

**THE NATIVE FAUNA OF  
THE NATIVE GARDEN @ HORTPARK:  
BIRDS, FISHES, AMPHIBIANS, REPTILES,  
BUTTERFLIES, MOTHS,  
DAMSELFLIES, AND DRAGONFLIES**



**Alvin F. S. L. Lok, W. F. Ang, Hugh T. W. Tan,  
Richard T. Corlett and P. Y. Tan**  
Editors

Raffles Museum of Biodiversity Research, National University of Singapore  
and Centre for Urban Greenery and Ecology, National Parks Board  
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**2012**



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**The Native Fauna of the Native Garden @ HortPark: Birds, Fishes, Amphibians, Reptiles, Butterflies, Moths, Damselflies, and Dragonflies** edited by  
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## INTRODUCTION

**A. F. S. L. Lok<sup>1\*</sup>** and **H. T. W. Tan<sup>2</sup>**

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Singapore's native vascular plant flora consists of 2,145 species (Chong et al., 2009), with only about 20–25% currently used for horticultural purposes in the urban environment. This means that much of the flora is still an untapped resource that can be utilised not only for its landscaping value, but also as a means of attracting native animals, including species that have long since been lost from our urban areas because of development. A landscaped area with 100% native species planted in a dense and structurally complex arrangement, such as the Native Garden @ HortPark, has considerable potential for attracting native animal life, although long-term monitoring will be necessary to assess the extent to which this occurs in practice.

### NATIVE GARDEN @ HORTPARK

The Native Garden @ HortPark is a collaborative project between the National University of Singapore (NUS) and the Centre for Urban Greenery and Ecology (CUGE), National Parks Board (NParks) under a research project funded by the Ministry of National Development (MND) Research Fund for the Built Environment—Enhancing the Urban Native Biodiversity of Singapore (Tan et al., 2010). The Native Garden @ HortPark is aimed at showcasing Singapore's native plant species as well as demonstrating, to both members of the public and professional landscape designers and horticulturists, how native plant species can be effectively used for urban landscaping. It is located beside the Butterfly Garden and adjacent to Hyderabad Road in HortPark (Fig. 1.1).

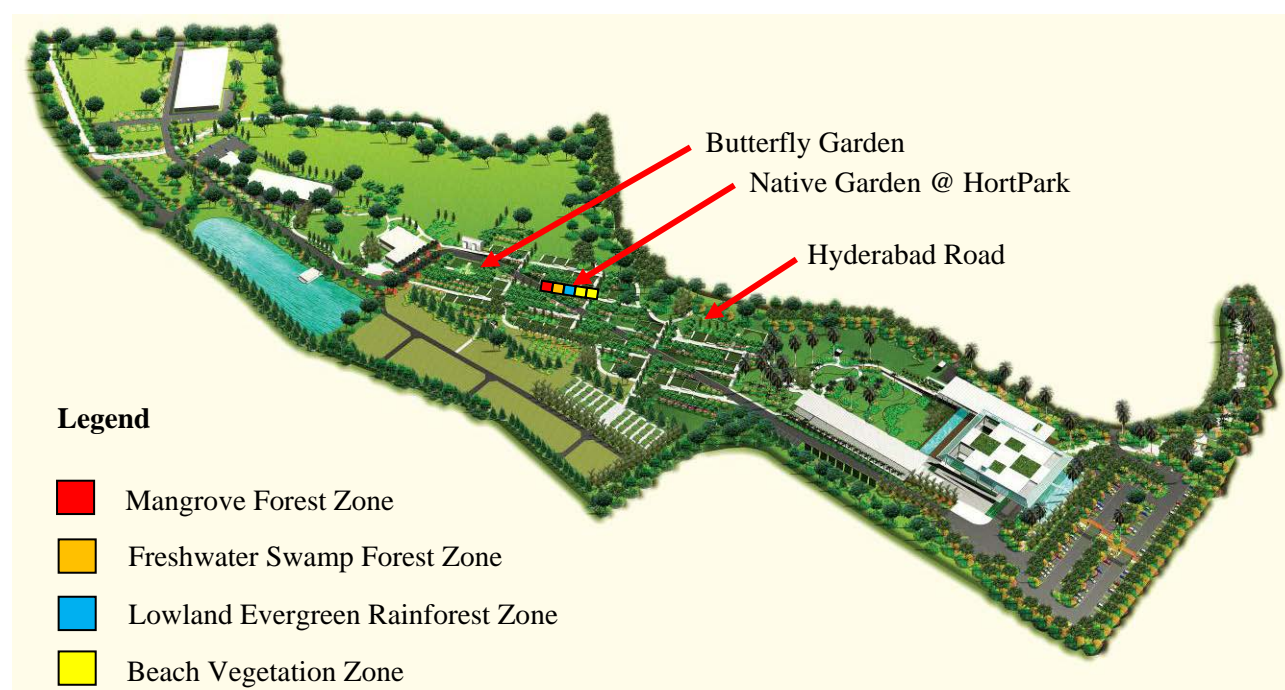


Fig. 1.1. A map of HortPark, indicating the exact location of the various plots of the Native Garden @ HortPark. (Map courtesy of: HortPark, National Parks Board).



Native Garden @ HortPark has demonstrated that native plants not only provide ecosystem services like their non-native counterparts, such as aesthetics, shading and cooling, recreation, dust retention, and sound dampening, but are also probably better adapted for providing food (nectar, pollen, fruits, seeds, leaves) and shelter (nesting and roosting sites, etc.) to native animals, since these species have evolved together. Planting native plant species also eliminates the danger of cultivated plants escaping into the wild and becoming invasive (Lok et al., 2010). A species-rich planting scheme also reduces the likelihood of pest and disease outbreaks compared to monocultures. Native plants in green open spaces or along roadside verges can also serve as a native “green corridor”, similar to a stepping stone, connecting the nature reserves and nature areas, allowing wildlife to traverse and utilise otherwise separate areas. Native plantings, in theory, should also be easier to maintain once established and with the right microclimate, as they are better adapted to local conditions, and are therefore more sustainable in the long term.

With the above in mind, the Native Garden @ HortPark was initially landscaped with three distinct zones, and was completed in May 2010. The first is the freshwater swamp forest zone (Fig. 1.2) which includes a small pond-cum-aquarium and gazebo, showcasing the many native swamp forest plants. The second zone is the lowland evergreen rainforest zone (Fig. 1.3) which is adjacent to the swamp forest zone. It contains a small picnic area as well as a stream containing many native aquatic and marsh plants, which flows downstream into the pond-cum-aquarium in the freshwater swamp forest zone. Lastly, there is the beach vegetation zone (Fig. 1.4) which lies to the rightmost end of the plot (when facing it from the path), and it has a shelter. An additional mangrove forest zone (Fig. 1.5; completed in March 2011) was included to showcase how mangrove plant species can be used in an urban setting, especially along freshwater waterways or waterbodies in Singapore. Including this fourth zone, the total area of the Native Garden @ HortPark stands at 576 m<sup>2</sup>.



Fig. 1.2. Freshwater swamp forest zone of the Native Garden @ HortPark. (Photograph by: Alvin Francis Lok Siew Loon).





Fig. 1.3. Lowland evergreen rainforest zone of the Native Garden @ HortPark. (Photograph by: Alvin Francis Lok Siew Loon).

The native plants used were selected based on three main criteria. The first was commercial availability, which we considered to be the most important factor, as large plants may then be purchased directly from commercial nurseries for immediate planting, instead of growing them from seeds or cuttings which would take a long time. The second criterion was the suitability of the plants for the site's growing conditions, e.g., the swamp forest zone was landscaped with plants that are adapted to grow in the waterlogged conditions. The last criterion was the ability of the plants to provide ecosystem services, such as supplying food in the form of fruits, nectar, and foliage, and a place for animals to live, hunt, and take shelter in (e.g., some birds prefer to nest in dense foliage).

### **MONITORING ANIMAL LIFE**

Regular monitoring was conducted for one year after planting was completed (May 2010 to April 2011), to ascertain the rate of colonisation or visits by native animal species to the plot. Such colonisations would include organisms using the plot for hunting (e.g., spiders amongst foliage), breeding (e.g., damselflies and dragonflies breeding in the pond, and nesting birds), for shelter (insects amongst the foliage), and for foraging (e.g., for nectar, fruits, insects, or foliage). Only organisms found at the plot in the above-mentioned situations were considered, and accidentals (here defined as organisms that happen to pass by without stopping to visit the plants) were omitted. From these criteria, a large variety of organisms can be expected to colonise or visit the plot, and these may include spiders, beetles, ants, wasps, bees, hornets, and so on. However for the surveys, only selected groups were monitored, due to limited expertise. These groups included the birds, reptiles and frogs (herpetofauna), butterflies and moths (Lepidoptera), and damselflies and





Fig. 1.4. Beach vegetation zone of the Native Garden @ HortPark. (Photograph by: Alvin Francis Lok Siew Loon).

dragonflies (Odonata). This book also includes information on the native fish species that were introduced into the pond. All groups of organisms mentioned above (with the exception of the fishes) were attracted to the plot naturally, and were not introduced.





Fig. 1.5. The newly planted mangrove forest zone of the Native Garden @ HortPark.

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## BIRDS

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## INTRODUCTION

A total of 439 species of birds have been recorded for the Republic of Singapore, with about 70 species presumed nationally extinct (Lim, 2009). A total of 369 bird species still occurs in Singapore, with 345 naturally-occurring (native) species, and 24 alien (non-native) species. In this book, alien or non-native species that have resulted from human introduction have been excluded (e.g., the commonly observed mynas and orioles) because the main aim of this study is to determine the efficacy of native plants to attract native animals.

