specific depletion rate of gastric contents (Higashi, 1978).

Dr Higashi's 1976 paper on estimating the population density and survival rate of *Mnais pruinosa* not only elaborated on population estimation by the mark-recapture method, but pointed out that the territories were usually occupied by orange-winged males, and the hyaline-winged males often took a satellite position. His 1981 paper on *M. pruinosa* stood out in that he conducted a simulation of "the appearance frequency of the reproductive process (mating or oviposition)", which involved the "virtual value of the appearance frequency of the female to the territory" and several other behavioural variables. Also, after 1982 he published the results of ecological research centred on the territorial behaviour of the genus *Mnais* in collaboration with Dr Shintaro Nomakuchi (Fig. 3). Dr Higashi has contributed to the progress of Odonatology while expanding the scope of his field, such as by reporting the results of joint research on polymorphisms and geographical variations of karyotype (number of chromosomes), isoenzymes, and the mitochondrial 16S rRNA gene.

As we have seen above, Dr Higashi was a researcher who analytically and comprehensively elucidated the field ecology of not only dragonflies but also some other insects, especially their behavioural aspects, and who produced highly general research results using statistical processing and simulation as powerful tools. He earned the trust of his fellow researchers and younger ones because of the calm and accuracy embraced in his gentle attitudes. I perceive that I have been influenced by his attitudes without being aware of it, so I would like to once again express my gratitude to Dr Higashi.

Acknowledgements
This obituary is a revised and English-translated version of the original one which was written in Japanese and published in Vol.64 (2022) of *TOMBO*, the journal of the Japanese Society for Odonatology. Mrs Hiroko Higashi (Dr Higashi's wife), Dr Makoto Tokuda, and Mr Masato Nakahara cooperated in writing the original version. Mr Keith Wilson and Mr Graham Reels kindly revised the English expression of the translated version. All the photos printed here were provided by Mrs. Higashi. Dr Shintaro Nomakuchi helped identify the damselfly species of Fig. 3. The list of Dr Higashi's research works was edited by Dr Tokuda and first published in *Saga Nature Study*, No. 27 (2021), the journal of the Saga Nature Study Society, and a revised one was published in *TOMBO* together with the obituary. The following list is the English translation of the latest version with permission to repost. I would like to express my gratitude to the above people and organizations.

Figure 3. *Mnais pruinosa,* Japan. Dr Kazunori Higashi wrote 12 papers on the ecology of the two Japanese species of the genus *Mnais*, most of which were the product of collaborative studies with his colleague, Dr Shintaro Nomakuchi. Photo credit: Mrs Hiroko Higashi.

List of research publications by Dr Kazunori Higashi from 1969 to 2014

*In Japanese (verbatim translation).

Books

*__Higashi, K.__ & Eguchi, 1982. K. *Research methods for animal interactions I - Intraspecies relations*. Kyoritsu Shuppan, Tokyo, 232 pp.

*__Higashi, K.__, Ubukata, H. & Tsubaki, Y., 1987. *Mating Systems and Social Structures of Dragonflies*. Tokai University Press, Tokyo, 318 pp.

*__Higashi, K.__, Sawabe, K. & Uéda, T., 2004. Another Akatombo (Red dragonfly) - *Pantala flavescens* and *Sympetrum depressiusculum*. In: T. Uéda (ed.), *Dragonflies and view of nature*. Kyoto University Academic Press, Kyoto, pp. 183–205.

*Tsubaki, Y., Ubukata, H., Uéda, T, & **Higashi, K.**, 2007. [translation supervision] *Dragonfly Natural History: Diversity of Behavior and Ecology* (Japanese version of P. S. Corbet, 1999: *Dragonflies: Behavior and Ecology of Odonata*). Kaiyusha, Tokyo, 798 pp.

Scholarly papers

Higashi, K., 1969. Territoriality and dispersal in the population of the dragonfly, *Crocothemis servilia* Drury (Odonata: Anisoptera). *Memoirs of the Faculty of Science, Kyushu University. Ser. E, Biology*, 5: 95–113.

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*Ubukata, H., Nomakuchi, S., **Higashi, K. &** Hirama, Y., 1993a. Butterflies collected from lowlands to highlands in northern and central Taiwan - July/August 1990 -. *Sylvicola*, 11: 5–12.

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Sawabe, K., Uéda, T., **Higashi, K.** & Lee, S.M. 2004. Genetic identity of Japanese *Sympetrum frequens* and Korean *S. depressiusculum* inferred from mitochondrial 16S rRNA sequences (Odonata: Libellulidae). *International Journal of Odonatology*, 7: 517–527.

*Nakahara, M. and **Higashi, K.**, 2008. A new habitat for *Platycnemis foliacea* was confirmed in Taku City, Saga Prefecture. *Saga Nature Study*, (14): 30.

*Nakahara, M. and **Higashi, K.**, 2009. *Sympetrum fonscolombii* so far been unrecorded in Saga Prefecture was collected in May. *Tombo*, 51: 58–59.

*Nakahara, M, **Higashi, K.** & Ito, T., 2011. The inhabiting situation of *Sympetrum pedemontanum* on the Sefuri Mountains, Saga Prefecture: 2009 Miyama Akane research team survey report. *Saga Nature Study*, 16: 43–48.
*Nakahara, M, **Higashi, K.** & Ito, T., 2012. The Result of the research of the inhabiting situation of *Sympetrum pedemontanum* along the Kase River water system in Saga Prefecture during 2010-2011. *Saga Nature Study*, 17: 25–27.
*Nakahara, M, **Higashi, K.** & Ito, T., 2013. The inhabiting situation of *Sympetrum pedemontanum* along the Kase River water system in Fuji-cho, Saga City, Saga Prefecture in 2012-The population declined further toward a critical situation. *Saga Nature Study*, 18: 21–24.
*Nakahara, M, **Higashi, K.** & Ito, T., 2014. The Result of the research of the inhabiting situation of *Sympetrum pedemontanum* on the Sefuri Mountains, Saga Prefecture in 2013. *Saga Nature Study*, 19: 29–32.

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A Profile of Sha Lo Tung, a Dragonfly Hotspot in Hong Kong and Case Study in Conservation Planning

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Abstract

The Sha Lo Tung basin, located within the Pat Sin Leng Country Park in the north-east New Territories of Hong Kong, is renowned for its dragonflies. The basin is home to four small abandoned Hakka villages. From the early 1980s a succession of campaigns have been mounted against a series of proposed developments at Sha Lo Tung. The controversy is considered to be an outstanding example of green groups using legal means to block repeated and determined attempts to use a country park and abandoned ancestral village lands for private property development. The diverse ecology of the area, especially its odonate populations, are the principal reason for the planning authority's ultimate refusal to approve development at the site. A summary of the odonate communities, ecology and history of the Sha Lo Tung basin is provided here together with an account of the various development proposals and the planning process outcomes. The developer, villagers and the Administrations' mutual struggles that finally led to a solution acceptable to all parties and also allowed for the full protection of the basin's exceptional wildlife is documented.

Background

Sha Lo Tung (SLT) has been repeatedly assessed as Hong Kong's top Dragonfly Hotspot and recognised as a high biodversity site in Hong Hong. Over the past 40 years there has been a series of intense struggles between green groups wishing to protect the site's fragile ecology and a determined private company intent on developing the upland valley, in Hong Kong's north-east New Territories. The long-standing conflicts and ensuing legal battles have become a cause célèbre[1].

The SLT basin is situated in a picturesque upland valley encircled on all sides by steep mountain slopes (Fig. 1 &

Figure 1. (A) Satellite image of Pearl River delta and the Greater Guangzhou megalopolis showing the location of Sha Lo Tung within Hong Kong's New Territories. Hong Kong and the New Territories' population is ca. 7.3 M (2022). Shenzhen, in the immediate central background, has a population ca. 17.6 M (2020), which is the 4th most populous city in China. Credit: Google Earth. (B) Map of the Sha Lo Tung basin, Hong Kong. Countryside series map (1: 25,000), 1987, North-east New Territories. Credit: Survey and Mapping Office, Land Department, Hong Kong SAR Government.

1 Alvin Y. So, Lily Xiao Hong Lee, Lee F. Yok-shiu (eds.), 1999. *Asia's Environmental Movements: Comparative Perspectives*. Armonk, New York: M. E. Sharpe, Inc. pp 319.

Fig. 2A). There is a prominent escarpment ridge to the north and east rising to its highest point at Wong Leng peak at 639 m and another prominent ridge to the west and south of the valley rising to 440 m at Cloudy Hill (Kau Lung Hang Shan). The valley is accessed by a road from Tai Po Market town to the south of SLT that rises up northwards over the southern mountain ridge at its lowest point (ca. 210 m). The relatively flat basin itself is about 160 m above sea level. The geology of the Pat Sin Leng is predominantly volcanic strata comprised of tuffaceous sandstone, reddish brown thinly-bedded siltstone and thickly-bedded conglomerate[2]. The sandy

2 Pat Sin Leng Formation. Civil Engineering and Development Department, The Government of the Hong Kong Special Administrative Region [Link].

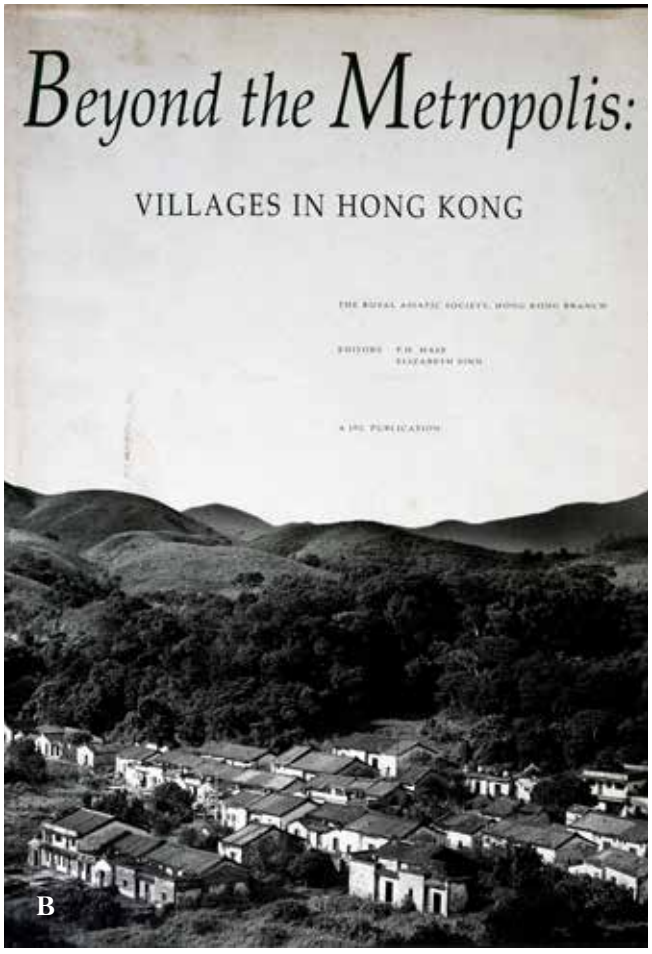


Figure 2. (A) Aerial photograph of the Sha Lo Tung basin taken shortly after completion of the Tai Po Industrial Estate reclamation (foreground), which commenced construction in 1976. Note the active agricultural paddies and almost complete lack of forest cover. Credit: Survey & Mapping Office, HKSAR Government. (B) Front cover of the book by Hase, P.H. & Sinn, E. (eds), (1995), titled: *Beyond the Metropolis: Villages in Hong Kong*. Joint Publishing Co. Ltd., Hong Kong. The village shown in the foreground photo is part of Cheung Uk, Sha Lo Tung with its associated *Fung Shui* woodland behind.

soils found within the valley and sandy-gravel streams gave rise to its local name Sha Lo Tung, which roughly translates to 'sand carried in a basket'.

