

THE BIOLOGY OF *EUPHAEA IMPAR* SELYS (ODONATA: EUPHAEIDAE) IN SINGAPORE

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INTRODUCTION

Euphaea impar is one of two euphaeids recorded from Singapore. The other is *Dysphaea dimidiata*, which is now probably extinct (Murphy et. al., 2008). *Euphaea impar* (Figs. 1, 2) belongs to the order Odonata, suborder Zygoptera, superfamily Calopterygoidea and family Euphaeidae, also known as gossamerwings (Silsby, 2001), or preferably satinwings, the former term being misleading. The Euphaeidae consist of 11 genera with 60 species restricted to the Old World (India and the Far East), except for one species that is found in the Middle East, extending to the eastern Mediterranean and Bulgaria, Hungary, and Romania.

BIOLOGY

Euphaeids lay their eggs in fast-flowing waters, and their larvae are usually found under stones so as not to be swept away, or among detritus in riffles of the stream (Orr, 2003). Their larvae differ from other zygopterans in that besides having the three saccoid gills at the tip of the abdomen, there are seven pairs of supplementary gills running down the sides of the abdomen (Fig. 3). On emerging as adults, *Euphaea* species larvae tend to travel only a few centimetres from the water in the early morning. Euphaeids generally possess wings that are scarcely petiolate, with close venation, numerous antenodals (15–38), short quadrilaterals, and well-developed pterostigmata (Silsby, 2001; Orr, 2003). Most breed in running water. Some such as *Cyclophaea cyanifrons*, and *Euphaea impar* breed in small forest streams, whereas others such as *Euphaea refulgens* breed in pools beneath waterfalls. Less commonly, some such as Indian species of *Anisopleura*, occasionally adapt to managed habitats and breed in irrigation channels running through tea plantations (Fraser, 1934).

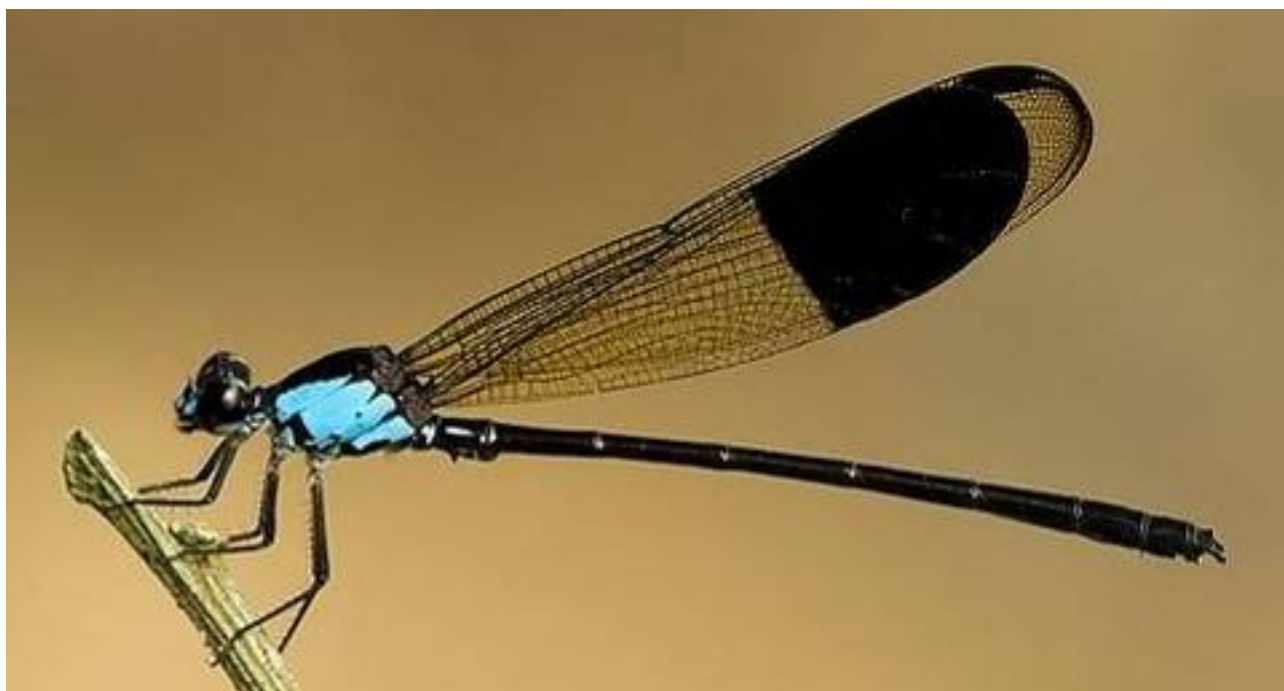


Fig. 1. *Euphaea impar* perched on a twig. Total body length = 55 mm. (Photograph by: Anthony Quek).