The national conservation statuses for birds are somewhat different from the other organisms surveyed, in that many species have migratory populations and hence native bird species have to be further subdivided into different categories (Wang & Hails, 2007) as follow:

1. For the purpose of this publication, populations of **native species** can be categorised into the following:
  - a. **Passage migrants** are species that only appear or are more commonly encountered during the north- or south-bound migration.
  - b. **Winter visitors** are species that spend all or most of the north-temperate winter in Singapore.
  - c. **Accidental species or vagrants** are species that are only recorded in Singapore on an irregular basis.
  - d. **Non-breeding visitors** are species not known to undertake a definite migration but occur in Singapore from time to time.
  - e. **Residents** are species that are present throughout the year. Some have viable populations and have been recorded to breed, while others do not have viable populations and have not been recorded to breed in Singapore.
2. Their **abundances** can be categorised into four groups:
  - a. **Common species** are those that are recorded every year in relatively large numbers.
  - b. **Uncommon species** are those that are recorded every year but in small numbers.
  - c. **Rare species** are those with 3–10 records per year (for residents) or 1–2 records per year (for passage migrants and winter visitors).
  - d. **Very rare species** are those that have less than three records in the last 50 years.

In Singapore, birds can be found in all naturally-occurring habitats, such as primary lowland evergreen rainforest, freshwater swamp forest, secondary forest, mangrove forest, beach vegetation, sandy shores, and coral reef flats. More recently, owing to urbanisation, new man-made or managed habitats are now available and attract different assemblages of birds. Such habitats include wasteland vegetation, parks, gardens, built-up areas, as well as artificial freshwater bodies and wetlands (reservoirs and their adjacent banks). To a certain degree, many birds are specialists and do well in—or prefer—certain habitats, but there are also other species that have wider ecological amplitudes and can be found in many habitats, making them rather successful in Singapore.

In this survey, the bird species that visit the plot were expected to be mostly suburban and urban bird species, which as mentioned above, are species that can tolerate human disturbance and



proximity. Birds may visit the plot for many reasons. Some are attracted to the flowers of various plant species, such as teruntum merah (*Lumnitzera littorea*) and gelam (*Melaleuca cajaputi*) for nectar (being nectivorous), while others are attracted to the fruits (being frugivorous) provided by various plants, such as sendudok (*Melastoma malabathricum*), seashore ardisia (*Ardisia elliptica*), and the common tree-vine (*Leea indica*). These nectivorous and frugivorous bird species are therefore directly reliant on the plants for their nutrition. Other species visit the plants to forage in the foliage for insects (being insectivorous), which may in turn have been attracted to the plants for food. This makes such birds indirectly reliant on the plants which feed their insect prey. Besides food, birds also visit the plants for nesting material or to nest within them. Other birds may simply be passing through on their way to somewhere else.

## METHODS

From 10 May to 9 December 2010, visits were made to the Native Garden @ HortPark. At each visit, a visual bird census was conducted for about 30–60 minutes, by walking around the site, spending equal time in the freshwater swamp forest, lowland evergreen rainforest, and beach vegetation zones of the plot. Surveys were made in the morning or afternoon, around 0700–0900 hours or 1700–1900 hours.

For each bird species observed at the Native Garden @ HortPark, the following are provided:

1. Scientific name
2. Common name
3. Family name
4. Common family name
5. Description of the adult (terminology used for the description of bird morphology and plumage is illustrated in Fig. 2.1)
6. Diet
7. Behaviour
8. Habitat
9. Natural distribution
10. National conservation status
11. References

Bird species are arranged alphabetically by their scientific names rather than common names, since some birds have more than one common name in wide circulation. In the figure legends, TL = total length from the tip of head to the tip of the abdomen.

## OBSERVATIONS

In this study, a total of 13 native species were observed (Table 2.1). Most of the species encountered at the Native Garden @ HortPark are resident species, with the exception of one species—a common passage migrant and winter visitor—the blue-tailed bee eater (*Merops philippinusei javanicus*). The only uncommon species is the oriental white-eye (*Zosterops palpebrosus aureiventer*). The annotated list of birds follows.

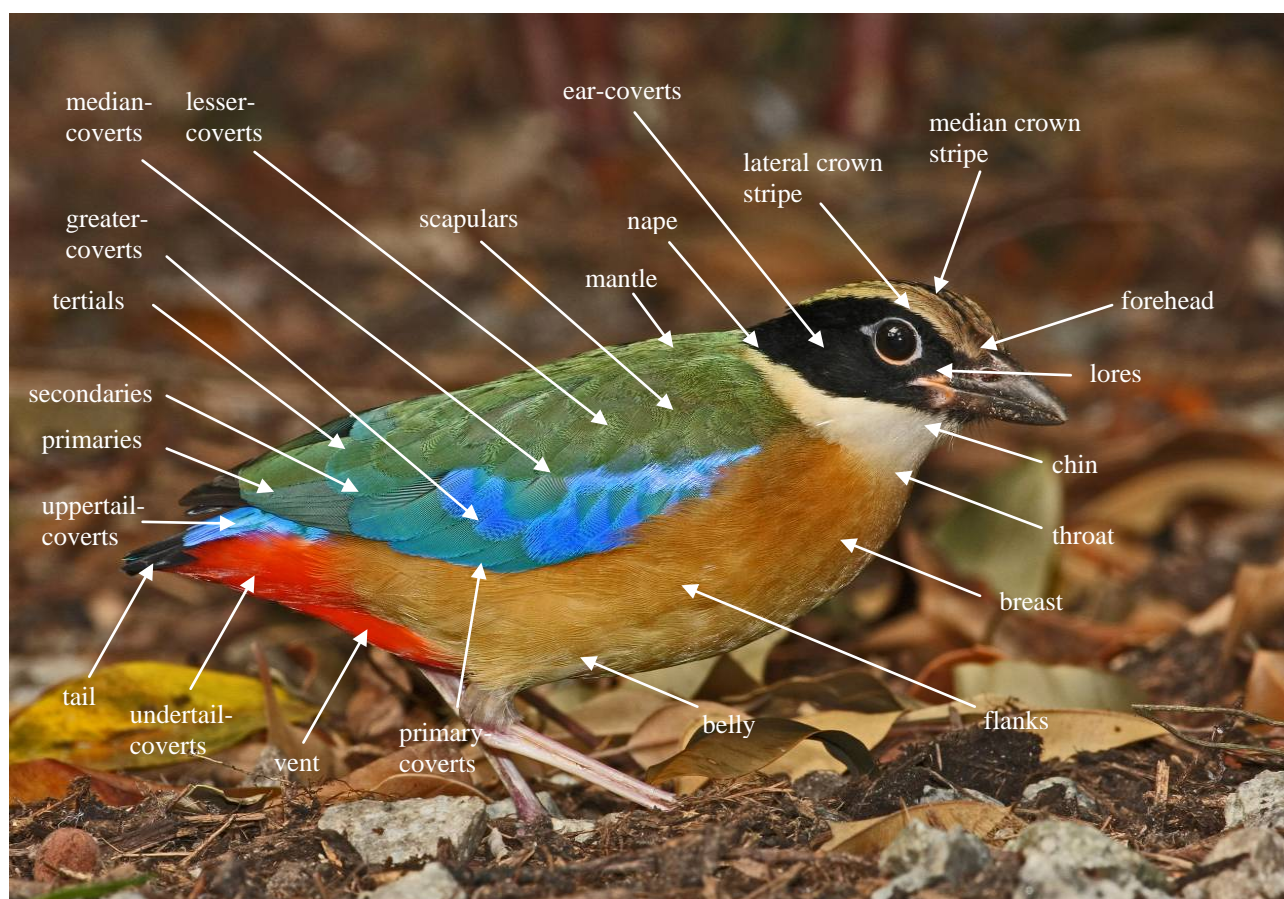


Fig. 2.1. Terminology for the description of the morphology and plumage of a bird. (Photograph by: Alvin Francis Lok Siew Loon).

Table 2.1. Native birds of the Native Garden @ HortPark.

S/No.	Scientific Name	Common Name	Family	Local Status
1.	<i>Aethopyga siparaja siparaja</i>	crimson sunbird	Nectariniidae	Common resident breeder
2.	<i>Anthreptes malacensis malacensis</i>	brown-throated sunbird	Nectariniidae	Common resident breeder
3.	<i>Dicaeum cruentatum ignitum</i>	scarlet-backed flowerpecker	Nectariniidae	Common resident breeder
4.	<i>Halcyon smyrnensis fusca</i>	white-throated kingfisher	Alcedinidae	Common resident breeder
5.	<i>Megalaima haemacephala indica</i>	coppersmith barbet	Capitinidae	Common resident breeder
6.	<i>Merops philippinus javanicus</i>	blue-tailed bee-eater	Meropidae	Common passage migrant and winter visitor
7.	<i>Cinnyris jugularis ornatus</i>	olive-backed sunbird	Nectariniidae	Common resident breeder
8.	<i>Orthotomus ruficeps cineraceus</i>	ashy tailorbird	Cisticolidae	Common resident breeder
9.	<i>Orthotomus sutorius maculicollis</i>	common tailorbird	Cisticolidae	Common resident breeder
10.	<i>Pycnonotus goiavier analis</i>	yellow-vented bulbul	Pycnonotidae	Common resident breeder
11.	<i>Todiramphus chloris humii</i>	collared kingfisher	Alcedinidae	Common resident breeder
12.	<i>Treron vernans vernans</i>	pink-necked green-pigeon	Columbidae	Common resident breeder
13.	<i>Zosterops palpebrosus auriventer</i>	oriental white-eye	Zosteropidae	Uncommon resident breeder

**ANNOTATED LIST OF NATIVE BIRD SPECIES**

**Scientific name:** *Aethopyga siparaja siparaja* (Raffles, 1822) (Fig. 2.2)

**Common name:** crimson sunbird

**Family name:** Nectariniidae

**Common family name:** flowerpecker and sunbird family

**Description:** Sunbirds are tiny, brightly coloured birds with long beaks, in which the two sexes are very different in appearance. In keeping with this, the adult male crimson sunbird has a brilliant crimson breast, face, and upper back, and a metallic blue forehead and tail, while the female is dull yellow and green all over. Many birds have only patches of crimson, however, and these are either juvenile males or adults outside of the breeding season.

**Diet:** Sunbirds are ecologically the Old World equivalent of the New World hummingbirds, feeding mainly on nectar and small invertebrates, although they occasionally also consume some small fruits. Unlike hummingbirds, sunbirds rarely hover when visiting flowers, although they can do so when necessary. The crimson sunbird is often encountered visiting flowering plants in forests, parks, and gardens. During the breeding season, it is seen actively foraging for insect adults and larvae amongst foliage, but it has a particular affinity for spiders which are often picked out of their webs.