The SLT basin is surrounded by the Pat Sin Leng Country Park (3,125 ha), which was designated in 1978. At the time of the park's designation the basin itself (ca. 57 ha), containing small villages and agricultural land, was excised from the Country Park. So, prior to 1997, the SLT basin had no official protection from development.

A brief synopsis of the fauna and flora recorded from SLT is provided at Appendix A.

Figure 3. Sha Lo Tung. (A) Photo of Cheung Uk, SLT, taken in January 2010. Photo credit: Chong Fat [Link]. (B) Lei Uk, Sha Lo Tung, with its assocaited *Fung Shui* woodland behind, 20 June 2003.

History of Sha Lo Tung

From 1661-1683 Hong Kong and the New Territories were part of the Great Clearance coastal area. During this period the Shunzhi Emperor of Qing (1643-1661) and his successor (his son), the Kangxi Emperor (1661–1722), ordered the complete evacuation of people from the coastal areas of Guangdong, Fujian, Zhejiang, Jiangxi and Shandong as a measure to thwart attacks from the Taiwan-based anti-Qing loyalist movement.

From the late 1600s to early 1700s members of the Hakka community, originally from northern China, began to repopulate Hong Kong and the New Territories. The Cheung clan were the first to arrive at SLT about 330 years ago followed by the Lei clan in the early 1700s. The Cheungs first settled in Lo Wai, SLT where there is limited space for buildings and the clan subsequently moved to establish Cheung Uk village. Lo Wai and its two daughter settlements became known as Lei Uk. The population in SLT peaked between around 1960 at nearly 450 persons. In 1958 there were 74 resident families with 442 persons and in 1960 there were 445 residents; 260 in Cheung Uk and 185 in the Lei villages[3]. During the late 1960s and 1970s, rice farming became non-viable throughout Hong Kong—especially in remote villages such as SLT—mainly due to competition from mainland China, where production costs were much lower. By the mid-1970s the population had dwindled to a few dozen elderly residents, dependent on remittances from family members elsewhere in Hong Kong and overseas, many from Birmingham, UK, where a number of SLT villagers had migrated. Agriculture became increasingly untenable and in 1995 the last resident moved out of SLT.

Cheung Uk is a fine example of a traditional New Territories unwalled village with parallel rows of houses (Fig. 2B). The Hakka dwellings are Grade II listed historic buildings but many have now become severely decayed, mainly due to the ravishes of ants, termites, Cairo Morning Glory (*Ipomoea cairica*), figs (*Ficus* spp.), and harsh weather conditions (Fig. 3).

Development proposals at Sha Lo Tung, 1982-1992

In 1979 the Sha Lo Tung Development Company (SLTDC) was formed. The vast majority of villagers were persuaded to sell their land and property at SLT to the SLTDC at HK$12 per square foot for agricultural land and $200,000 for building plots on the condition that the villagers received a new village house and preservation of the Cheung Uk ancestral hall, plus a HK$3M welfare donation for each of the two clans, the Cheungs and

3 Hase, P.H. & Sinn, E. (eds), 1995. *Beyond the Metropolis:Villages in Hong Kong*. Joint Publishing Co. Ltd., Hong Kong.

the Leis. From 1982 to 1989 the SLTDC submitted a series of proposals for planning consent involving village and luxury residential developments, a country club and golf clubhouse facility, and an 18-hole golf course. The golf course extended into government land within the Pat Sin Leng Country Park. In 1990 the Administration agreed to release government owned village land and Country Park land to the SLTDC and granted outline approval for the development. When local green groups discovered the proposed release of Country Park land for commercial interests, that appeared to be in contravention of the Country Parks legislation, they were very angry and formed a united campaign against the development, resulting in a Judicial Review. In July 1992 the Judicial Review overturned the decision to release government land and the outline planning permission was revoked. The Administration then advised that any future plans must avoid utilising any land in the Country Park and instructed the developer to complete an Environmental Impact Assessment (EIA).

Dragonfly surveys in Hong Kong and Sha Lo Tung 1991-1995

When I arrived in Hong Kong in January 1991 to take up a government fisheries management post, I was immediately struck by the great diversity of Odonata, even though it was winter. The only local book I could find on the subject was *Insects of Hong Kong* by D.S. Hill et al., 1982[4]. The book contains a handful of black and white photographs of larvae and a few adults. Not a single *Orthetrum*, was mentioned, which is the most commonly encountered genus of dragonflies in Hong Kong, containing many abundantly common and widespread species. Moreover, there were errors in identification and typographical mistakes in the book. For example *Euphaea decorata* is labelled as *Neurobasis chinensis* and vice versa. Syoziro Asahina had made repeated visits to Hong Kong and published several accounts including three papers covering the complete fauna known at that time: the first in 1965[5] and the second two in 1987[6] (Zygoptera) and 1988[7] (Anisoptera). These papers were the first to provide accurate and relatively comprehensive accounts of the Hong Kong odonate fauna. But, Asahina's surveys were limited in their extent, academic, and covered only 68 species—about 50% of the odonate fauna now known to frequent Hong Kong. It was apparent to me then that there was a clear need for a comprehensive 'field guide' style account of the Hong Kong Odonata that covered all corners of the territory. In my free time I completed such a territory-wide survey of odonates in all types of wetland habitat and five years later at the end of 1995 I published a book on the *Dragonflies of Hong Kong*[8] covering 104 species. In those days books were not set out using a computer but prepared with layout paper, a laborious process. Every time I thought I'd finished the book I'd find another species or taxon new to Hong Kong. I felt sorry for the Urban Council's Editor, Elaine Fung and the Designer, Vincent Leung who in the end abandoned trying to match the text with the photos. Together, we agreed to publish the book before the end of 1995 regardless of how many new Hong Kong species I had found.

I first visited SLT in summer of 1992, following a personal request from David Melville (Executive Director of World Wide Fund for Nature Hong Kong from 1992 to 1999) to survey the odonate fauna. David was concerned that there might be insufficient ecological data to justify the protection of the SLT basin from development. To my great surprise and delight, on my first visit to SLT in May 1992, I observed several flying *Macromia* species, which is a genus that had never previously been recorded from Hong Kong, and many adult gomphid species. Later, in the summer of 1992, I collected mature adult *Macromia* larvae belonging to three species and bred them out to determine the identity of these elusive river cruisers, publishing a new species, *Macromia katae,* in 1993 and revealing the identity of the other two species, *M. berlandi* and *M. urania,* both new records for Hong Kong and China[9]. In 1995 I also published an account of the Gomphidae of Hong Kong with numerous records from SLT including *Gomphidia kelloggi* that had only previously been recorded from a single site in Fujian, the type locality[10]. It has since been recorded from Guangdong but has a very restricted distribution. In 1996 I subsequently described a new *Macromidia, M. ellenae,* that I had found at SLT in 1995[11]. In total I recorded 68 odonate species from SLT between 1991 and 1995 out of a total of 106 known from the territory at that time (two more species were added to the HK odonate fauna in late 1995 after the *Hong Kong Dragonflies* book was published).

4 Hill, D.S., Hore, P. & Thornton, L.W.B., 1982: *Insects of Hong Kong.* Pub. Hong Kong University Press.

5 Asahina, S., 1965. The Odonata of Hong Kong. *Kontyû* 33(4): 493-506.

6 Asahina, S., 1987. A revised list of the Odonata of Hong Kong. Part 1. Zygoptera. *Tombo* 30(1-4):7-24.

7 Asahina, S., 1988. A revised list of the Odonata of Hong Kong. II. Anisoptera. *Kontyû* 56(4): 689-705.

8 Wilson, K.D.P., 1995: *Hong Kong Dragonflies*. Urban Council Hong Kong

9 Wilson, K.D.P., 1993: Notes on the *Macromia* (Anisoptera: Corduliidae) of Hong Kong with description of *Macromia katae* spec. nov. *Odonatologica* 22(2): 233-241. [Link].

10 Wilson, K.D.P., 1995: The Gomphidae dragonflies of Hong Kong, with descriptions of two new species. *Odonatologica* 24(3): 319-340. [Link].

11 Wilson, K.D.P., 1996: The Idionychinae (Anisoptera: Corduliidae) from Hong Kong with a description of *Macromidia ellenae* spec. nov. *Odonatologica* 25(4): 355-366. [Link].

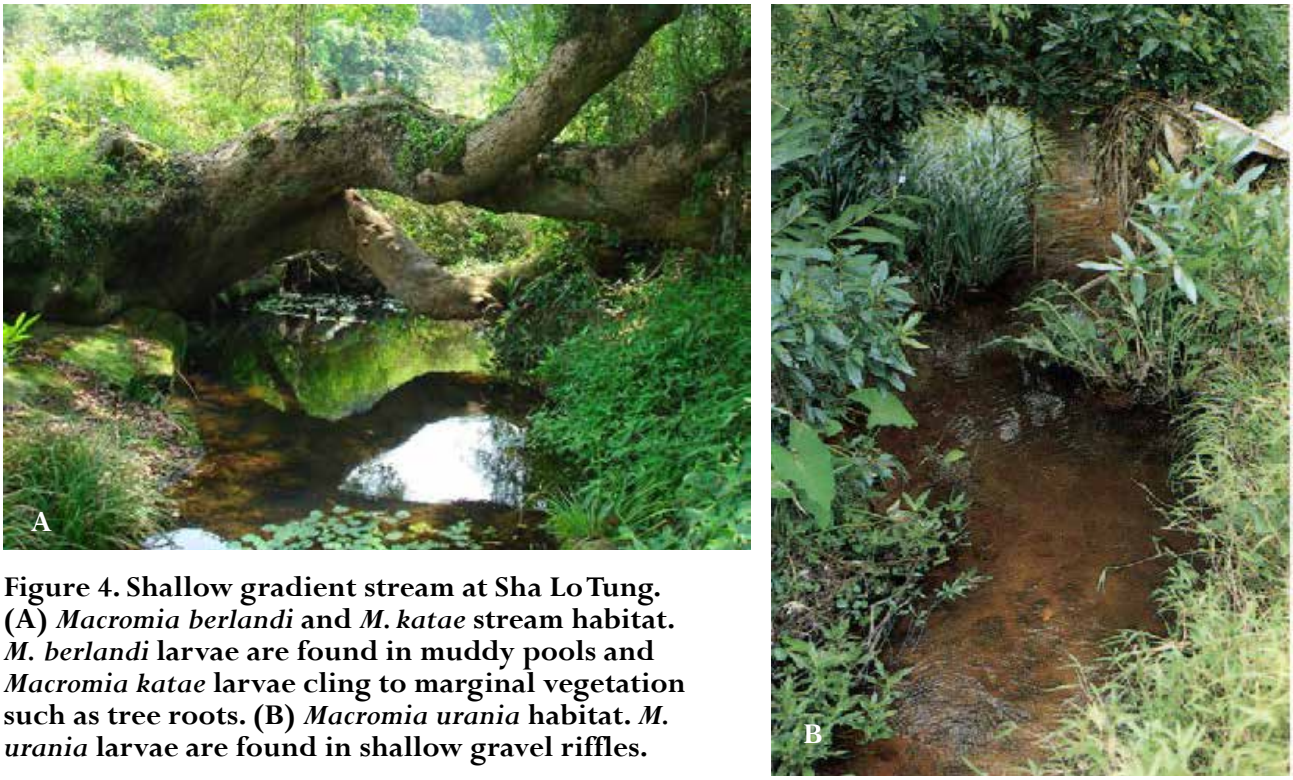


Figure 4. Shallow gradient stream at Sha Lo Tung. (A) *Macromia berlandi* and *M. katae* stream habitat. *M. berlandi* larvae are found in muddy pools and *Macromia katae* larvae cling to marginal vegetation such as tree roots. (B) *Macromia urania* habitat. *M. urania* larvae are found in shallow gravel riffles.