Fig. 2. Close up of thorax region of *Euphaea impar*. (Photographs by: Anthony Quek).

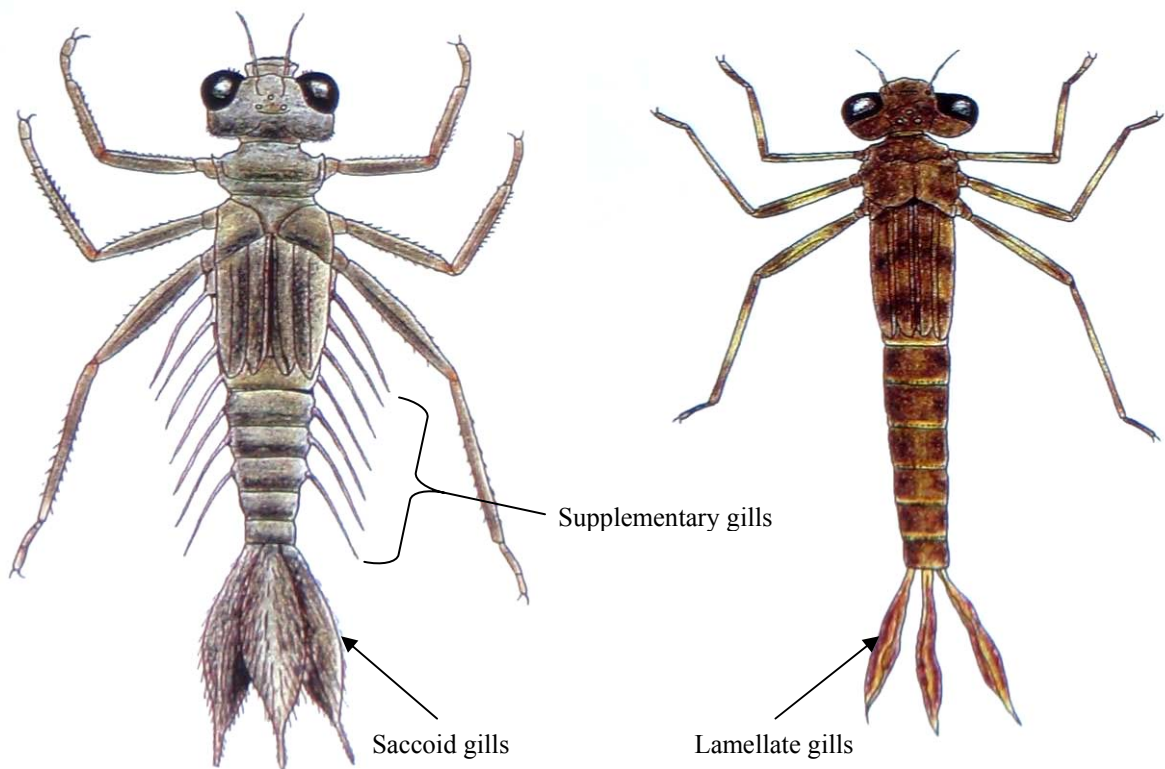


Fig. 3. *Euphaea* larva (left) showing seven pairs of supplementary gills compared to the usual coenagrionid larva (right). (Drawings from Orr, 2003).



Fig. 4. *Euphaea impar* habitat at the Sime Forest showing a sandy stream bed lined by thick vegetation. (Photograph by: Alvin Francis Lok Siew Loon).