**Behaviour:** This bird is most often observed visiting flowers for nectar or, particularly during the breeding season, searching foliage for insects and spiders. Spiders appear to be the most common animal prey brought to nestlings. The nest is often built close to human habitation, on branch tips and on fences, especially the barbed-wired segments.

**Habitat:** Beach vegetation, mangrove forest, lowland evergreen rainforest, abandoned plantations, gardens, and parks. In Singapore, this bird is also fairly common in suburban and urban habitats, and is relatively tolerant of human disturbance.



Fig. 2.2. *Aethopyga siparaja siparaja* (Raffles, 1822). Adult male. TL = 11 cm. (Photograph by: Ang Wee Foong).





Fig. 2.3. *Anthreptes malacensis malacensis* (Scopoli, 1786). TL = 14 cm. (Photograph by: Alvin Francis Lok Siew Loon).

**Natural distribution:** It has a wide distribution, ranging from the Himalayan foothills and northeast India, to southwest China, and through Southeast Asia to Borneo, Java, the Philippines, and Sulawesi.

**National conservation status:** common resident breeder

**References:** Jeyarajasingam & Pearson (1999); Robson (2005); Ryan (2006); Wang & Hails (2007); Wells (2007)

**Scientific name:** *Anthreptes malacensis malacensis* (Scopoli, 1786) (Fig. 2.3)

**Common name:** brown-throated sunbird

**Family name:** Nectariniidae

**Common family name:** flowerpecker and sunbird family

**Description:** As with other sunbirds, males and females look very different. Moreover, some of the male's feathers are iridescent, so the colour depends on the angle of observation. Adult males have a yellow underside, a brown throat and metallic dark green and purple upperparts. In contrast, the female has yellow underparts and an olive back.

**Diet:** It feeds mainly on nectar and small invertebrates, but occasionally takes some small fruits. This subspecies is often encountered visiting flowers in forests, parks, and gardens. During the breeding season, it can be seen actively foraging for insect adults or larvae amongst foliage, and especially spiders.

**Behaviour:** This bird is often seen visiting flowers for nectar, although more often observed gleaning foliage for insects during the breeding season. Spiders seem to be the favoured animal prey brought to nestlings.

**Habitat:** It inhabits many habitats including mangrove forest, mature to disturbed forest, woodland, beach vegetation, plantations, gardens, and parks. In Singapore it is one of the most common sunbirds in suburban and urban habitats, and it is very tolerant of human disturbance.

**Natural distribution:** Throughout Southeast Asia from Myanmar and Vietnam to Sumatra, Borneo, Java, Bali, the Philippines, Sulawesi and the Lesser Sundas.

**National conservation status:** common resident breeder

**References:** Jeyarajasingam & Pearson (1999); Robson (2005); Ryan (2006); Wang & Hails (2007); Wells (2007)





Fig. 2.4. *Dicaeum cruentatum ignitum* (Begbie, 1834). Adult male. TL = 9 cm. (Photograph by: Mark Chua).

**Scientific name:** *Dicaeum cruentatum ignitum* (Begbie, 1834) (Fig. 2.4).

**Common name:** scarlet-backed flowerpecker

**Family name:** Nectariniidae

**Common family name:** flowerpecker and sunbird family

**Description:** Flowerpeckers are related to sunbirds, but are even smaller and have shorter beaks and tails. Males and females are different. The adult male of this subspecies has a bright red crown and upperparts, contrasting with the black side of the head and breast, and the blue-black wings. The female, in contrast, is duller coloured, except for the bright red rump and upper part of the tail.

**Diet:** It feeds on soft fruits, nectar, and small invertebrates. Most commonly found high up in the canopy feeding on the flowers and fruits of parasitic mistletoes, but it also descends lower to feed on the soft fruits of sendudok (*Melastoma malabathricum*) and the Jamaican cherry (*Muntingia calabura*). Flowerpeckers are the major dispersal agents for mistletoes (Loranthaceae and *Viscum* species), depositing the sticky seeds on the twigs of host trees where they can germinate and grow.

**Behaviour:** It is predominantly a suburban or urban species in Singapore, favouring managed habitats. It is usually heard calling from the highest branches of a tree infected with mistletoes, particularly *Viscum* species.

**Habitat:** This subspecies is found in mangrove forest, open woodland, plantations, parks, and wooded gardens.

**Natural distribution:** It has a wide distribution from northeast India and southern China through Southeast Asia to Sumatra and Borneo.

**National conservation status:** common resident breeder

**References:** Jeyarajasingam & Pearson (1999); Robson (2005); Wang & Hails (2007); Wells (2007)



Fig. 2.5. *Halcyon smyrnensis fusca* (Boddaert, 1783). TL = 28 cm. (Photograph by: Ingo Waschikies).

**Scientific name:** *Halcyon smyrnensis fusca* (Boddaert, 1783) (Fig. 2.5)

**Common name:** white-throated kingfisher

**Family name:** Alcedinidae

**Common family name:** kingfisher family

**Description:** This is a medium-sized kingfisher, with a dark-chestnut head, belly, and flanks. The throat and breast are white. The back wings and tail are a bright sky-blue, with the exception of the lesser coverts which are dark-chestnut, and medium coverts which are blackish-blue. The bill is a dull blackish-red while the orbital skin, legs, and feet are a brighter orange-red.

**Diet:** A wide variety of prey has been recorded for this subspecies, including large insects, crabs, snails, earthworms, frogs, toads, lizards, snakes, bird nestlings, and in coastal areas, fish.

**Typical behaviour:** It is typically a sit-and-wait predator, spending long periods perched motionless, with its tail wagging and head bobbing occasionally, before diving head first into the water or landing on its feet to grab prey. The prey item is then usually battered before consumption.

**Habitat:** It inhabits many habitats, including beach, mangrove forest, near reservoirs, but also sites away from water bodies such as parks, forest edge, and even in industrial estates.

**Natural distribution:** This subspecies ranges from India and Sri Lanka eastwards to southeast China and Taiwan, and southwards through Thailand, Peninsular Malaysia, Sumatra, and West Java.

**National conservation status:** common resident breeder

**References:** Jeyarajasingam & Pearson (1999); Wells (1999); Woodall (2001); Robson (2005); Wang & Hails (2007)





Fig. 2.6. *Megalaima haemacephala indica* Lantham, 1790. Adult male. TL = 15 cm. (Photograph by: Alvin Francis Lok Siew Loon).

**Scientific name:** *Megalaima haemacephala indica* Lantham, 1790 (Fig. 2.6)

**Common name:** coppersmith barbet

**Family name:** Capitinidae

**Common family name:** barbet family

**Description:** This is a small, chunky, green barbet, with greenish-cream striped underparts, and reddish legs and orbital skin. The forehead and fore crown are red in males. This subspecies has a yellow patch above and below the eye, and a black eye-stripe and moustache, bordered at the rear by a black band. Females lack the red forehead and fore crown, and the orbital skin and legs are a duller red.

**Diet:** It is mainly frugivorous, although occasionally eating insects. Fruits taken include figs, very ripe papayas (*Carica papaya*), mangoes (*Mangifera* species), custard apples (*Annona reticulata*), and other small fleshy fruits. Insects are taken especially during the breeding season when an increased protein diet is essential. Insects taken include beetles, mantids, crickets, and various insect larvae.

**Typical behaviour:** This barbet is predominantly a suburban or urban species, favouring managed habitats. It is usually heard before it is seen, often sitting on a high branch calling. It is easily overlooked owing to its colouration, even with the bright-red forehead and fore crown.

**Habitat:** In Singapore, it is often found in parks, gardens, and forest edge, but usually never venturing into the forest interior. It is very common in suburban and urban areas, although it is not often noticed, unless a fig tree (*Ficus* species) is mass-fruiting.

**Natural distribution:** This subspecies is originally native to India, Bangladesh, and Bhutan but has spread eastwards to Myanmar, Thailand, and Vietnam, and southwards to Peninsular Malaysia, Sumatra, Java, and the Philippines. This subspecies spread on its own accord following deforestation and urban development, so it can reasonably be considered as a 'new native' in Singapore, rather than an alien.

**National conservation status:** common resident breeder

**References:** Jeyarajasingam & Pearson (1999); Robson (2005); Shorts & Horne (2002); Wang & Hails (2007); Wells (1999)

**Scientific name:** *Merops philippinus javanicus* Horsfield, 1821 (Fig. 2.7)

**Common name:** blue-tailed bee-eater

**Family name:** Meropidae

**Common family name:** bee-eater family

**Description:** A bird with a bronze-green crown to the back and greenish-blue rump and uppertail-coverts. There is a black band across the eye, from the lore to the ear coverts. It is pale buff-yellow at chin and neck, and a dull-chestnut at the throat. The breast is a mixture of pale buff-yellow at the upper breast just below the throat, with an increasing dull yellow-green tinge towards the belly and flanks. The wings are a medium-green with a bright greenish blue at the tertials.

**Diet:** This subspecies eats many insects which are usually taken while in flight, including honey bees, wasps, moths, and butterflies, but its favourite prey item appears to be dragonflies.

**Typical behaviour:** It feeds by making long flights from high branches, telephone or electrical wires, or lamp posts, with rapid wing beats to gain altitude, followed by a steep downwards swoop. If a stinging insect is caught, it is brought back to a branch where the stinger is removed by repeated rubbing against the branch prior to swallowing it whole.

**Habitat:** It is frequently found in open country with a few tall trees as vantage points to hunt. It is commonly found in parks, forest edge, reservoir edges, open grassland, mangrove forest, and suburban gardens.

**Natural distribution:** It is widely distributed from North Pakistan and India, east to southeast China, and throughout Southeast Asia, to New Guinea and New Britain.

**National conservation status:** common passage migrant and winter visitor

**References:** Jeyarajasingam & Pearson (1999); Wells (1999); Robson (2005); Wang & Hails (2007)





Fig. 2.7. *Merops philippinus javanicus* Horsfield, 1821. TL = 30 cm. (Photograph by: Mark Chua).