Development proposals at Sha Lo Tung, 1995

In 1995 the SLTDC submitted a revised development proposal for SLT. The 18-hole golf course had been dropped to nine holes and it no longer extended into the surrounding Pat Sin Leng Country Park. Furthermore, an EIA had been completed for the first time. In preparing the EIA, Günther Theischinger (Research Associate of the Australian Museum and a Visiting Fellow at the Smithsonian Institution) had been brought in to advise SLTDC as an independent expert dragonfly consultant. Günther has described over 60 odonata species, several genera of Australian dragonflies and written several books. In 1995, at the age of 55, he was also extremely fit and I well remember he had an incredibly firm hand-shake. We made a very enjoyable joint visit to SLT on the 27 February 1995. Günther was very affable and great company. I very much enjoyed showing him the various habitats frequented by the three species of *Macromia* at SLT and was able to net examples of all three species of larvae from a SLT stream on the day of our joint visit; four *Macromia berlandi* larvae from a stream pool, a single *M. katae* larva from adjacent marginal tree root vegetation and the third species, *M. urania* from a nearby gravel riffle (Fig. 4). At Günther's suggestion we wrote a joint paper describing the three *Macromia* larvae that occur at SLT including their habitat preferences, male patrolling patterns and female oviposition behaviour[12]. Günther supplied excellent drawings of the larvae and reviewed the odonate data I had collected from SLT. He concurred with me that SLT was exceptional within Hong Kong for Odonata and indeed of international importance. Needless to say, Günther's relationship with the SLTDC was short-lived.

The1995 revised development proposals and EIA[13] were reviewed by the Advisory Council on the Environment (ACE). The role of ACE was to advise the Administration on the quality and effectiveness of the EIA process in relation to the revised proposals. ACE considered the EIA reports had been professionally produced but had severe reservations on the effectiveness of the proposed mitigation measures outlined in the EIA. In early 1996, after several meetings, ACE voted against approving the SLT EIA and its associated development proposals. The Administration had recommended to ACE that the EIA should be endorsed but for the first time ACE voted against the government's recommendation and declined to approve the EIA.

In mid-1996 upon a suggestion and encouragement from Norman Moore, the distinguished odonatologist and conservationist, I submitted a paper detailing the odonate fauna and development threats at SLT. In the paper I outlined a case for Site of Special Scientific Interest designation as a means of helping to protect the SLT stream fauna[14].

12 Wilson, K.D.P. & G. Theischinger, 1996. Further notes on the *Macromia* Rambur from Hong Kong, with descriptions of the larvae (Anisoptera: Corduliidae). *Odonatologica* 25(3): 275-282. [Link].

13 Axis Environmental, 1995. Sha Lo Tung revised Development Plan, Supplementary Environmental Impact Assessment. Prepared by Axis Environmental Consultants Ltd. for the Sha Lo Tung Development Co. Ltd.

14 Wilson, K.D.P., 1997. The odonate faunas from two Hong Kong streams, with details of developmental threats. *Odonatologica* 26(2): 195-204. [Link]

Villagers' protest, 1995

In June 1995 several villagers, frustrated at the lack of progress in gaining approval for development at SLT, took direct action for the first time. A 6 ha tract of former agricultural land was cleared by a bulldozer causing sediment deposition in the adjacent stream (Fig. 5A). The villagers agreed to stop the land clearance work on the expectation that the village redevelopment proposals, under assessment at that time, would ultimately receive approval.

Site of Special Scientific Interest (SSSI) and Development Permission Area (DPA) designation, 1997-1999

On the 14 January 1997 the Planning Committee (District Board North), Lands Department approved a proposal from the Agriculture and Fisheries Department (AFD), made earlier in 1996, to designate the SLT streams, with a 30 m buffer zone each side, as a Site of Scientific Interest (SSSI) - Figure 5(B). The SSSI was subsequently officially designated on 16 January 1997.

In response to the lack of development approval and the designation of SSSI status for SLT the villagers arranged for an excavator to return to SLT and trash the site (Fig. 5A). Large areas of farmland were bulldozed and irrigation channels destroyed. I vividly recall attending a special meeting, held on 16 January 1997, in my capacity as a local Odonata expert, and not as a representative of AFD, where I worked as a Senior Fisheries Officer. The meeting was also attended by the Administration's senior planning personnel and chaired by Gordon Siu, the Secretary for Planning, Environment and Lands (SPEL). The main purpose of the meeting was to address the ongoing issue of excavators actively trashing the SLT basin. AFD's SSSI designation conferred no official legal protection for the SLT basin unless the land classification was incorporated into a Development Permission Area (DPA) granting full planning controls. After much objection from the Planning Department, over the extremely short time scale afforded to them to prepare and draft the necessary planning control paperwork and maps, the draft DPA was nevertheless gazetted on 24 January 1997, the following week, just eight days later. A 'Stop Work' order was then imposed for the destructive works being undertaken at SLT and the digger drivers quickly disappeared upon threat of arrest.

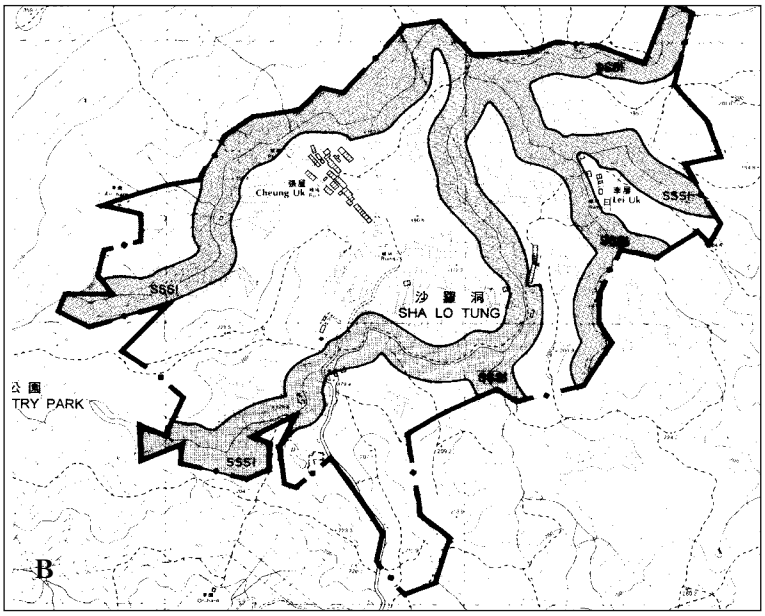


Figure 5. (A) In June 1995 villagers protested by undertaking direct action at Sha Lo Tung. An excavator was used to clear 6 hs of former agricultural land causing significant sedimentation in the adjacent stream watercourse. Excavators were returned to the site in further protest in the winter of 1996-97. (B) Map of the Sha Lo Tung SSSI designated 16 January 1997 by Agriculture & Fisheries Department. The designated area includes the stream plus a 30 m buffer zone either side of the stream watercourse.

In March 1997 the SLTDC strongly objected to the draft DPA and in September 1998 the developer submitted a report titled: *Ecological Significance of Sha Lo Tung*, prepared by Dr Maria Milicich, working as an independent ecosystem specialist consultant reporting directly to SLTDC. The report attempted to downplay the relative importance of the odonate community and other ecology of the SLT, especially in the north-east marsh area. However, the objections to the draft DPA by SLTDC, villagers and several other interested parties were eventually overruled by the Town Planning Board on 24 November 1998 and on the 20 April 1999 the Chief Executive in Council approved the DPA plan. On 14 December 1999, the Chief Executive in Council extended the DPA for an additional year up to 24 January 2001 to provide sufficient time to consider objections and options put forward by SLTDC on the development of SLT.

In November 2000 a new application for village redevelopment at SLT by the SLTDC was rejected by the Administration.

Dragonfly surveys, 1997

In 1997 I published a complete list of Hong Kong dragonflies and made recommendations for their conservation[15]. At that time 107 species were enumerated and I predicted that: 'a total of 125 could yet be exceeded'. The total now stands at 130 but several non-resident vagrants are included in the list. The main increase in species recorded from the territory is due to recolonisation in Hong Kong's rapidly redeveloping forest areas[16]. With respect to SLT I stated: 'Undoubtedly the best Hong Kong stream site for species richness with 68 species now known from this location. Many stream specialists are supported in the Sha Lo Tung basin. SSSI status was declared January 1997. Seven of Hong Kong's eight corduliid species occur in Sha Lo Tung including all three Hong Kong *Macromia* species and both *Macromidia* species[17]. It is the only site in the world to possess two *Macromidia* species. It is the type locality for *Macromia katae* and *Macromidia ellenae*. *Zygonyx asahinai* and the [then[18]] endemic *Drepanosticta hongkongensis* occur at this site. This area also supports eleven species of gomphid from ten genera which makes it the richest site for these stream specialists in Hong Kong and ranks it amongst the world's richest gomphid sites. *Gomphidia kelloggi* thrives within the basin and is only known from the type locality in Fujian outside of Hong Kong [now also known from Guangdong]. A *Sieboldius* species has also been observed and one female captured at Sha Lo Tung. Its status is unknown [now confirmed as *S. alexanderi*]. *Prodasineura croconota* previously thought to be a Taiwanese endemic occurs here. *Gynacantha japonica* and *Polycanthagyna erythromelas* also occur. *Lamelligomphus hongkongensis* has been recorded once and this only occurs at one other site the type locality Tai Tong' [*L. hongkongensis* was later synonymised with *L. hainanensis* by Wilson & Reels, 2001[19]].