Perch preference can vary from twigs in heavy shade, or rocks in shade or sun (Thompson, 1998; Silsby, 2001). Males are territorial, preferring brightly lit perches on twigs and rocks, presumably to best display their wing iridescence to attract females and defend a territory adjacent to moving water. There also seems to be some courtship prior to mating, but this has not been well observed (Thompson 1998; Orr, 2003). Females, by contrast, are usually found in shaded forest areas, where they hunt by ambushing prey—launching themselves from prominent twigs at passing prey (Silsby, 2001). It is for this reason that the females are infrequently observed beside streams, whereas males are usually observed. They are generally observed only while ovipositing or mating.

Copulation and oviposition has seldom been witnessed in euphuids. However, *Bayadera indica*, has been observed in tandem pairs taking long flights downstream looking for a suitable spot to deposit their eggs. A tandem pair of *Dysphea lugens* was observed landing on a log in swift water; the pair disengaged and the female crawled 0.5 m underwater to oviposit, while the male waited above. On her reappearance the pair reformed in tandem, and flew further downstream (Orr, 2001). *Euphaea ameeke*, probably a sister species to *Euphaea impar*, has been recorded as mating for 105–202 seconds. After insemination the pair fly off in tandem and the female descends underwater to oviposit while the male perches above on guard (Thompson, 1998). The duration between encounter and concluding an oviposition bout in one pair observed by Thompson (1998) was about one hour. Similar observations were made on ovipositing females of *Euphaea decora* from Hong Kong, and *Euphaea costalis* from Borneo (Reels & Dow, 2006). *Euphaea impar* has only rarely been observed ovipositing, and this usually also involves the female backing down a twig into the water where the eggs are laid. However Choong (2005) observed an unusual ovipositing behaviour in *Euphaea impar*, where a female specimen was noticed hovering 15–20 cm above a stream and attempted a high speed 45–70° dive into water, although it failed to break the water surface on the first attempt. On the second attempt, it managed to break the water surface, after which it clung to a rock 5–10 cm beneath the water surface for 30 minutes while laying its eggs.

Male *Euphaea impar*, like those of other satinwings, tend to embark on short fluttery flights from their perches and always land with wings closed above the body (Silsby, 2001). Males have a somewhat heavy build with a bright blue thorax that has a black stripe down the centre of the dorsal surface. The abdomen is completely black and the hind wings have a large black patch covering a little less than half of the terminal end of the hind wing. The female on the



Fig. 5. *Euphaea impar* habitat at the braided stream system of Sime Road Forest dominated by pulai paya (*Alstonia spatulata*) and simpoh air (*Dillenia suffruticosa*). (Photograph by: Ng Ting Hui).



Fig. 6. *Euphaea impar* habitat at the Nee Soon Swamp Forest showing a stream with muddy bottom and lined with heavy vegetation. (Photograph by: Alvin Francis Lok Siew Loon).

other hand is very dull with light khaki green replacing the bright blues of the males and lacks the distinctive black patch found on the hind wings in males. The function of the terminal black patch on the male hindwing is not clear. Independent observations by us (also Orr, 2001), suggest that it may be used to signal to other males in agonistic displays and does not seem to be used in courtship. However, the closely related *Euphaea ameeke*, with which it is sometimes syntopic in Borneo, is also highly territorial (Thompson, 1998; Orr, 2001) but lacks these wing markings, having distinctly narrower hindwings. Given that the only other obvious difference between the two species is their thoracic marking, it seems likely that females would use this cue in species recognition, at least where the two species fly together.