Fig. 2.8. *Cinnerys jugularis ornatus* Lesson, 1827. Adult male. TL = 11 cm. (Photograph by: Ingo Waschikies).

**Scientific name:** *Cinnerys jugularis ornatus* Lesson, 1827 (Fig. 2.8)

**Common name:** olive-backed sunbird

**Family name:** Nectariniidae

**Common family name:** flowerpecker and sunbird family

**Description:** Like other sunbirds, this subspecies is sexually dimorphic. Males are deep metallic-blue on the forehead, lores, around the eyes, chin, cheeks, throat, and breast. The crown, ear-coverts, and nape are olive-green. The mantle, back, and rump are olive-brown. The wings are predominantly brown to olive-brown with hints of black to dark-brown. The flanks, belly, vent, and undertail-coverts are bright lemon-yellow, and the tail is brownish-olive. The female is overall similarly coloured to the male, except the deep metallic-blue parts such as the forehead, lores, areas around the eyes, chin, cheeks, throat, and breast are dull-yellow as are the other parts which are bright lemon-yellow on the male, such as the flanks, belly, vent, and undertail-coverts.

**Diet:** It is mainly nectivorous and insectivorous. This subspecies is often encountered visiting many flowering plants in forests, parks, and gardens. During the breeding season, it is seen actively foraging for insect adults and larvae amongst foliage but has a particular affinity for spider prey.

**Typical behaviour:** It is often observed visiting flowering plants for nectar, although more often seen gleaning foliage for insects during the breeding season. Spiders seem to be the favoured prey for its nestlings. The nest is built often within reach of humans, usually on the tip of a branch or on fences, especially the barbed-wired segments.

**Habitat:** It inhabits many habitats including mangrove forest, mature to disturbed forest, woodland, beach vegetation, plantations, gardens, and parks. In Singapore, it is very common in suburban and urban habitats, and is very tolerant of human disturbance.

**Natural distribution:** It is widely distributed from islands in the Bay of Bengal, southern China (Yunnan and Guangdong to Hainan islands), throughout Southeast Asia, Papua New Guinea, northeast Australia, and the Solomon islands.

**National conservation status:** common resident breeder

**References:** Jeyarajasingam & Pearson (1999); Woodall (2001); Robson (2005); Wang & Hails (2007); Wells (2007)



Fig. 2.9. *Orthotomus ruficeps cineraceus* Blyth, 1845. Adult male. TL = 12 cm. (Photograph by: Mark Chua).

**Scientific name:** *Orthotomus ruficeps cineraceus* Blyth, 1845 (Fig. 2.9)

**Common name:** ashy tailorbird

**Family name:** Cisticolidae

**Common family name:** cisticola family

**Description:** This is a small grey bird, with rusty-orange cheeks, ear coverts, chin, forehead, and lores. The median crown stripe is medium-grey with a slight tinge of orange. The nape, back scapulars, as well as the lesser, medium, and greater wing coverts, are a dark-grey, while the primary coverts, primaries, and secondaries are a brownish-grey. The tail is shorter than that of the common tailorbird and is brownish-grey. The throat, breast, flanks, and belly are a distinctly lighter grey. The beak and legs are salmon-pink.

**Diet:** It feeds almost exclusively on small invertebrates—mainly insects such as small beetles, bugs, ants, flies, moths, and butterflies, which it gleans from plants.

**Typical behaviour:** It moves around mostly in pairs and builds a nest by sewing two or three leaves together. It usually chooses an area with dense foliage for nest building. It forages in both the undergrowth as well as tree crown levels.

**Habitat:** It inhabits lowland forest, mainly in coastal areas, particularly mangrove forest and coastal scrub, but is also found in urban gardens, and even roadsides.

**Natural distribution:** This subspecies ranges from the extreme south of Myanmar, through south Thailand and Peninsular Malaysia, to Sumatra.

**National conservation status:** common resident breeder

**References:** Jeyarajasingam & Pearson (1999); Robson (2005); Ryan (2006); Wang & Hails (2007); Wells (2007)





Fig. 2.10. *Orthotomus sutorius maculicollis* Moore f., 1855. TL = 12 cm. (Photograph by: Ingo Waschikies).

**Scientific name:** *Orthotomus sutorius maculicollis* Moore f., 1855 (Fig. 2.10)

**Common name:** common tailorbird, longtailed tailorbird

**Family name:** Cisticolidae

**Common family name:** cisticola family

**Description:** This is a small bird with a long bill and tail. The reddish-brown forehead and olive-green upperparts are distinctive, while the undersides are pale grey. The elongated central tail feathers of the breeding male are nearly as long as the body.

**Diet:** This subspecies feeds almost exclusively on small invertebrates, mainly insects such as small beetles, bugs, ants, flies, moths, and butterflies, but also occasionally consumes nectar.

**Behaviour:** These birds are highly territorial and are usually found in pairs, moving through dense, low vegetation. They are noisy birds, with a surprisingly loud and monotonous song. Their nests are constructed by sewing leaves together, which is the origin of the common name. It usually selects an area with dense foliage for nest building and has bred successfully in the Native Garden @ HortPark. Some nests are made from a single large leaf—simpoh air (*Dillenia suffruticosa*) is a common choice in Singapore—while in other cases they sew two or three leaves together.

**Habitat:** It inhabits forest edge, parks, gardens, plantations, and mangrove forest. It favours dense shrubbery, especially in urban areas.

**Natural distribution:** This subspecies ranges from India and southern China throughout Southeast Asia to Java.

**National conservation status:** common resident breeder

**References:** Jeyarajasingam & Pearson (1999); Robson (2005); Ryan (2006); Wang & Hails (2007); Wells (2007)





Fig. 2.11. *Pycnonotus goiavier analis* (Horsefield, 1821). TL = 20 cm. (Photograph by: Mark Chua).

**Scientific name:** *Pycnonotus goiavier analis* (Horsefield, 1821) (Fig. 2.11)

**Common name:** yellow-vented bulbul

**Family name:** Pycnonotidae

**Common family name:** bulbul family

**Description:** A rather dull, brownish bird, distinguished by the black mask around the eyes, extending forward to the black beak, the white eyebrow, the dark top on the head, and the yellow patch under the tail, which gives this subspecies its common name. From a distance the head has a distinctive striped appearance.

**Diet:** This subspecies consumes a wide variety of food, including fruits, nectar, and invertebrates, but fruits dominate the diet. Fruits taken include those of figs (*Ficus* species), simpoh air (*Dillenia suffruticosa*), tembusu (*Fagraea fragrans*), sendudok (*Melastoma melabathricum*), and many other small fleshy fruits. Invertebrate prey include grasshoppers, caterpillars, moths, butterflies, mantids, beetles, and many others.

**Behaviour:** It is predominantly a suburban or urban subspecies, favouring managed habitats.

**Habitat:** It is not fussy about its habitat and can be found in urban gardens, parks, forest edge, mangrove forest edge, beach vegetation, but never occurring in primary forests.

**Natural distribution:** This subspecies ranges through Southeast Asia from southern Thailand to Sumatra, Borneo, Java, and Bali.

**National conservation status:** common resident breeder

**References:** Jeyarajasingam & Pearson (1999); Fishpool & Tobias (2005); Robson (2005); Wang & Hails (2007); Wells (2007)



Fig. 2.12. *Todiramphus chloris humii* (Sharpe, 1892). TL = 24 cm. (Photograph by: Mark Chua).

**Scientific name:** *Todiramphus chloris humii* (Sharpe, 1892) (Fig. 2.12)

**Common name:** collared kingfisher

**Family name:** Alcedinidae

**Common family name:** kingfisher family

**Description:** A bright blue kingfisher with a contrasting white collar and underparts. Its presence is often revealed first by its loud, shrill call “kek-kek-kek...”

**Diet:** Coastal populations feed on shrimps, crabs, and small fish. Non-coastal populations are more adaptable, feeding on many insects such as butterflies, carpenter bees, cicadas, grasshoppers, moths, and wasps, as well as spiders, frogs, lizards, and even small snakes.

**Behaviour:** It perches for long periods before swooping down at its prey, slamming it on the ground before swallowing it. It also captures prey in flight. It nests in holes in trees, active ant or termite nests, and occasionally on earth banks.

**Habitat:** It inhabits disturbed forest, agricultural land, urban areas, as well as mangrove forest and other coastal areas.

**Natural distribution:** This subspecies ranges from the Middle East, through India and Southeast Asia, to New Guinea, northern Australia, Samoa and Tonga, mostly along the coast.

**National conservation status:** common resident breeder

**References:** Jeyarajasingam & Pearson (1999); Wells (1999); Woodall (2001); Robson (2005); Wang & Hails (2007)





Fig. 2.13. *Treron vernans vernans* (Linnaeus, 1771). TL = 25 cm. Male on right. (Photograph by: Mark Chua).

**Scientific name:** *Treron vernans vernans* (Linnaeus, 1771) (Fig. 2.13)

**Common name:** pink-necked green pigeon

**Family name:** Columbidae

**Common family name:** pigeon and dove family

**Description:** Medium-sized, leaf-green pigeons with bright pink legs. The adult males are distinguished from the duller females and juveniles by the grey face, dull-pink nape and upper breast, and the bright orange lower breast.

**Diet:** This subspecies eats only fruits (frugivorous), consuming mainly figs (*Ficus* species) and other small-seeded species, such as sendudok (*Melastoma malabathricum*) and the Jamaican cherry (*Muntingia calabura*). Unlike most frugivores, green pigeons grind up small seeds in their muscular crops, so they do not act as seed-dispersal agents.

**Behaviour:** It usually moves around in large flocks of up to 30 birds, but is also found in smaller groups. Birds congregate in fruiting trees and almost never come to the ground. Nesting occurs all year round.

**Habitat:** It is found in many habitats, including secondary and primary forest, forest edge, mangrove forest, parks, urban gardens, and plantations.

**Natural distribution:** It is widely distributed from south Myanmar and south Vietnam, through Peninsular Malaysia, to Sumatra, Java, Borneo, Sulawesi, and the Philippines.