Figure 6. Judicial Review (SLTDC v Chief Executive in Council) site visit to Sha Lo Tung, 12 December 2000. The Court of First Instance, High Court of Hong Kong, with the Honourable Mr Justice Cheung presiding (front left) and Keith D.P. Wilson, representing the Administration (right), on the Court's site inspection at Sha Lo Tung, during the week-long hearing that commenced 11 December 2000. His Lordship was able to see for himself that there was indeed a significant stream flowing from the north-east marsh at SLT, entering the main stream flowing to Hok Tau Reservoir. The existence of this stream flow was a direct contradiction of the evidence given by the SLTDC's hydrological expert who asserted there was no such flow from the north-east marsh entering the main SLT stream flowing to Hok Tau Reservoir, which in his view invalidated its status as an SSSI. Very unusually, for Dec-Jan winter periods in Hong Kong, it had rained heavily during the night and early morning just before the court's visit, bolstering the marsh stream flow in the north-east SLT.

Judicial Review, 2000-2001

On the 11 December 2000 the Court of First Instance, High Court of Hong Kong SAR Government, with the Honourable Mr Justice Cheung presiding, held the first day of a week-long Judicial Review brought about by the SLTDC who challenged the DPA on the basis that the decision to designate the north-east part of SLT as SSSI was unlawful and irrational. To support their arguments Dr Rosser Garrison was contracted by the SLTDC. Rosser Garrison was a Senior Insect Biosystematist and Odonata expert with the Department of Entomology, California Department of Food and Agriculture (now retired), who has published 100s of papers on New World Odonata and several important books. Rosser Garrison arrived in Hong Kong in July 1999, spending several weeks to review and assess the Odonata of SLT. On the second day of the court hearing the Honourable Mr Justice Cheung and key representatives for both sides attended a site visit to SLT (Fig. 6).

15 Wilson, K.D.P., 1997: *An annotated checklist of the Hong Kong dragonflies with recommendations for their conservation*. Memoirs of the Hong Kong Natural History Society 21: 1-68. [Link].

16 Wilson, K.D.P., 2014. Odonata recolonisation of Hong Kong's forests. *Agrion* 18(1): 3-20. [Link]

17 The SLT species mentioned here belonging to the Corduliidae family have been moved to Macromiidae (*Macromia* spp.), Synthemistidae (*Macromidia* spp.) and family *incertae sedis* in respect of *Idionyx*, following genetic molecular studies.

18 *Drepanosticta hongkongensis* is now known from Fujian, Guangxi, Guangdong, Hong Kong and Vietnam

19 Wilson, K.D.P. & G.T. Reels, 2001. Odonata of Hainan, China. *Odonatologica* 30(2): 145-208. [Link].

Dr Rosser Garrison's comments titled: 'Errors in Agriculture & Fisheries Department's ecological arguments'
In reference to AFD's statement: 'SLT, particularly the areas around the stream watercourses, is an area of high ecological value in view of the presence of an extremely diverse community of dragonflies and other aquatic fauna such as freshwater fish and amphibians', Rosser Garrison commented: 'Listings of species of Odonata collected at a site do not justify establishment of study zones, nature preserves or the like. It does more harm than good to proclaim such sites without adequate data to back up the conclusions. Excessive use of such protective measures cheapens their effectiveness and breeds disregard for the law by the public'. In response to another of AFD's statements: 'It was certain that the area was an important "Site of Special Scientific Interest" worthy of conservation protection [Extract from TPB minutes 27 Mar 1998, page 71 Item 246(n)]' Rosser Garrison commented: 'After reviewing (Keith) Wilson's published papers and examining two unpublished manuscripts on the taxonomy (collection) of Odonata (dragonflies) of Hong Kong and Guangdong, I find it difficult to reconcile Mr Wilson's work with several ecological statements reported in the TPB meeting of 27 March 1998. Virtually no ecological work - habitat preferences, population dynamics including average life span analysis, dispersal properties or home range studies, quantitative sampling of larvae etc - has, to my knowledge, been conducted with any odonate fauna of Hong Kong and surrounding areas. This is a necessary prerequisite to an assessment of ecological status and value and ultimately to an assessment of conservation requirement.' Apart from his comments on AFD statements Rosser also provided a detailed report. Part of Rosser's SLT Odonata report summary is provided below.

Summary of Rosser's findings and statement
'The odonate fauna of the site is diverse but most species are not exceptional by international standards and the habitats there are not unique, being highly disturbed as is typical in SE Asia. Nevertheless, by Hong Kong standards, the stream regions of the SLT sites are worth preserving for their odonates. Because of the poorly known status, odonates that highlight the SLT site are *Gomphidia kelloggi, Lamelligomphus hongkongensis* (Gomphidae), *Macromia katae*, and *Macromidia ellenae* (Corluiidae). Yet it is likely that these apparently restricted species will be found to be far more widespread once odonate collecting is undertaken more extensively in other parts of the New Territories, Hong Kong Island, and in China and surrounding countries. Nevertheless, by Hong Kong standards, the stream regions of the SLT site are worth preserving for their odonates. If development is undertaken at SLT, then the 2 main stream-based areas designated as SSSIs seem adequate to protect the current odonate fauna of the site, whereas the designated "N.E. SSSI" does not have such a stream and was clearly not established for odonate conservation on any sound scientific basis. The value of SLT for site diversity lies in good habitat management plan in order to ensure that the SLT site retains its odonate fauna. The control of everyday activities, coupled with a sensible management plan catering to a detailed documentation of local odonate biology and ecology, should ensure the SLT site retains and enhances its current odonate fauna when developed.'

It appears that Rosser Garrison had to a large extent overlooked Professor David Dudgeon`s numerous peer-reviewed papers in international journals that had catalogued his studies on the ecology of Hong Kong`s stream macroinvertebrate communities. Forty-nine of Dudgeon's peer-reviewed Hong Kong stream ecology papers had been published prior to 1997. Five of these publications were specifically focused on the life cycle and ecology of Hong Kong stream odonates. Three years earlier Dudgeon had published the *Hills and Streams: An Ecology of Hong Kong* textbook in 1994, that specifically describes the ecology of Hong Kong streams[20]. In 1996 Dudgeon and Chan had published a report titled: *Ecological Study of Freshwater Wetland Habitats in Hong Kong*[21]. The study group had surveyed 33 key wetland habitats that had been identified in Hong Kong. The stated main aims of the survey were: '(a) to inventory local wetlands and identify those sites with high biodiversity, (b) to classify local wetlands into groups or ecotypes and to identify wherever possible, the environmental variables or conditions that influence their characteristics, biodiversity and conservation value. Such classification provides an essential underpinning for conservation recommendations, since it will be necessary to include at least one wetland of each ecotype in the final list of sites selected, (c) to rank sites on the basis of their conservation value, and recommend to government those sites which are particularly worthy of conservation, and (d) to draw attention to any species which are endangered, threatened or of ecological significance, and to identify taxa which may be used as environmental 'indicators' of wetland characteristics'. In respect of SLT the report recommended to AFD: 'This site undoubtedly justifies SSSI status on the basis of its stream dragonfly fauna'. David Dudgeon is an Emeritus Professor of Ecology & Biodiversity at the University of Hong Kong, where he has spent over 40 years researching the ecology, biodiversity and conservation of the animals that inhabit the streams and rivers of monsoonal Asia. His work concerns food-web dynamics and energy flow in streams, and the broader issue of conservation of freshwater biodiversity in a rapidly-changing, human-dominated world. He has published over

20 David Dudgeon & Richard T. Corlett, 1994. *Hills and Streams: An Ecology of Hong Kong.* Hong Kong University Press.

21 David Dudgeon & Eddie ChanWing-chung, 1996. *Ecological Study of Freshwater Wetland Habitats in Hong Kong.* Report prepared for the Agriculture & Fisheries Department, Hong Kong Government. [Link].

200 papers in peer-reviewed ISI journals [Link]. His latest book, titled *Freshwater Biodiversity: Status, Threats and Conservation*, was published in 2020[22].

Judicial Review decision 9 January 2001

The various arguments from both sides that the north-east marsh should or should not be designated a SSSI were fully explored in the 2000 Judicial Review with expert hydrological consultants and ecological experts arguing for the SLTDC. The review found there were clear scientific reasons to designate the north-east marsh as an SSSI to protect the downstream fauna immediately below the marsh. Justice Cheung ruled: '(1) that the decision to extend the Plan (DPA) was a lawful and rational one so as to enable the Town Planning Board to consider the options put forward by the applicant and (2) the designation of the north-east area of Sha Lo Tung as a Site of Special Scientific Interest is not unlawful or irrational. There is evidence which is capable of enabling the Town Planning Board to form the view that the north-east area should be designated as a Site of Special Scientific Interest: the marshland in the north-east and the streams in the Sha Lo Tung form the ecological structure for wildlife habitat'. The full Judicial Review decision makes interesting reading, see link attached [Link][23].

Sha Lo Tung Outline Zoning Plan (OZP), 2002

Following the Judicial Review decision to dismiss the SLTDC's objections to the DPA, the SLT Outline Zoning Plan (OZP) was subsequently approved by the Chief Executive in Council on 8 February 2002. The conservation-led OZP replaced the earlier DPA plan, which was first gazetted in 1997. The TPB provided the following accompanying press release information at that time.

- The general planning intention in respect of the planning scheme area is to conserve the areas of ecological significance, to preserve the natural landscape, to promote conservation and to maintain the rural character of the area.
- To conserve the streamcourses and the freshwater marsh in the north-eastern portion of the area, which are of special scientific interest, a total of 21.61 hectares covering the stream courses and a 30 m wide buffer area on both sides of the streamcourses are designated "Site of Special Scientific Interest" ("SSSI").
- To conserve the existing natural character and landscape of the well-vegetated areas which constitute important topographical features and to provide added protection for the ecologically sensitive areas, 11.73 hectares of land is zoned "Conservation Area" ("CA").
- The remaining 21.86 hectares of the area, which consists of foothills, lower hill slopes, spurs, isolated knolls, woodland or vegetated land, is zoned "Green Belt" to serve as a buffer for the "CA" and "SSSI" zones.
- To preserve the old Hakka village houses in the area, which are traditional vernacular buildings with unique architectural features and of high group value, particularly in Cheung Uk, Lei Uk and Lo Wai, any demolition of or any addition, alteration and/or modification to an existing village house requires planning permission from the Board.
- In order to meet the small house demand of indigenous villagers, two hectares of land is zoned "Village Type Development".

Civic Exchange - A way Forward, 2002

Civic Exchange is an independent Hong Kong public-policy think tank established in 2000[24].