PAST AND PRESENT RECORDS

According to specimens deposited in the Zoological Reference Collection (ZRC), Raffles Museum of Biodiversity Research, National University of Singapore, *Euphaea impar* was first recorded in Singapore in 1992 at Nee Soon Swamp Forest by Victor Ong (Lua, unpublished), although Tang (2008) indicated that this species was first recorded in 1997 at the Central Catchment Nature Reserve (CCNR) and has since been found at Lorong Banir, MacRitchie Reservoir, Rifle Range Road Forest, Sime Road Forest (Fig. 4), Upper Pierce Reservoir and Upper Seletar Reservoir. The typical habitat of *Euphaea impar* in Singapore is usually near relatively pristine, clear, shallow-flowing streams in primary or secondary forest, with a sandy or slightly muddy substrate with accumulations of detritus and leaf litter, and sometimes with large rocks. The stream banks are usually well-vegetated, providing suitable perches from which the males guard their territory. The vividly-coloured males are somewhat more frequently encountered because they are usually seen along streams, whereas the duller females are usually encountered in the shady undergrowth. Typically, there are three main types of habitats of *Euphaea impar* in Singapore: firstly sandy, clear-water streams with dense marginal vegetation (mainly simpoh air [*Dillenia suffruticosa*] and mali mali [*Leea indica*]) (Fig. 4); secondly, a muddy braided stream system at the lower reaches of the Sime Road Forest where the canopy consists predominantly of pulai paya (*Alstonia spathula*) and has a relatively open undergrowth (Fig. 5); thirdly, small forest streams with muddy bottoms (especially in the Nee Soon Swamp Forest) (Fig. 6). *Euphaea impar* is very sensitive to movement, making approaching it for macro shots difficult, with the subject flying higher and higher when disturbed. Flash photography also can be very difficult with this species and requires careful and prolonged stalking until the subject becomes accustomed to the flash and ceases to fly away with each discharge.

CONCLUSIONS

Euphaea impar is listed as being common in the CCNR (Norma-Rashid et al., 2008). However because the habitats where *Euphaea impar* occurs, (within the Bukit Timah Nature Reserve [BTNR] and the Central Catchment Nature Reserve [CCNR]) account for only approximately 5% of the entire land area of Singapore (Corlett, 1992), and in these areas *Euphaea impar* is only found in certain streams and at extremely low densities, this species should therefore be considered nationally endangered. These zygopterans also have very restricted territories and for each stream where this species was encountered, only a lone male was found for the entire stretch of the stream. Therefore any loss of habitat could be disastrous for this species in Singapore.

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LITERATURE CITED

- Choong, C. Y., 2005. Dive! Dive! Dive! Oviposition behaviour of *Euphaea impar*. *Malaysian Naturalist*, **59**(1): 46–48.
- Corlett, R. T., 1992. The ecological transformation of Singapore, 1819–1990. *Journal of Biogeography*, **19**(4): 411–420.
- Fraser, F. C., 1934. *The Fauna of British India including Ceylon and Burma. Odonata, Volume 2*. Taylor and Francis, London. 442 pp.
- Lua, H. K., unpublished. *Singapore Odonata Collections List*.
- Murphy, D. H., L. F. Cheong, L. K. Wang & S. Ang, 2008. Springtails, peripatus and insects (to moths). In: Davison, G. W. H, P. K. L. Ng & H. C. Ho (eds.), *The Singapore Red Data Book: Threatened Plants and Animals of Singapore. 2nd Edition*. The Nature Society (Singapore), Singapore. Pp. 247–249.

- Norma-Rashid, Y., L. F. Cheong, H. K. Lua & D. H. Murphy, 2008. *The Dragonflies (Odonata) of Singapore: Current Status Records and Collections of the Raffles Museum of Biodiversity Research*. http://rmbr.nus.edu.sg/raffles_museum_pub/raffles_museum_checklists.php. (Accessed 20 Feb.2009).
- Orr, A.G., 2001. An annotated checklist of the Odonata of Brunei with ecological notes and descriptions of hitherto unknown males and larvae. *International Journal of Odonatology*, **4**(2): 167–220.
- Orr, A. G., 2003. *Dragonflies of Borneo*. Natural History Publications, Borneo. 195 pp.
- Orr, A. G., 2005. *Dragonflies of Peninsular Malaysia and Singapore*. Natural History Publications, Borneo. 127 pp.
- Reels, G. T. & R. Dow, 2006. Underwater oviposition behaviour in two species of *Euphaea* in Borneo and Hong Kong (Zygoptera: Euphaeidae). *International Journal of Odonatology*, **9**(2): 197–204.
- Silsby, J., 2001. *Dragonflies of World*. Smithsonian Institution Press, USA. 216 pp.
- Tang, B. H., 2008. *Dragonflies and Damselflies of Singapore*. <http://www.greenunity.net/odonata/intro.asp>. (Accessed 20 Feb.2008).
- Thompson, D. J., 1998. On the biology of the damselfly *Euphaea ameeke* van Tol & Norma-Rashid in Borneo (Zygoptera: Euphaeidae). *Odonatologica*, **27**(2): 259–265.