**National conservation status:** common resident breeder

**References:** Baptista et al. (1998); Jeyarajasingam & Pearson (1999); Wells (1999); Robson (2005); Wang & Hails (2007)



Fig. 2.14. *Zosterops palpebrosus auriventer* Hume, 1878. TL = 11 cm. (Photograph by: Mark Chua).

**Scientific name:** *Zosterops palpebrosus auriventer* Hume, 1878 (Fig. 2.14)

**Common name:** oriental white-eye

**Family name:** Traditionally, the genus *Zosterops* was included in the Zosteropidae (white-eye family), but molecular evidence places the white-eyes among the Timaliidae (babblers).

**Description:** A small, yellow-green bird with a conspicuous white ring around each eye. The throat and upper breast are yellow and the undersides are light grey. The tail is black. Males and females are alike.

**Diet:** It visits flowering plants for insects, nectar, and small fruits, such as those of sendudok (*Melastoma malabathricum*), mahang (*Macaranga* spp.), and silverback (*Rhodamnia cinerea*).

**Behaviour:** When not breeding, it is most often observed moving amongst foliage in small groups, checking both sides of leaves for insects. Because of the greenish colouration, these groups are usually detected first by their soft contact calls. Nest building is done by both members of a pair and the compact nest is constructed between the terminal twigs of a branch.

**Habitat:** Its habitats include mangrove forest, coastal and sub-coastal scrub, open woodland, plantations, secondary and primary forest, forest edge, gardens, and parks.

**Natural distribution:** This widespread subspecies ranges from eastern Afghanistan through India to southwest China and most of Southeast Asia.

**National conservation status:** uncommon resident breeder. This subspecies disappeared from Singapore in the 1970s and the current wild population may have re-established from cage birds.

**References:** Jeyarajasingam & Pearson (1999); Wells (1999); Robson (2005); Wang & Hails (2007)



## DISCUSSION

In this survey, 13 bird taxa were encountered. Most of these are resilient taxa that are found in a wide variety of habitats such as parks, suburban gardens, and even in the more built-up areas of Singapore, showing their high tolerance for anthropogenic disturbances. Of the 13 taxa encountered, three taxa were nectivorous, four taxa were predominantly frugivorous, and the remaining six were predominantly insectivorous or carnivorous. Two subspecies of kingfishers—the white-throated kingfisher (*Halcyon smyrnensis fusca*; Fig. 2.5) and the collared kingfisher (*Todiramphus chloris humii*; Fig. 2.12)—have been observed in and around the Native Garden @ HortPark eating lizards, such as geckos and skinks, rather than fish which are abundant in the pond. This diet was confirmed when a regurgitated pellet from a kingfisher was found at the gazebo area with a lizard's jaw and remnants of its skeleton found within. All species encountered at the plot are resident breeders in Singapore, except for the blue-tailed bee-eater (*Merops philippinus javanicus*; Fig. 2.7) which is a common passage migrant and winter visitor. The oriental white-eye (*Zosterops palpebrosus auriventer*; Fig. 2.14) is listed as an uncommon resident breeder, but individuals encountered at the plot were all observed during the migratory winter period and were believed to be from winter visiting populations. Besides foraging for various food types at the plot, two species were observed breeding in the plot. The common tailorbird (*Orthotomus sutorius maculicollis*) was found nesting in a hedge of sea lettuce (*Scaevola taccada*), while a pair of pinked-necked pigeons (*Treron vernans vernans*) was observed nesting in the crown of a bintangor gasing (*Callophyllum pulcherrimum*) tree. Other birds, especially the sunbirds, were observed collecting pieces of bark as nesting material.

Nocturnal surveys were not conducted, but would possibly yield additional species such as nightjars or owls. A heron-like species was also encountered at the plot along the stream area when it was flushed from the undergrowth, but it flew away too quickly for its identity to be ascertained. The Native Garden @ HortPark, despite its small size, has been successful in attracting native bird life. The latest extension to the plot, the mangrove forest zone (Fig. 1.5), with the numerous shrubs of teruntum merah (*Lumnitzera littorea*; Fig. 2.15), is expected to attract greater numbers of nectar-feeding species such as the flowerpeckers and sunbirds.

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Fig. 2.15. Teruntum merah (*Lumnitzera littorea*) flowers in the mangrove forest zone of the Native Garden @ HortPark. This shrub species attracts numerous flowerpeckers and sunbirds. (Photograph by: Alvin Francis Lok Siew Loon).

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## FISHES

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## INTRODUCTION

Natural freshwater habitats in Singapore consist mainly of freshwater forest streams and patches of freshwater swamp forest, but Singapore lacks any large natural rivers (Yeo et al., 2010). Most of the forest streams are confined to the Bukit Timah Nature Reserve (BTNR) and the Central Catchment Nature Reserve (CCNR), which are still forested but far from pristine. These streams are mainly slow-moving, shaded, shallow, and usually mildly acidic (pH 5–6), flowing over various substrates such as sand (Fig. 3.1), mud, or clay, with accumulations of leaf and wood debris. Freshwater swamp forest streams (Fig. 3.2) have water that is usually stained a weak tea-colour owing to increased levels of tannins, and have lower pH (5–6) because of the higher humic acid inputs from decaying vegetation on the forest floor and stream beds. Freshwater swamp forest waters in Singapore are, however, not as dark or acidic as those of peat swamp forest streams in Malaysia or Indonesia, whose waters are tea-coloured and have a pH range of 3–4.



Fig. 3.1. A sandy-bottomed, semi-closed canopy stream at Sime Road forest. (Photograph by: Alvin Francis Lok Siew Loon).





Fig. 3.2. A slow-moving freshwater swamp forest stream at Nee Soon Swamp Forest. (Photograph by: Alvin Francis Lok Siew Loon).

The freshwater bodies in Singapore are full of aquatic life, with fishes being the most easily observed, although many usually well-hidden invertebrates (e.g. aquatic insects and crustaceans such as crabs and shrimps) do occur as well.

Here, we highlight the hardy native fish species that were introduced at the Native Garden @ HortPark, in the small pond and stream within the freshwater swamp forest zone (Fig. 3.3). In order not to deplete the populations in the nature reserves, these fishes were purchased from a fish importer and thus are probably of Malaysian or Indonesian stock. In the small pond and stream, frog and toad tadpoles and odonate larvae were also observed soon after the area was established.

Fish are wholly aquatic vertebrates that possess gills throughout their life history and use fins for locomotion. Their bodies are usually covered with scales, although there are exceptions (e.g., catfishes lack scales). While most fishes require and utilise dissolved oxygen in water, some fishes such as the walking catfishes (Clariidae), swamp eels (Synbranchidae), anabantoid fishes (Anabantidae, Osphronemidae), and snakeheads (Channidae) utilise atmospheric air, and thus require an open water surface or they will literally drown.



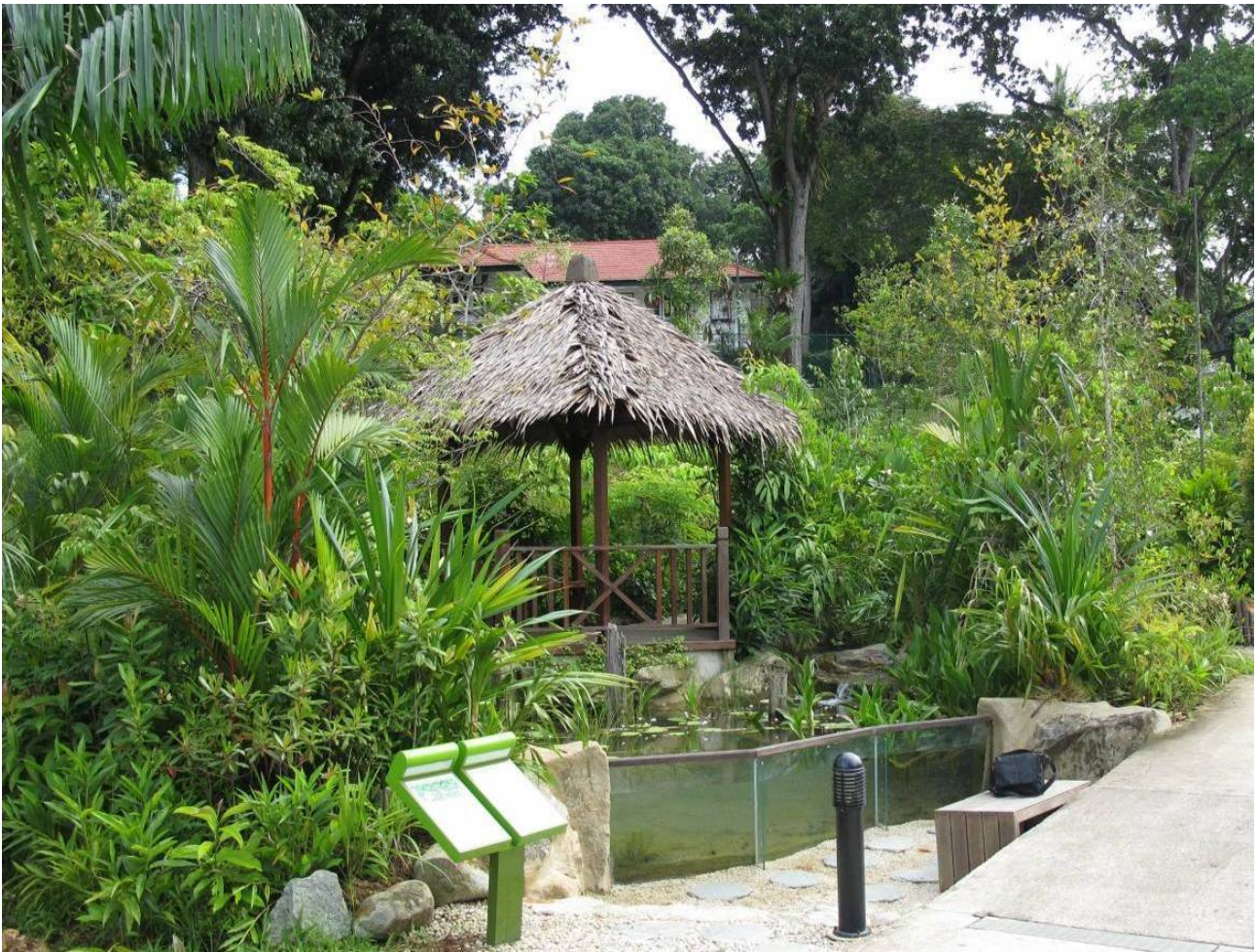


Fig. 3.3. Overall view of the Native Garden @ HortPark, showing the pond area which features freshwater swamp forest plants. (Photograph by: Alvin Francis Lok Siew Loon).