Despite the implementation of conservation-led planning controls the Sha Lo Tung OZP still allowed for limited village house development within the valley and there was a lack of any significant management. There were also ongoing problems with war-gamers and off-road vehicles who frequently accessed the site and damaged the fragile ecology of the stream channels and old village buildings. In addition, illegal poaching targeting the IUCN red-listed Critically Endangered Chinese Three-striped Box Turtle (*Cuora trifasciata*) was also taking place at SLT and nearby Ping Shan Chai stream (Fig. 7)[25]. On 27 April 2002 I attended a round-table meeting of government and non-government experts, convened by Civic Exchange, to try and determine a way forward for the SLT impasse. The participants had expertise in ecological, legal, planning, land use and development issues. The main issues discussed were the outstanding 'hope' value of the villagers and developers and the Administration's reticence to resume land or provide compensation for conservation purposes or 'hope' value. Significant funding would be required to buy the private land at SLT for conservation, and restore the Hakka village property. In 1996 it was estimated that around $2,400 million [1996 prices] would be needed for

22 David Dudgeon, 2020. *Freshwater Biodiversity: Status, Threats and Conservation*. Cambridge University Press.

23 Cheung, P.J., 2001. Sha Lo Tung Development Company Ltd. v the Chief Executive in Council. High Court of the Hong Kong Special Administrative Region Court of First Instance. HCAL 124/2000. [Link]

24 Civic Exchange, Suite 2405, 9 Queen's Road Central, Hong Kong [Link].

25 K.D.P. Wilson reported to AFD Country Parks that he had found and destroyed 11 Chinese Three-striped Box Turtle (*Cuora trifasciata*) illegal baited traps at SLT and Ping Shan Chai streams on the 29 April 2001. One of the traps contained a captive Chinese Three-striped Box Turtle, which was released on site and photographed (Fig. 7).

Figure 7. Illegal trapping of IUCN red-listed Critically Endangered Chinese Three-striped Box Turtle (*Cuora trifasciata*) at Sha Lo Tung and Ping Shan Chai streams, 29 April 2001. Hong Kong is perhaps one of the few locations where wild populations of this turtle may be still be found. (A) Forested stream site with trap containing captive turtle. (B) Poorly concealed trap, baited with odorous fish fillets. (C) Baited trap containing captive turtle. (D) Released Chinese Three-striped Box Turtle. Photo credits: Keith D.P. Wilson.

resumption[26].

The meeting concluded that the best way forward would be a government land-swap deal with the developer and villagers. The SLT valley could then become government land and be incorporated within the Pat Sin Leng Country Park. If the government lacked the political will to achieve a land-swap deal then the best alternative solution would be the establishment of an independent land trust that would acquire and restore the buildings and manage the lands for conservation (similar to the National Trust in the UK).

Public-Private Partnership scheme, 2004

In 2004 a New Nature Conservation Policy (NNCP) was announced by the Hong Kong Administration to help regulate, protect and manage key natural resources important for conservation of biological diversity in Hong Kong, taking into account social and economic considerations. It was an attempt by the Administration to resolve conflicts between private land owners and the need to protect sites of high conservation and ecological value. A scoring system was utilised to assess the relative ecological importance of sites to determine a priority for enhanced conservation under the NNCP[27]. In November 2004 the Environment, Transport and Works Bureau (ET&WB) (now Environment Bureau) invited submission of proposals for 12 areas selected as potential 'pilot projects' for the 'Public-Private Partnership (PPP)' scheme under the Government's NNCP. Of the 12 sites identified as priority sites for enhanced conservation the top two rated sites, considered the most important for biodiversity, were Mai Po & Deep Bay Ramsar site and Sha Lo Tung. A total of six applications were received including one for SLT.

Under the SLT PPP scheme the proponent proposed to surrender all of its land in SLT valley (representing 96% of the private land in the valley to the Government for the establishment of an Ecological Reserve of about 52 hectares). In exchange, it requested a piece of government land of ca. 5 ha in the southern 'Green Belt' zone for the development of a Multi-cultural Education Centre and Columbarium Complex (Fig. 8). In

26 Civic Exchange, 2002. *Conservation of Sha Lo Tung A way forward* [Link].

27 *New Nature Conservation Policy,* Hong Kong SAR Government [Link].

addition the proponent agreed to implement a comprehensive management plan to protect and enhance the ecology of the area. In April 2008 the ACE recommended to support the Sha Lo Tung project from a nature conservation angle but identified a need to ensure the ecological mitigation and enhancement measures proposed were fully implemented and sustained. Following pressure from green groups and government the SLTDC then proceeded to prepare a fresh EIA for the SLT PPP scheme. The EIA titled: *Pilot Project for Public – Private Partnership Conservation Scheme, Sha Lo Tung Valley, Tai Po* was finalised and submitted by Environmental Resources Management in August 2008[28].

Most green groups were vehemently opposed to the SLT columbarium plans and associated development under the PPP proposals. Ten environmental groups[29] jointly voiced their concerns in a statement, dated 14 June 2012, that the project could destroy the butterfly and dragonfly haven. They opined that the government should do a land-swap deal with the SLTDC. A letter from the Hong Kong Countryside Foundation, titled: *Important rural site should not become columbarium,* printed in the South China Morning Post, 9 July 2012, summed up many of the green groups' objections:

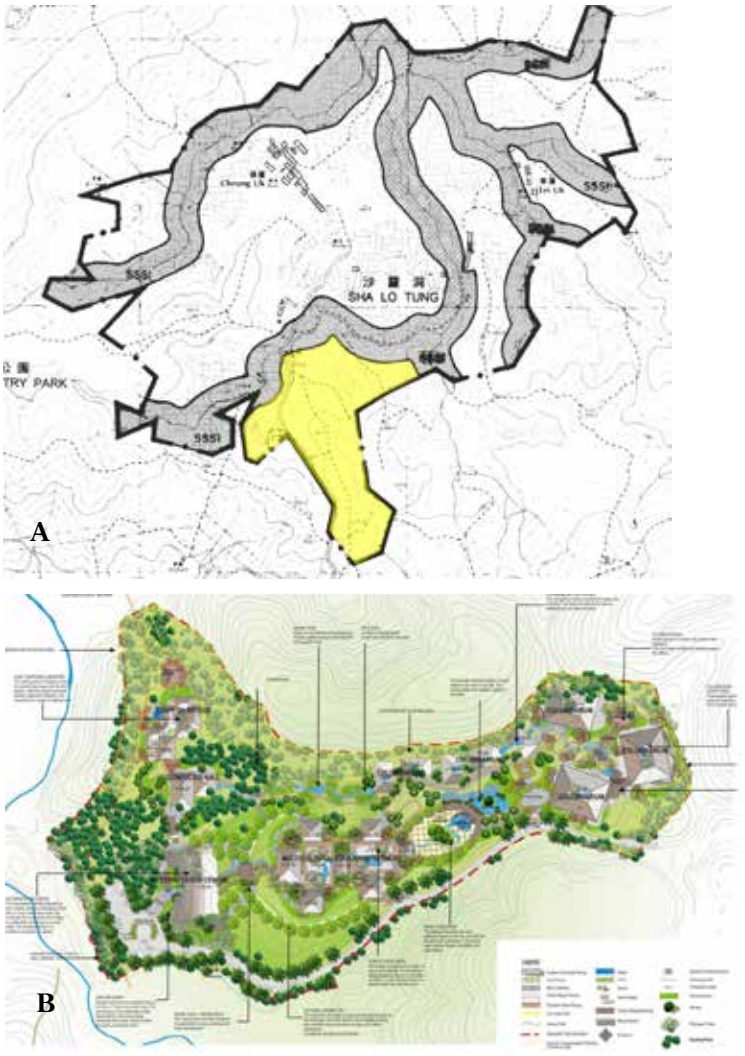


Figure 8. (A) Map of the Sha Lo Tung Special Site of Scientific Interest (shaded grey) showing the area (shaded yellow) for the proposed Pilot Project for Public-Private Partnership (PPP) Conservation Scheme development. (B) Proposed development under the Pilot PPP Conservation Scheme, Sha Lo Tung Valley, Tai Po, Hong Kong. Credit: ERM, 2008 [Link].

> *I wish to highlight the underlying planning and land issues related to the proposed development of a huge columbarium at Sha Lo Tung.*
>
> *The development proposal is for four major buildings to be erected to house 60,000 niches* [storage of funerary urns]. *At a rate of HK$100,000 per niche, this will generate revenue of HK$6 billion and require the developer to pay to the government a HK$3 billion land premium for the direct grant by private treaty of some four hectares of highly ecologically sensitive government land to enable this scheme to proceed.*
>
> *There is no land exchange involved as all the private land in Sha Lo Tung is to remain in private hands.*
>
> *Why on earth is the administration selling off such a site in such a location with so little in return other than generating super profits for the developer and a huge premium for itself?*
>
> *In 2004 and again in 2010, Sha Lo Tung was ranked by separate government studies to be second only to Mai Po as the most important ecological site in Hong Kong. So it is inexplicable that officials are even considering such a lousy deal when it is blindingly obvious that there should be no development at all in Sha Lo Tung and that the most appropriate way forward is for a "value for value" land exchange, to be offered with a suitable columbarium site identified elsewhere of sufficient size to compensate the Sha Lo Tung Development Company for the mainly agricultural land it owns.*
>
> *In fact, the government has already identified such a site close by, on the former Shuen Wan landfill adjacent to Tai Po Industrial Estate, which could be considered for use in such a "value for value" land exchange.*

28 Environmental Resources Management, 2008. *Pilot Project for Public – Private Partnership Conservation Scheme, Sha Lo Tung Valley, Tai Po.* [Link]

29 Hong Kong green groups: WWF-HK, Hong Kong Countryside Foundation, Conservancy Association, Friends of the Earth, Hong Kong Bird Watching Society, Green Lantau Association, Greenpeace, Green Produce Foundation, Green Sense, and Kadoorie Farm and Botanic Garden.

A columbarium of half the size should generate sufficient revenue to adequately compensate the developer for the land it owns. This would mean a straight swap of land without the need to charge a premium.

If this were to occur, the approximate 26 hectares of private land would be surrendered and, together with a similar amount of government land that exists within this priority enclave, could then be subsumed into Pat Sin Leng Country Park for the daily enjoyment forever by Hong Kong people under the appropriate statutory management and protection of the Country and Marine Parks Authority.

This is an altogether better-value scheme as far as the public is concerned, which the developer should now pursue with the government.

Roger Nissim, Director, Hong Kong Countryside Foundation

Oilseed rape protest

The SLT Public-Private Partnership proposal was not selected as one of the PPP pilot projects and did not receive approval from the Administration. In the winter of 2015-2016, to express their dissatisfaction at the lack of progress on village redevelopment at SLT, some of the villagers cleared areas of vegetation in the SLT valley and planted Oilseed Rape (*Brassica napus*). The bright yellow, blossoming fields of Oilseed Rape (a crop not normally grown in Hong Kong) attracted many visitors and gained widespread public attention to the villagers' plight. The issue was widely covered by the press[30].

Dragonfly surveys 2016-2017

Graham Reels conducted several Odonata surveys at SLT throughout 2016 and 2017, recording most of the restricted-distribution species including 11 species of Gomphidae, three *Macromia* species, and two *Macromidia* species[31]. However, many marsh and pond species that had previously been recorded from SLT were not encountered, perhaps reflecting the loss of these types of lentic habitat at Hong Kong over the previous 10 years. Based on these survey findings, in a 2020 publication, Reels utilised a metric to score 33 key wetland sites, previously identified by Dudgeon & Chan (1996 - see footnote 21) and Wilson (1997 - see "Dragonfly surveys, 1997" on page 18) and concurred with Wilson that Sha Lo Tung/Hok Tau supported by far the most important dragonfly assemblage in Hong Kong[32].