## METHODS

A total of 14 native freshwater fish species (Table 3.1) was introduced into the stream and pond areas of the Native Garden @ HortPark. These fishes are from the families Cyprinidae (carp family), Cobitidae (loach family), Aplocheilidae (toothed-carp family), Hemiramphidae (halfbeak family), Channidae (snakehead family), Anabantidae (climbing perch family), and Osphronemidae (fighting fish, gourami, or pikehead family). Most of the fishes were quarantined before being released into the pond, while the anabantoid fishes were introduced into the pond and the various stream sections that are quite shallow and filled with plant debris.

Although members of the carp family (Cyprinidae) are usually quite sensitive to water temperature, the introduced species were selected from those that are common in the aquarium trade. These tend to be more hardy and tolerant of higher stocking densities, longer durations of direct exposure to sunlight, and the warmer water temperatures, unlike the heavily shaded and cool water temperatures of their natural habitats. These characteristics increase their chances of establishment in the pond and stream areas of the Native Garden @ HortPark.

Each fish description includes its scientific name, common name, scientific family name, common family name, adult description, diet, typical behaviour, habitat, natural distribution, and national conservation status. In the figure legends, the following abbreviation is used: TBL = total body length from the tip of the mouth to the tip of the caudal or tail fin (Fig. 3.4).



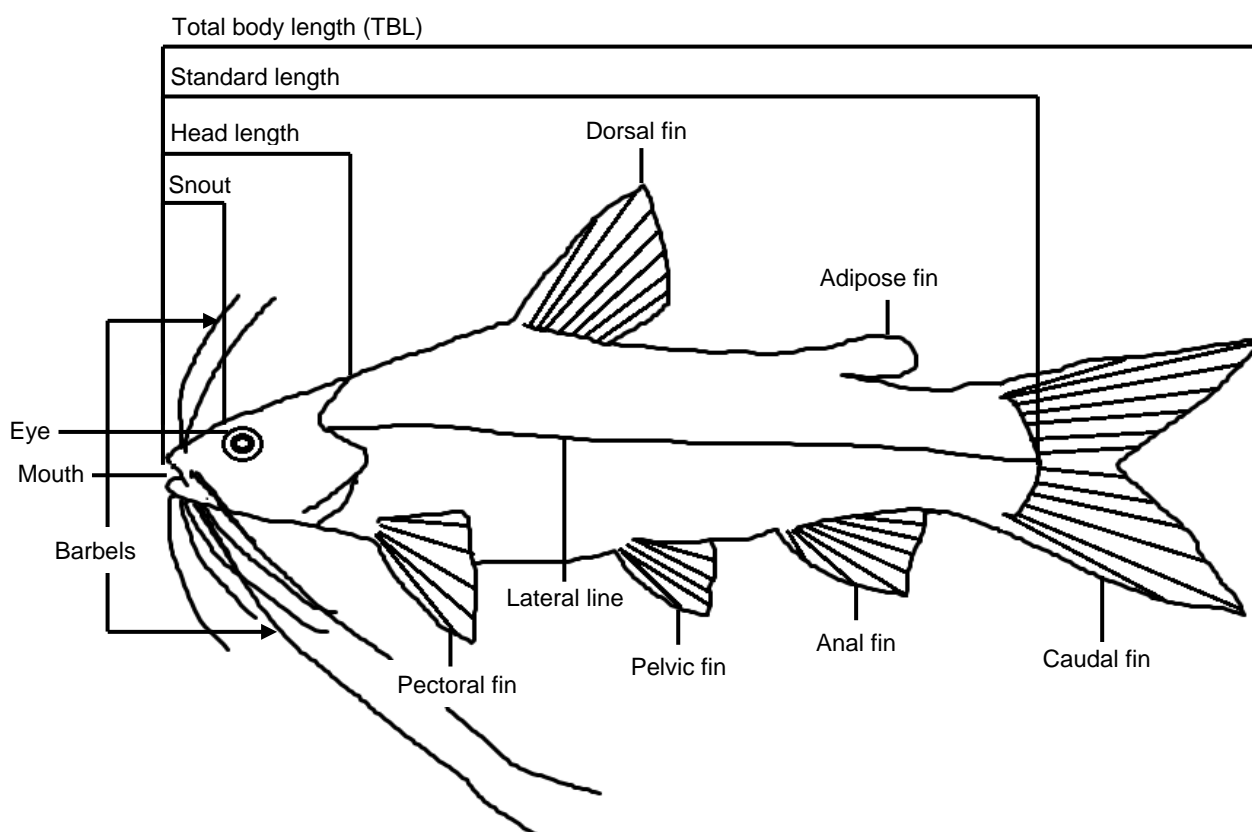


Fig. 3.4. General parts of a fish. (Adapted from Lim & Ng [1990]).

Table 3.1. Native fishes of the Native Garden @ HortPark.

S/No.	Scientific Name	Common Name	Family	Local Status
1.	<i>Anabas testudineus</i>	Asian climbing perch	Anabantidae	Widespread and common
2.	<i>Aplocheilichthys panchax</i>	whitespot	Aplocheilidae	Widespread and common
3.	<i>Betta pugnax</i>	forest fighting fish	Osphronemidae	Restricted to a few areas but common
4.	<i>Channa gachua</i>	dwarf snakehead	Channidae	Restricted to a few areas and rare
5.	<i>Dermogenys collettei</i>	Malayan pygmy halfbeak	Hemiramphidae	Widespread and common
6.	<i>Luciocephalus pulcher</i>	Malayan pikehead	Osphronemidae	Restricted to a few areas and rare
7.	<i>Pangio semicincta</i>	banded eel-loach, banded coolie loach, Malayan banded eel-loach	Cobitidae	Indeterminate
8.	<i>Systomus lateristriga</i>	spanner barb, T-barb	Cyprinidae	Restricted to a few areas and rare
9.	<i>Rasbora elegans</i>	two-spot rasbora	Cyprinidae	Restricted to a few areas but common
10.	<i>Systomus hexazona</i>	six-banded tiger barb	Cyprinidae	Restricted to a few areas but common
11.	<i>Trichopodus trichopterus</i>	three-spot gourami, sepat	Osphronemidae	Widespread and common
12.	<i>Trichopsis vittata</i>	croaking gourami	Osphronemidae	Widespread and common
13.	<i>Trigonostigma heteromorpha</i>	harlequin rasbora	Cyprinidae	Restricted to a few areas but common

## ANNOTATED LIST OF FRESHWATER FISH SPECIES

**Scientific name:** *Anabas testudineus* (Bloch, 1792) (Fig. 3.5)

**Common name:** Asian climbing perch

**Scientific family name:** Anabantidae

**Common family name:** climbing perch family

**Description:** The body is somewhat stocky and stout, olive-grey, with the TBL up to about 23 cm. The body is covered with large, hard scales that help in reducing moisture loss when the fish is out of water; otherwise it has a defensive purpose when the fish is submersed. The head is rounded, and the gill covers bear serrated edges and a black spot at the distal edge. Another black spot is present at the base of the caudal fin. The dorsal fin is long, from above the start of the pectoral fins to the caudal fin, the anterior two thirds of which are spiny and the posterior third soft-rayed. The pectoral and pelvic fins are pointed, and clear. The anal fin is long, and the anterior half is spiny, while the posterior half is soft-rayed. The caudal fin is rounded, and soft.

**Diet:** It is carnivorous, consuming small fishes, crustaceans, and insects.

**Typical behaviour:** It is bottom- to mid-dwelling and gregarious or solitary. It breathes air and is able to survive out of water if kept damp. It has been observed to move across open fields in search of new water bodies after heavy rainfall.

**Habitat:** It lives in forest streams and ponds, water bodies in rural areas, and flooded rice fields.

**Natural distribution:** India to Bangladesh, through Indochina to South China, the Philippines, Malaysia, and Indonesia

**National conservation status:** widespread and common

**References:** Mohsin & Ambak (1983); Roberts (1989); Lim & Ng (1990); Kottelat et al. (1993); Inger & Chin (2002); Baker & Lim (2008)



Fig. 3.5. *Anabas testudineus* (Bloch, 1792). TBL = 20 cm. (Photograph by: Nick Baker).



Fig. 3.6. *Aplocheilichthys panchax* (Hamilton, 1822). TBL = 4 cm. (Photograph by: Nick Baker).

**Scientific name:** *Aplocheilichthys panchax* (Hamilton, 1822) (Fig. 3.6)

**Common name:** whitespot

**Scientific family name:** Aplocheilichthyidae

**Common family name:** toothed carp family

**Description:** The body is slender, yellow-brownish or greyish, with the TBL up to about 6 cm. The top of the head is flattened, with the mouth pointing upwards, and a black line along the lower jaw. A shiny white spot is on top of the head, between the rear of the eyes. The dorsal fin is bluish with a basal black spot. The pectoral fins are soft and rounded. The pelvic fins are short, without an elongated tip, and soft. The anal fin is orange only in the distal margin, and squarish. The caudal fin is round and slightly pointed.

**Diet:** It consumes small aquatic invertebrates.

**Typical behaviour:** It is surface-dwelling.

**Habitat:** It is usually in forest streams, rural streams, drains, ponds, reservoirs, and mangrove estuaries.

**Natural distribution:** India to Indochina (including Myanmar and Thailand), to Malaysia and western Indonesia

**National conservation status:** widespread and common

**References:** Mohsin & Ambak (1983); Lim & Ng (1990); Kottelat et al. (1993); Baker & Lim (2008)





Fig. 3.7. *Betta pugnax* (Cantor, 1849). TBL = 6 cm. (Photograph by: Nick Baker).

**Scientific name:** *Betta pugnax* (Cantor, 1849) (Fig. 3.7)

**Common name:** forest fighting fish

**Scientific family name:** Osphronemidae

**Common family name:** gourami family

**Description:** The body is slender, compressed laterally, brown, with varying pattern (either bright greenish blue spots on scales or two horizontal black stripes from head to base of caudal fin), TBL up to about 10 cm. The fins are brownish. The dorsal fin is short and pointed. The pectoral fins are rounded. The pelvic fins are short, with an elongated tip. The anal fin is broad-based with a pointed rear tip. The caudal fin is rounded or lanceolate.

**Diet:** Omnivorous, consumes insects and algae.

**Typical behaviour:** It is a solitary, mouth-brooding, mid-dwelling fish, and usually found among submerged leaf litter.

**Habitat:** It is found in flowing, shaded forest streams, stagnant streams and small pools.

**Natural distribution:** Peninsular Malaysia, Singapore, Sumatra, and Borneo

**National conservation status:** restricted to a few areas but common

**References:** Mohsin & Ambak (1983); Roberts (1989); Lim & Ng (1990); Baker & Lim (2008)





Fig. 3.8. *Channa gachua* (Hamilton, 1822). TBL = up to 15 cm. (Photograph by: Nick Baker).

**Scientific name:** *Channa gachua* (Hamilton, 1822) (Fig. 3.8)

**Common name:** dwarf snakehead

**Scientific family name:** Channidae

**Common family name:** snakehead family

**Description:** The body is slender, and has a broad and dorso-ventrally flattened head. The body is pale brown, with a TBL up to 18 cm. The dorsal, caudal and anal fins are greenish to bluish, and outlined with red or orange. The dorsal fin is broad based, originating from the above pectoral fins to the rear end of the fish's body, excluding the caudal fin. The pectoral fins show black barring, and are rounded. The pelvic fins are small and short, originating slightly below the pectoral fin base. The anal fin is broad-based, originating around midway of body to the base of the caudal peduncle. The caudal fin is rounded.

**Diet:** It is carnivorous, and consumes mainly small fishes, but also taking small insects and crustaceans.

**Typical behaviour:** It is a nocturnal predator, hiding amongst submerged leaves and twigs. It is a mouth brooder, keeping its young in its mouth till they are large enough to fend for themselves.

**Habitat:** It inhabits shaded, shallow, small streams, but also pools in swamp forest.

**Natural distribution:** East and Southeast Asia

**National conservation status:** It is restricted to a few areas and rare. It was presumed to be nationally extinct until its rediscovery in 1989.

**References:** Mohsin & Ambak (1983); Roberts (1989); Lim & Ng (1990); Baker & Lim (2008)



Fig. 3.9. *Dermogenys collettei* (Meisner, 2001). TBL = 5 cm. (Photograph by: Nick Baker).

**Scientific name:** *Dermogenys collettei* (Meisner, 2001) (Fig. 3.9)

**Common name:** Malayan pygmy halfbeak

**Scientific family name:** Hemiramphidae

**Common family name:** halfbeak family

**Description:** The greyish body is slender and the TBL is up to about 7 cm, with the head narrowing to the tip of the mouth. The lower jaw of the mouth is longer and extends further than the upper jaw by at least two times. The dorsal fin of males possesses a red mark, while females have yellow or colourless fins that are short-based, originating just behind the anal fin. The dorsal fin is short and soft, originating far back at the posterior end. The pectoral fins are pointed and soft. The pelvic fins are located around the middle of the body, pointed and clear. The anal fins are short and soft, opposite the dorsal fin. The caudal fin is rounded and clear.

**Diet:** It is carnivorous and consumes mainly insects.

**Typical behaviour:** It is surface-dwelling and usually found in groups.

**Habitat:** It inhabits fresh and brackish waters of forest streams, reservoirs, and mangrove areas.

**Natural distribution:** Peninsular Malaysia, Singapore, and Sumatra

**National conservation status:** widespread and common

**References:** Lim & Ng (1990); Baker & Lim (2008)





Fig. 3.10. *Luciocephalus pulcher* (Gray, 1830). TBL = up to 18 cm. (Photograph by: Nick Baker).

**Scientific name:** *Luciocephalus pulcher* (Gray, 1830) (Fig. 3.10)

**Common name:** Malayan pikehead

**Scientific family name:** Osphronemidae

**Common family name:** gourami family

**Description:** The cylindrical, elongated body has a TBL of up to 18 cm. The head is pointed, with a pointed snout. The body possesses black-brown irregular stripes on the sides. The dorsal side is brown, while the ventral side is whitish, with a thin black stripe running across the body. The dorsal fin is short and pointed, placed far back, opposite the posterior end of the anal fin base. The pectoral fins are pointed and clear. Markings are present on the pelvic and anal fins. The pelvic fins are elongated, and act as feelers. The anal fin is deeply notched. The caudal fin is yellowish with three to five broad vertical black bars. The mouth is capable of telescopic extension to capture fish.

**Diet:** It is carnivorous and mainly consumes small fish and crustaceans.

**Typical behaviour:** It is a surface-dwelling, solitary mouth brooder.

**Habitat:** It inhabits shaded, slow-flowing, acidic forest streams.

**Natural distribution:** Peninsular Malaysia, Singapore, Sumatra, and Borneo

**National conservation status:** restricted to a few areas and rare

**References:** Mohsin & Ambak (1983); Roberts (1989); Lim & Ng (1990); Kottelat et al. (1993); Baker & Lim (2008)



Fig. 3.11. *Pangio semicincta* (Fraser-Brunner, 1940). TBL = 6 cm. (Photograph by: Ang Wee Foong).

**Scientific name:** *Pangio semicincta* (Fraser-Brunner, 1940) (Fig. 3.11)

**Common name:** banded eel-loach, banded coolie loach, Malayan banded eel-loach

**Scientific family name:** Cobitidae

**Common family name:** loach family

**Description:** The body is cylindrical and slender, eel-like, with a TBL of up to about 8 cm. The head has four pairs of barbels. The body is yellow-brown, with 8–15 vertical dark brown bars that do not extend past the mid lateral of the body. Dorsal, pectoral, pelvic, and anal fins are short and rounded. The dorsal fin is placed far back, a little off the anterior base of the anal fins. The pectoral fins are near the operculum of the gills and horizontally placed. Pelvic fins are found around the middle of the body. The anal fins are opposite the posterior end of the dorsal fin. The caudal fin is slightly emarginate.

**Diet:** It is omnivorous and usually consumes small benthic invertebrates.

**Typical behaviour:** This is a bottom-dwelling fish.

**Habitat:** It inhabits slow-flowing forest streams with sandy beds, and usually found in submerged leaf litter and vegetation.

**Natural distribution:** Peninsular Malaysia, Singapore (locally extinct), Sumatra, Java, and Borneo

**National conservation status:** Indeterminate. It was last recorded in 1963.

**References:** Mohsin & Ambak (1983); Roberts (1989); Lim & Ng (1990); Kottelat et al. (1993); Baker & Lim (2008)





Fig. 3.12. *Rasbora elegans* Volz, 1903. TBL = 6–9 cm. (Photograph by: Nick Baker).

**Scientific name:** *Rasbora elegans* Volz, 1903 (Fig. 3.12)

**Common name:** two-spot rasbora

**Scientific family name:** Cyprinidae

**Common family name:** carp family

**Description:** Its body is slender and elongate, with a TBL of up to about 12 cm. The upper half of the body is greyish to dusky brown, and the lower half of body silver. A squarish black spot is found on the mid body between the origins of the dorsal and pelvic fins, and another spot at the base of the forked caudal fin. The transparent dorsal fin is broadly pointed, with a convex posterior margin. The anal, pectoral, and pelvic fins are pointed and transparent. The caudal fin is forked and transparent.

**Diet:** It is insectivorous and consumes aquatic insects.

**Typical behaviour:** It is a mid- to surface-dwelling fish that is usually found in groups.

**Habitat:** It inhabits forest streams.

**Natural distribution:** Peninsular Malaysia, Singapore, Borneo, and Sumatra

**National conservation status:** restricted to a few areas but common

**References:** Mohsin & Ambak (1983); Roberts (1989); Lim & Ng (1990); Kottelat et al. (1993); Inger & Chin (2002); Baker & Lim (2008)





Fig. 3.13. *Systomus hexazona* (Weber & de Beaufort, 1912). TBL = 5 cm. (Photograph by: Tan Heok Hui).

**Scientific name:** *Systomus hexazona* (Weber & de Beaufort, 1912) (Fig. 3.13)

**Common name:** six-banded tiger barb

**Scientific family name:** Cyprinidae

**Common family name:** carp family

**Description:** The body is yellowish silver, rhomboid, with a TBL of up to 5 cm. The body is covered with six black bars throughout its entire length. The first bar originates from above the eye. The second bar originates from the dorsal fin, midway between first and third bar. The third bar originates from the anterior part of dorsal fin base. These three bands are free-ending and do not run fully across the body. The fourth bar originates around the anterior part of the anal fin. The fifth bar forms a ring around the body behind the fourth bar, while the sixth bar also forms a ring, but at the caudal peduncle fin. The dorsal, pelvic, and anal fins are pointed and reddish. The pectoral fins are pointed and clear. The caudal fin is forked and transparent.

**Diet:** It is omnivorous, and consumes small aquatic invertebrates.

**Typical behaviour:** This fish is a mid- to surface-dweller and usually found in groups.

**Habitat:** It inhabits forest streams.

**Natural distribution:** Thailand, Peninsular Malaysia, Singapore, Borneo, and Sumatra

**National conservation status:** restricted to a few areas but common

**References:** Mohsin & Ambak (1983); Lim & Ng (1990); Baker & Lim (2008)



Fig. 3.14. *Sysomus lateristriga* (Valenciennes, 1842). TBL = up to 18 cm. (Photograph by: Nick Baker).