Non in-situ land exchange, 2017-2022

To achieve the long-term conservation of Sha Lo Tung, in June 2017, the Hong Kong Administration announced it had given in-principle approval for a non-in-situ land exchange. The government, in exchange for the privately owned land at SLT would provide land at the restored Shuen Wan landfill site in Tai Po. After a long period of evaluation and negotiation, the exchange was finally approved in 2021, permitting the future construction of a private golf course facility at the former tip. Completion of formalities were announced on 19 July 2022 when the Administration issued a press release titled: *Completion of non-in-situ land exchange procedures for long-term conservation of Sha Lo Tung,* which stated that the long-awaited signing of all the necessary paperwork for the non-in-situ land exchange of SLT with the SLTDC had been undertaken. The signing of documents had taken place on the previous day, 18 July 2022, marking the completion of the land exchange procedures and the end of 40 years of wrangling between government, green groups, villagers and the developer.

Management Agreement at Sha Lo Tung, 2018-2022

In January 2018, the Environment and Conservation Fund (ECF) Committee in Hong Kong approved the funding of a Nature Conservation Management Agreement Scheme for SLT. The Management Agreement contract is administered by the Countryside Conservation Office (CCO) of the Environmental Protection Department (EPD), Hong Kong SAR and was subsequently awarded to Green Power Limited. Green Power is a charitable institution founded in 1988 by a group of dedicated volunteers who were concerned about local environmental problems. The initial two-year agreement, which commenced 1 April 2018, was for the conservation management of lands surrounding the abandoned Cheung Uk and Lee Uk villages (the Lei Uk daughter village closest to Cheung Uk) with the principal aims of preventing habitat degradation and enhancing the biodiversity of the site by: (i) restoring the irrigation facilities, in order to replicate the old rice paddy system and reconstruct marsh wetland, (ii) establishing an 'eco-pond' for dragonflies, freshwater fish and amphibians, (iii) undertaking surveys of dragonflies, freshwater fish, reptiles, amphibians, mammals, butterflies and plants, (iv) control of invasive species,

30 South China Morning Post, 24 February, 2016. Rapeseed saga: Hong Kong developer reports planting of crops in Sha Lo Tung village to police [Link]

31 Reels, G.T., 2019. *An annotated check list of Hong Kong dragonflies and assessment of their local conservation significance.* Faunistic Studies in South-East Asian and Pacific Island Odonata. Journal of the International Dragonfly Fund 30:1-49. [Link].

32 Reels, G.T., 2020. *A ranking of key dragonfly sites in Hong Kong using a species conservation value assessment metric.* Faunistic Studies in South-East Asian and Pacific Island Odonata. Journal of the International Dragonfly Fund 31:1-50. [Link].

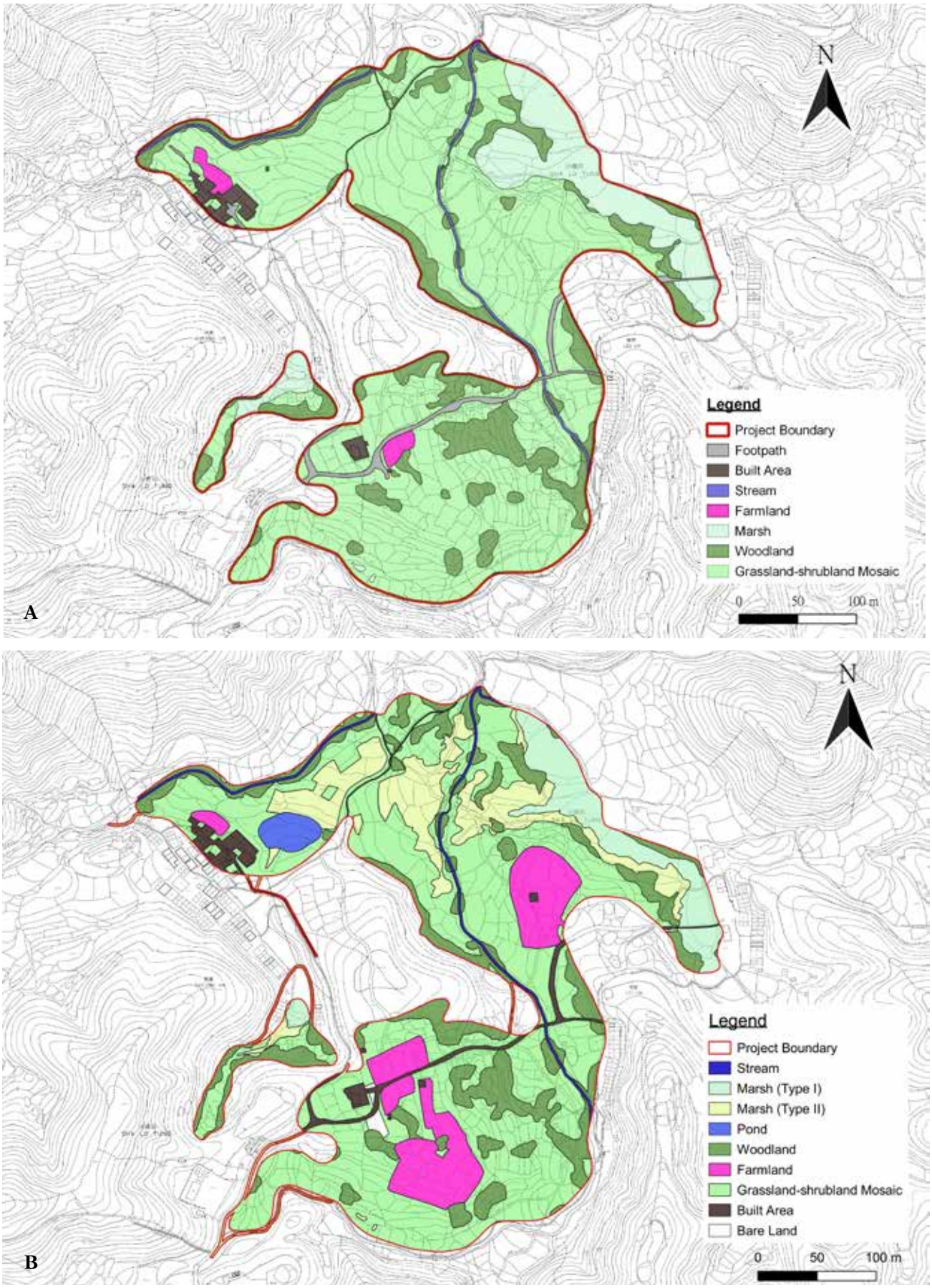


Figure 9. Habitat maps showing habitat restoration activities in the Sha Lo Tung basin. (A) Habitat map of SLT area managed by Green Power produced in 2018. (B) Habitat map of SLT area managed by Green Power, produced December 2021. Map credits: Green Power.

(v) control of off-road vehicles, man-made hill fires, vandalism and poaching, and (vi) public education programmes. In August 2018 Green Power completed a habitat map for the 11.5 ha of woodland, streams, marshes and agricultural land under their control, with the help of drone photography (Fig. 9A).

The management agreement for SLT was renewed for a further two years from April 2020. By November 2020 Green Power had successfully initiated its programme to restore a highly-damaged aquatic ecosystem and disturbed agricultural land by creating paddy wetland, an eco-pond and marshy swamps (Fig. 10). The changes in habitat can be assessed by comparing the 2018 habitat map with the lastest habitat map produced by Green Power in December 2021 (Fig. 9A cf. Fig. 9B). A YouTube time lapse video of the pond construction at SLT was uploaded 7 May 2021 [Link]. Green Power still have some outstanding issues and challenges in controlling invasive plant species, mainly Mikania (*Mikania micrantha*) and Cairo Morning Glory (*Ipomoea cairica*), and renovating the old rice paddy irrigation systems. Regular surveys conducted by Green Power have now raised the number of Odonata recorded from SLT to 80 species representing over 60% of all dragonfly species found in Hong Kong[33].

Following the signing of the land-swap documents in July 2022, on 19 August 2022 the Agriculture, Fisheries and Conservation Department (AFCD) announced a tender titled: *Provision of Habitat Management and Related Services at Sha Lo Tung* with submissions due by 29 September 2022. The tender provides for comprehensive monitoring, conservation management of SLT basin's marshes, former agricultural rice paddies and eco-pond, including requirements to control invasive species, restore the traditional irrigation systems and undertake education programmes. Green Power's management agreement was extended in April 2022 to cover the period until a tender award has been made.

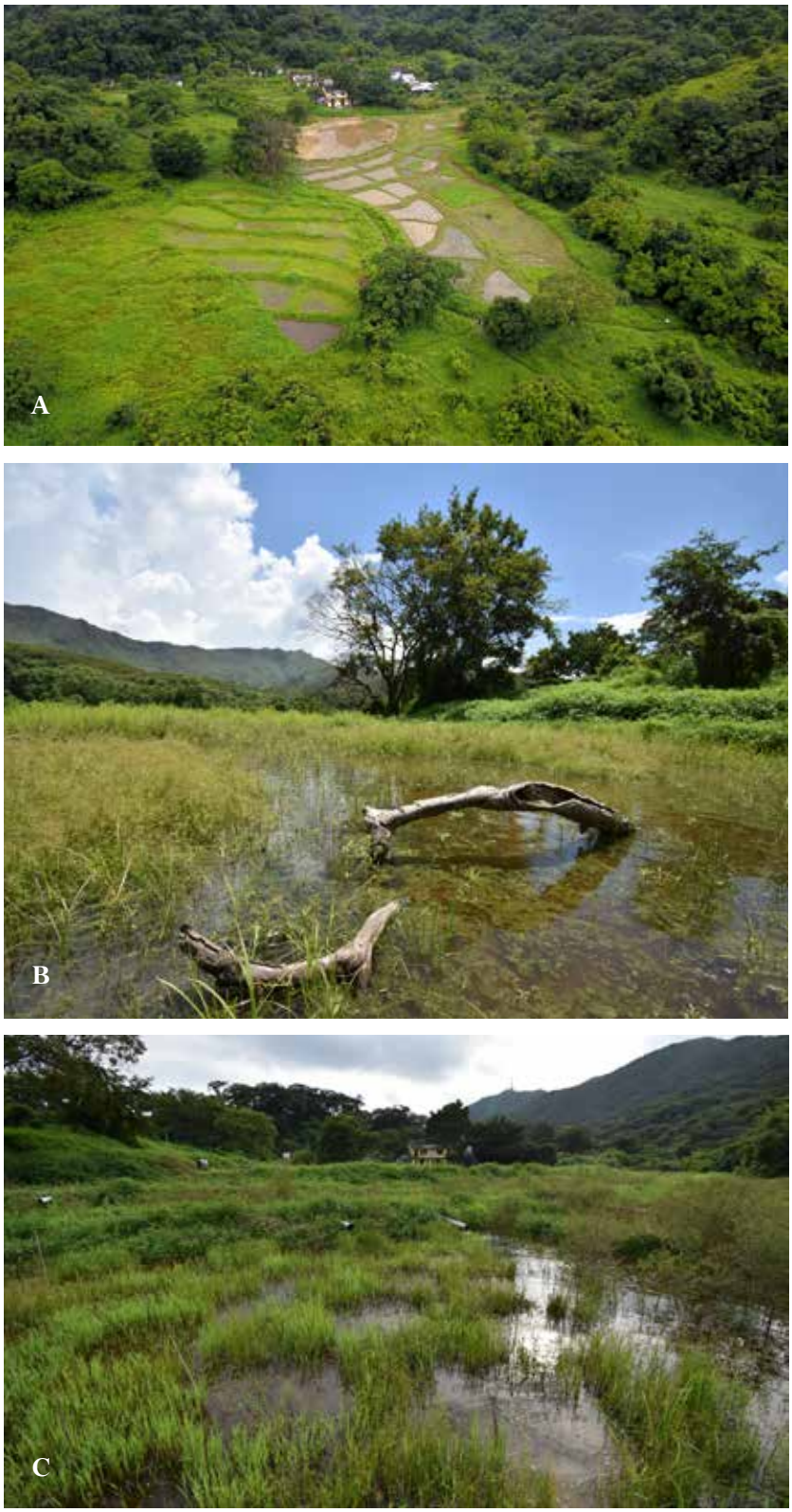


Figure 10. Habitat restoration at Sha Lo Tung. (A) Aerial photo showing restored agricultural lands and the creation of wetland ponded areas and marshy swamps, 27 May 2020. (B) Shallow, marshy pond, 14 August 2020. (C) Wet marsh, 23 September 2021. Credits: Green Power [Link], photography: Lau Kin Ming.

33 Green Power, 2022. About Sha Lo Tung. [Link].

Sha Lo Tong as a planning case study

The SLT controversy has been of major importance in forcing the Hong Kong Administration to address many of the planning and conservation issues raised by the conflicts between development and conservation in an area where land is scarce and natural resources under great pressure[34]. The planning process has been fully tested and the legal complexity of environment related planning decision-making has been highlighted by the SLT saga. Although it took forty years, on this rare occasion it appears a satisfactory outcome has finally been achieved that has proved to be acceptable to the main parties involved. Most importantly Sha Lo Tung will continue to be Hong Kong's premiere Dragonfly Hotspot.

Acknowledgements

I particularly wish to acknowledge the efforts of Gary Ades, Ruy Barretto, Patrick Chan Pink-ki, David Cook, Cheng Luk-ki, Paul Crow, Tom Dahmer, John Fellowes, David Dudgeon, Billy Hau, Lisa Hopkinson, David Melville, Michael Lau, Graham Reels, Tam Tze-wai. and Günther Theischinger in helping to secure a bright future for Hong Kong's premiere Dragonfly Hotspot. Thanks also to Graham Reels and Brian Darvell for reviewing the paper and improving the text. I'm also grateful to Green Power and the Countryside Conservation Office of the Hong Kong SAR for their kind permission to use their SLT habitat maps and photos.

Postscript

After completing this article I belatedly received a copy of a 120 page book (in Chinese) titled: '紙上的沙螺洞 (*Sha Lo Tung in print*)', which was published in 2020 by Green Power, Hong Kong. The book explores the history and ecology of Sha Lo Tung [Link]. There are introductory forewards from Wong Kam-sing, Secretary for Environment, Hong Kong SAR Government, Cheung Tin Chuen (張天存) and Cheung Wing Keung (張永強), Cheung Uk, Sha Lo Tung village representatives and myself, Keith D.P. Wilson representing the dragonflies.

Contact Green Power for a copy of the book [Link].

Figure 11. Extracts from the book (in Chinese) titled: '紙上的沙螺洞 (*Sha Lo Tung in print*)', published by Green Power, Hong Kong, 2020 - ISBN 9789628132416 [Link]. (A) Front cover. (B) Lands Department, HKSAR Government aerial photo of the Sha Lo Tung valley taken in 1963, when the valley's population was at its peak, showing the extensive terraced wet rice paddy development throughout the valley. (C) Chapter providing an account of the natural history of Sha Lo Tung.

34 Li, J., Liu, J-z & Li, W-f., 2017. The Dilemma of Urban Natural Conservation Planning: The Case of Sha Lo Tung, Hong Kong. *Urban Planning International*. 32(5): 80-86. (English summary, text in Chinese). DOI: 10.22217/upi.2015.255 [Link]

Appendix A.
A brief synopsis of the fauna and flora of Sha Lo Tung, Hong Kong

Mammals
At least 16 species of mammals have been recorded at SLT, including the IUCN red-listed Endangered Chinese Pangolin (*Manis pentadactyla*), Indian Muntjac (*Muntiacus muntjak*), Leopard Cat (*Prionailurus bengalensis*), Small Indian Civet (*Viverricula indica*), Crab-eating Mongoose (*Herpestes urva*) and Malayan Porcupine (*Hystrix brachyura*).

Birds
Over 110 species of birds have been recorded within the SLT basin (about 30% of Hong Kong's total). It is not recognised as especially important for any particular species but a wide diversity of birds occur including many egrets, bitterns and raptors.

Amphibians & reptiles
Sha Lo Tung supports at least 13 species of amphibians and 16 species of reptile. The Hong Kong Cascade Frog (*Amolops hongkongensis*), which is IUCN red-listed as Endangered, occurs at SLT and the Bull Frog (*Hoplobatrachus rugulosus*), which is listed in the Key Protected Animal List of China: Class II (as *Hoplobatrachus chinensis*). The Hong Kong Newt (*Paramesotriton hongkongensis*) is restricted to central Guangdong and Hong Kong, and was described from Hong Kong. It has been found in the SLT streams and is IUCN red-listed as Vulnerable. Both the Tokay (*Gekko gecko*) and King Cobra (*Ophiophagus hannah*), are regularly observed and both of these are listed as Endangered in the China Red Data Book. The King Cobra is IUCN red-listed as Vulnerable. The Critically Endangered Chinese Three-striped Box Turtle (*Cuora trifasciata*) has been recorded from SLT. The sandy forest streams at SLT are well-suited to this small turtle, with has a distinctive golden-yellow crown marking on its head. It is now extirpated in the wild across most of its range due to illegal hunting to supply the demand from the unregulated Chinese medicine trade.

Freshwater fish
Of the nineteen freshwater fish that have been recorded at SLT perhaps the most interesting is the rare Hong Kong Paradise Fish (*Macropodus hongkongensis*), which frequents gently flowing streams and marshy areas at SLT. It has a very limited distribution and is restricted to a few small areas in Hong Kong and south-east Guangdong[1].

Odonata
Sha Lo Tung is the most important Dragonfly Hotspot in Hong Kong. To date, over 80 species of Odonata have been recorded from SLT, representing over 60% of the dragonfly fauna, which currently stands at 130 species. Many have very restricted distributions including Chinese Tiger (*Gomphidia kelloggi*), IUCN red-listed as Endangered, South China Cruiser (*Macromia katae*), red-listed as Vulnerable and Spangled Shadow-emerald (*Macromidia ellenae*), which is restricted to Guangdong and Hong Kong. The latter two species were described from SLT. The gomphid Small Dragonhunter (*Sieboldius alexanderi*), which is locally uncommon and restricted to south and southeast China, has also been recorded. The first Hong Kong record of White-tipped Grappletail (*Heliogomphus retroflexus*) was found at Sha Lo Tung in July 2009. Photographs of a wide selection of forest loving odonate species recorded from SLT and Hong Kong from 1990 to 2006 were provided in Wilson {2014: Odonata recolonisation of Hong Kong's Forests *Agrion* 18(1): 13-17 [Link]}.

Lepidoptera
Over 100 butterfly species have been observed at SLT, several are protected with high conservation value such as Common Birdwing (*Troides helena*) and Golden Birdwing (*Troides aeacus*). Sha Lo Tung is one of Hong Kong's very few habitats and breeding grounds for Yellow Coster (*Acraea issoria*); which is uncommon in Hong Kong.

Plants
SLT is home to more than 400 plant species. There are several protected species of orchid including Bee Orchid (*Cleisostoma simondii*), which is an epiphytic orchid growing on Fung Shui trees in Cheung Uk Fung Shui woodland, and Bamboo Orchid (*Arundina graminifolia*), which is not uncommon on Hong Kong's exposed grassy hillsides. The scarce and restricted *Liparis ferruginea* orchid has been recorded from SLT and at only three other sites in Hong Kong where it occurs in waterlogged and boggy grassy fields. The Illigera (*Illigera celebica*) climber occurs, which is listed as a category II protected plant that grows in the wet Asian tropics. Six species of conservation concern, including Incense Tree (*Aquilaria sinensis*), red-listed as Vulnerable, Lamb of Tartary (*Cibotium barometz*), Indian Birthwort (*Aristolochia tagala*), which is one of the larval food-plants of both Hong Kong birdwing butterflies, Pavetta (*Pavetta hongkongensis*) and Hairy Fruited Ormosia Tree (*Ormosia pachycarpa*) are recorded. In 2021 Green Power discovered *Bauhinia apertilobata* growing at SLT, which is a new Hong Kong record for this plant that is restricted to southern China.

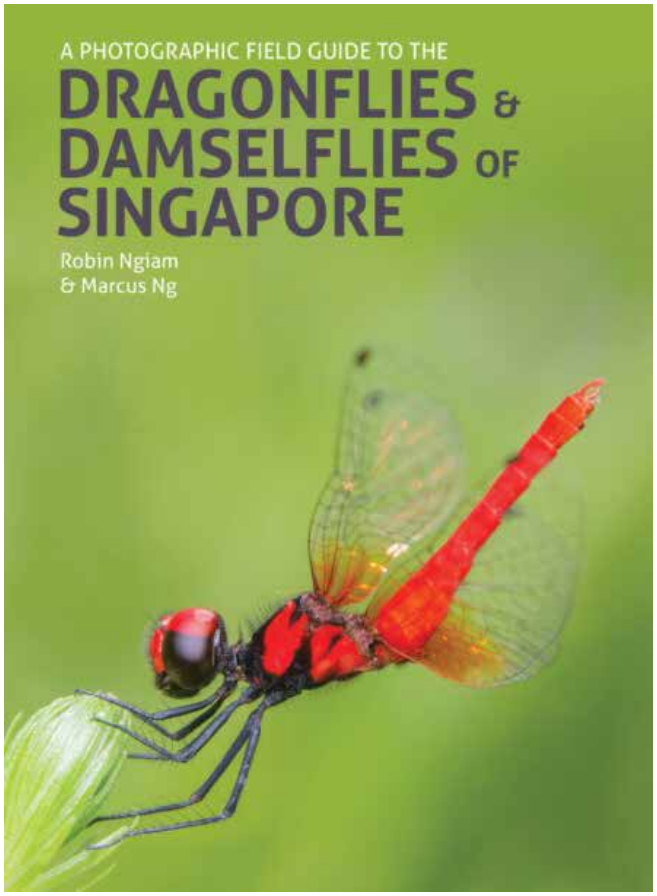
1 Chan, B. P-l., Dudgeon, D. & Chen, X-l., 2006. Threatened fishes of the world: *Macropodus hongkongensis* Freyhof and Herder, 2002 (Osphronemidae). *Environ Biol Fish* 81: 367-368. DOI 10.1007/s10641-007-9210-0 [Link].

A Photographic Field Guide to the Dragonflies and Damselflies of Singapore

Authors: Robin Ngiam & Marcus Ng
Publisher: John Beaufoy Publishing Ltd., Oxford, England - December 2022
Hardback, ISBN: 9781912081400
ca. 700 col. photos, 340 pp

Book review by Rory Dow

[rory.dow230@yahoo.co.uk]



Southeast Asia is not generally well supplied with field guides on Odonata, but this is the third book to cover the odonate fauna of Singapore. Therefore one might reasonably ask – is there a need for another book and what does this one have to offer that the others do not? Orr's *Dragonflies of Peninsular Malaysia and Singapore*, published in 2005, covers a much larger area and fauna and this, coupled with its small size, means that it can give little detail specifically about Singapore. It is also approaching 18 years old now. *A Photographic Guide to the Dragonflies of Singapore* by Tang *et al.*, published in 2010, while very good, is also somewhat out-of-date, with a number of additions to the fauna of Singapore made since it was published. So, there is definitely a need for a new book and this one includes a wealth of information not present in the previous publications.

The odonate fauna of Singapore is undoubtedly the best known of any area in Southeast Asia. With 136 species known, although the size of the fauna is comparable to that of the entirety of Europe, it is very manageable for a field guide in the sense that it has relatively few closely similar and therefore hard to deal with species. The authors have done an admirable job of documenting the fauna and it is particularly remarkable that they have included at least one photograph (in most cases many more) in life of almost every species, which surely would not have been possible until the last few years. The photographs in life are supplemented with details of morphology where needed, in some cases using paintings done by A.G. Orr, in others photographs. For many species the larvae are illustrated as well, either by photographs or using Orr's line drawings. Moreover, QR code links are provided that link to *The Biodiversity of Singapore* website, hosted by the Lee Kong Chian Natural History Museum, where additional photographs of larvae and adults have been posted for most species [Link]. For each species an English name is given as well as the scientific name, measurements and a brief description. Habitat and behaviour are discussed, as well as the distribution in Singapore and beyond. These are of course all standard features of a field guide. Three features are less typical but very welcome. There is a discussion of etymology for most species and where the larva is known a brief description is given. Most notably for each species the national and current global (IUCN Red List status) conservation status are given and 10 species are listed as nationally extinct. For almost anywhere else in Southeast Asia it would not be sensible to make judgements about national or even regional extinctions with the information currently available, but for Singapore, with its small size and high population density, including many nature enthusiasts armed with cameras, these judgements are, sadly, justified. However in one case, as noted by the authors, it is perhaps doubtful that the species in question (*Neurothemis disparilis*, known with certainty only from a small area in the west of Borneo) ever really occurred in Singapore.

The dangers of using field guides outside of the region for which they are written are well known (but all too often ignored) but, given that the odonate fauna of Singapore is a subset of that of Peninsular Malaysia, if used sensibly and in the knowledge that many additional and in some cases similar species are present, then this book

will also be very useful in Peninsular Malaysia and in the lowlands of the closest parts of Sumatra to Singapore, which appear to have a very similar fauna to those of Singapore and Peninsular Malaysia.

My only criticisms of the book are minor. The first concerns the use of English names – not that they are used but that they are given greater prominence than the scientific names. However I suspect that this has more to do with the publisher than the author, especially since the authors, rightly, state in the introductory part of the book (on page 8) "Readers are encouraged to identify dragonflies by their scientific names to be precise and avoid misidentifications." The second is that given the number of Albert Orr's illustrations used in the book he could perhaps have been given a more prominent acknowledgement.

I wholeheartedly recommend this book to anyone with an interest in the Odonata of Singapore and Southeast Asian Odonata generally. It is a valuable addition to any library on the subject and an invaluable one for any nature enthusiast either living in Singapore or visiting the country. I suspect that there are still a few additions to the fauna of Singapore awaiting discovery and this book will help to make their eventual discovery easier.

Rory Dow

POND DAMSELFLIES 99

ORNATE CORALTAIL *Ceriagrion cerinorubellum* (Brauer, 1865)

Size HWL: 17–18mm; TBL: 35–38mm

Description Small-medium damselfly with unmistakable colours. Eyes bluish-green. Male's thorax greenish-blue. Abdomen mostly black except for orange-red on segments 1–2 and 7–10. Appendages very squat – a feature of the genus. Female similar but thorax more greenish than blue and abdominal colours paler.

Habitat & Habits Found in diverse well-vegetated habitats, including urban and rural ponds, marshes and open swamps within forests; also in semi-forested streams. Widespread and common damselfly, though less so than the Blue Sprite and Common Bluetail (pp. 115 and 103). Voracious predator of insects and even tenerals of other damselflies. Has been seen consuming smaller or even similarly sized damselflies such as *Archibasis* and *Pseudagrion* species.

Presence in Singapore Recorded in the nature reserves, adjacent nature parks, Pulau Ubin and many urban parks.

Etymology *Cerinum* is Latin for 'wax coloured' (pale yellow) and aptly describes many members of the genus. Here used in both the generic and specific epithets, combined respectively with *agrion* (a common element in damselfly names) and *rubellum* (Latin for 'reddish').

Distribution Widespread in tropical South and Southeast Asia.

National Conservation Status Least Concern; Widespread and Common.

IUCN Red List Status Least Concern.

Larva Light brown head and thorax, and dark brown abdomen. Caudal gills heavily patterned, with basal half shaded in light brown.

Male is fairly conspicuous among waterside vegetation.

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BRONZE FLUTTERER *Rhyothemis obsolescens* Kirby, 1889

Size HWL: 23–25mm; TBL: 24–28mm

Description Smallish dark dragonfly with brilliant wing colours. Eyes brownish-red and dark brown; thorax and abdomen dark brown to blackish. Abdomen length more than twice width of hindwing; compare with relatively shorter abdomen of the Small Bronze Flutterer (p. 294). Hindwing base well expanded, though less so than in Small Bronze. Wings entirely opaque and metallic bronze, with iridescent light and dark markings and magenta reflex in good light. May be mistaken for the Common Parasol (p. 263) from afar, but its smaller size, shiny wings and different basking habits are evident at close range. Female similar to male, but usually with hyaline patches near wing-tips.

Habitat & Habits Favours well-vegetated open marshes, ponds, reservoir inlets and edges of swampy forests. Both sexes, but especially females, may also bask some distance from water on hilltops, tree canopies and masses of fallen branches in forest edges and clearings. May form feeding swarms or soar over the canopy sometimes in mixed flocks with other species such as the Wandering Glider (p. 282). Perches with wings depressed or held at an angle. Often basks at tip of a twig or reed, its wings gleaming as they tilt and turn to catch the sun. Typical flight fluttery and slow. Pairs engage in delicate courtship dance, with each individual taking turns to hover slightly above and in front of the other. This 'waltz' is performed repeatedly before, as well as after, copulation.

Presence in Singapore Recorded in forests and well-vegetated locations near forests, including the Bukit Timah and Central Catchment Nature Reserves, Windsor Nature Park, the Singapore Botanic Gardens, the Istana, the Western Catchment, Kent Ridge Park and Pulau Ubin.

Etymology In Latin, *obsolescens* means 'passing out of use'. Specific epithet may be a reference to obsolete status of bronze.

Distribution Sundaland, mainland Southeast Asia and north-east India.

National Conservation Status Least Concern; Widespread but Uncommon.

IUCN Red List Status Least Concern.

Larva To the authors' best knowledge, undescribed; should be typical of genus.

Dorsal view of a male, showing the iridescent wing markings.

SKIMMERS 195

Male in typical pose, with the wings slightly depressed and at an angle.

Female with hyaline patches on the wings.

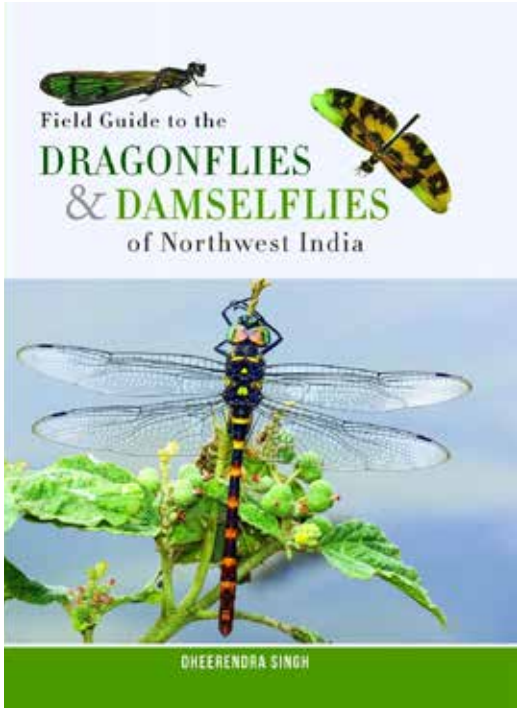
Pair in wheel.

New book

Field Guide to the Dragonflies & Damselflies of Northwest India

Author: Dheerendra Singh

Publisher: M/s Bishen Singh Mahendra Pal Singh,
Dehradun, Uttarakhand 248001, India [www.bsmpsbooks.com]
528 pages, 500+ colour photos
Paperback published July 2022. ISBN: 9788194332329



The book is lavishly illustrated and beautifully designed field guide which provides the first comprehensive overview of the Odonata of the northwestern part of India, comprising two main geographic regions: the Himalayan range and the Gangetic Plain, as well as the western arid zones of the Great Indian Desert (also known as the Thar Desert). This field guide covers the states of Jammu-Kashmir, Himachal Pradesh, Punjab, Uttarakhand, Haryana, Delhi, Uttar Pradesh, and Rajasthan.

A total of 162 species of damselflies (Zygoptera) and dragonflies (Anisoptera) are described and illustrated in this field guide. The book includes in-depth details of general knowledge of dragonflies such as anatomy, life history, behaviour, habitat, and an outline of the geography, ecology, and biogeography of Northwest India. An illustrated identification key to the 162 species has been provided. It is kept as simple as possible to help find the right family, genus, and species, supported by numerous drawings to show the meaning of the technical terms mentioned in the text.

The description of each family provides an introduction giving brief information about the worldwide distribution, and the status of that family within present Indian borders, followed by a basic overview of the general characteristics. The species account provides a general statement of a first impression of a species at a glance in the field, field characters; sometimes hand characters (illustrated in the identification keys), habits and behaviour, and habitat followed by a distribution (range, India, Northwest India), status and flight period. Distribution maps are shown for all species based on studied literature and authors' field observations. Photographs show a male, female, and variations for most species and point out the main numbered characters to observe in the field. Illustrated throughout in colour over 500 photos are neatly placed in this book. Common English names for families and species along with the scientific names have been provided.

Threats and conservation of Indian Odonata have been addressed in detail, dragonfly watching tips, an extensive glossary, literature, a checklist of damselflies and dragonflies of Northwest India and an index to English and scientific names have also been provided in the field guide.

This book is very comprehensive yet easy to use by beginners and experts alike. With the publication of this field guide, the author hopes to lay a foundation for future research and help to raise local awareness about this group of freshwater insects, which will contribute to better protection and management of freshwater ecosystems, and it is sure to lure new enthusiasts who wish to improve their knowledge of the order Odonata.