**Scientific name:** *Sysomus lateristriga* (Valenciennes, 1842) (Fig. 3.14)

**Common name:** spanner barb, T-barb

**Scientific family name:** Cyprinidae

**Common family name:** carp family

**Description:** The body is silvery, rhomboidal, with a TBL of up to 18 cm. There is one black bar that runs about halfway down the body between the head and the dorsal fin, and another black bar that runs down the body at the start of the dorsal fin. A black stripe originates from the base of the caudal fin, running mid-laterally across the posterior half of the body and ending just slightly behind the black vertical band near the dorsal fin. The dorsal fin is broad, pointed, and clear. The pectoral, pelvic, and anal fins are pointed and transparent. The caudal fin is forked and transparent.

**Diet:** This fish is omnivorous and usually consumes small aquatic invertebrates.

**Typical behaviour:** It is a near bottom to mid-water level dweller, fast-swimming, and usually found in groups.

**Habitat:** It inhabits forest streams, hill streams, and is found below waterfalls.

**Natural distribution:** Thailand, Peninsular Malaysia, Singapore, Sumatra, Java, Banka, and Borneo

**National conservation status:** restricted to a few areas and rare

**References:** Mohsin & Ambak (1983); Roberts (1989); Lim & Ng (1990); Kottelat et al. (1993); Inger & Chin (2002); Baker & Lim (2008)





Fig. 3.15. *Trichopodus trichopterus* (Pallas, 1770). TBL = 12 cm. (Photograph by: Nick Baker).

**Scientific name:** *Trichopodus trichopterus* (Pallas, 1770) (Fig. 3.15)

**Common name:** three-spot gourami, sepat

**Scientific family name:** Osphronemidae

**Common family name:** gourami family

**Description:** The body is ovoid, laterally compressed, silvery grey with a bluish sheen, with a TBL of up to 15 cm. Numerous broken, faintly-marked, thin transverse grey bars are found on the body. A black spot is found in the middle of body and at the base of the caudal fin. The pelvic fins are thread-like, and used as a tactile organ. The dorsal fin is soft. The fins are brown, and the pelvic fin is also yellowish. The pectoral fins are usually transparent. The caudal fin is slightly emarginate or truncate.

**Diet:** It is omnivorous and usually consumes small aquatic invertebrates.

**Typical behaviour:** It is a mid- to surface-dwelling, air-breathing fish that usually occurs in groups.

**Habitat:** It inhabits forest and rural streams, ponds, and reservoirs.

**Natural distribution:** Thailand, throughout Indochina to Peninsular Malaysia, Singapore, Sumatra, Java, and Borneo

**National conservation status:** widespread and common

**References:** Mohsin & Ambak (1983); Roberts (1989); Lim & Ng (1990); Kottelat et al. (1993); Inger & Chin (2002); Baker & Lim (2008)



Fig. 3.16. *Trichopsis vittata* (Cuvier, 1831). TBL = 5 cm. (Photograph by: Nick Baker).

**Scientific name:** *Trichopsis vittata* (Cuvier, 1831) (Fig. 3.16)

**Common name:** croaking gourami

**Scientific family name:** Osphronemidae

**Common family name:** gourami family

**Description:** The body is slender, compressed laterally, greyish brown, with four horizontal black stripes from head to base of caudal fin, with the TBL to about 6 cm. Head pointed. Caudal fin lanceolate, anal fin broad-based with pointed rear tip with red markings. Base of dorsal fin short, originating from opposite the anterior base of anal fins, pointed, soft, and clear. Pelvic fins soft, extending into a pointed tip. Pectoral fins rounded and clear. Eye with bright blue ring.

**Diet:** It is omnivorous, and usually consumes small aquatic invertebrates.

**Typical behaviour:** Surface-dwelling, gregarious or singly. Males produce soft croaking sounds during breeding season.

**Habitat:** It inhabits forest and rural streams, drains, ponds and reservoirs.

**Natural distribution:** Throughout Indochina, Peninsular Malaysia, Singapore, Sumatra, Java, and Borneo

**National conservation status:** Widespread and common. This species is usually an indication of human disturbance.

**References:** Mohsin & Ambak (1983); Lim & Ng (1990); Kottelat et al. (1993); Baker & Lim (2008)





Fig. 3.17. *Trigonostigma heteromorpha* (Duncker, 1904). TBL = 4.5 cm. (Photograph by: Nick Baker).

**Scientific name:** *Trigonostigma heteromorpha* (Duncker, 1904) (Fig. 3.17)

**Common name:** Harlequin rasbora

**Scientific family name:** Cyprinidae

**Common family name:** carp family

**Description:** The body is pinkish, rhomboid, with a TBL up to about 5 cm. The abdomen is silvery, and the posterior half of body is covered by a black triangular blotch that extends to the base of the forked caudal fin. A small vertical black mark is also present behind the gill cover. The dorsal and caudal fins are reddish orange, and the other fins are pointed and transparent.

**Diet:** This fish is omnivorous and usually consumes small aquatic invertebrates.

**Typical behaviour:** It is a mid to surface dweller and usually found in groups.

**Habitat:** It inhabits forest streams.

**Natural distribution:** Peninsular Malaysia, Singapore, Borneo, and Sumatra

**National conservation status:** restricted to a few areas but common

**References:** Mohsin & Ambak (1983); Lim & Ng (1990); Kottelat et al. (1993); Baker & Lim (2008)

## DISCUSSION

Anabantoid fishes, such as the climbing perch (*Anabas testudineus*; Fig. 3.5), forest fighting fish (*Betta pugnax*; Fig. 3.7), Malayan pikehead (*Luciocephalus pulcher*; Fig. 3.10), three-spot gourami (*Trichopodus trichopterus*; Fig. 3.15), croaking gourami (*Trichopsis vittata*; Fig. 3.16), and other species such as the dwarf snakehead (*Channa gachua*; Fig. 3.8), whitespot (*Aplocheilichthys panchax*; Fig. 3.6), and the Malayan halfbeak (*Dermogenys collettei*; Fig. 3.9), were preferred candidates for introduction into the pond at the Native Garden @ HortPark, as these have a higher tolerance to low dissolved oxygen levels or have the ability to utilise atmospheric air to breathe. This is important, as water circulation within the plot is powered by three submerged impeller-driven pumps that can fail if a power trip occurs, and this can result in a massive fish kill if species are susceptible to low oxygen levels. Inclusion of more species of anabantoid fishes can also help ensure that these fish do not compete with the other co-inhabitants (especially members of the carp family) in that pond, especially when the pumps fail.

Predatory fishes such as the climbing perch, Malayan pikehead, and the dwarf snakehead were also introduced to control the exotic fan-tailed guppy population that was introduced by members of the public. (Publicly accessible water bodies inevitably become repositories of 'donated' fish species presented by public members, so this is something that has to be tolerated.) Although these predatory fish will also feed on the other native species introduced to the plot, the fan-tailed guppies would more likely fall prey to these predators as they are slower swimming because of their large fantail. The predatory species would also help keep the other fish populations in check. To prevent future introduction of exotic fauna into the pond, an educational sign was installed to advise members of the public against the releasing of any fauna into the pond water. An electronic fish feeder that dispenses small, dried feeding pellets twice per day was also installed to supplement the food of the fishes.

It was a deliberate measure to ensure that all the strata of the pond water were occupied by various levels of inhabitants, that is, bottom-dwelling species such as the banded eel-loach (*Pangio semicincta*; Fig. 3.11) were introduced with surface-dwellers such as the whitespot, Malayan pygmy halfbeak, and the croaking gourami, while most of the other species fill all the other layers in between. The behaviours also vary greatly from species to species introduced and these are included in the species descriptions given above.

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## HERPTILES: AMPHIBIANS AND REPTILES

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### INTRODUCTION

Amphibians and reptiles (classes Amphibia and Reptilia, respectively) are often grouped together as herpetofauna or herptiles (the biological study of amphibians and reptiles being known as herpetology), perhaps owing to their superficial similarities in appearance. However, these two groups of vertebrates (i.e., animals with backbones, as opposed to invertebrates such as insects) have very different life cycle stages and characteristics. In this chapter, we will introduce the most commonly encountered amphibian and reptile species at the Native Garden @ HortPark.

The biggest distinguishing feature between the amphibians and the reptiles is the former's reliance on water for a part of their life cycle. Amphibians (Greek *amphi*-, on both sides; Greek *bios*, life) undergo a water-breathing larval stage, before transforming (or metamorphosing) into an air-breathing adult stage. This means that most amphibians are never too far away from reliable water sources for reproduction. An easily recognisable example is the aquatic tadpole and the adult frog. Conversely, this does not occur in reptiles, with all free-living forms breathing air. This is made possible by the development of an amniotic egg with a tough layer of eggshell, allowing the embryo to develop within a sheltered environment despite drier conditions on land. However, there are exceptions to the generalisations above. For instance, some frogs undergo direct development, with the eggs hatching into miniature adults without going through the tadpole stage, while some snakes give birth to live young instead of producing eggs.

Another notable feature of the reptiles is the presence of protective scales and/or scutes (bony plates) on their watertight skin. This is in contrast to the permeable skin of amphibians, which allows amphibians to absorb oxygen through their skin in moist conditions. While most amphibians lack scales altogether, the worm-like caecilians have a unique type of scales within their skin.

Modern day amphibians consist of three orders: Anura (frogs and toads), Caudata (salamanders; which do not occur in Singapore), and Gymnophiona (caecilians). A total of 28 amphibian species can be found in Singapore, with 27 species of anurans and one species of caecilian. While the majority of amphibian species are found mainly in forested areas, a good number of them are adapted to open habitats and can be readily found in gardens and fields. Additionally, most amphibians are active during the night (i.e., nocturnal) and that means that the best time to see and hear amphibians is after a light drizzle at dusk.

There are four orders of reptiles, namely Crocodilia (crocodiles and alligators), Sphenodontia (the tuatara, which occurs only in New Zealand), Squamata (snakes and lizards), and Testudines (turtles and tortoises). A total of 98 reptilian species can be found in Singapore. Snakes and lizards form the majority of the reptiles in Singapore. Unlike the amphibians which are mainly nocturnal, a sizable proportion of lizards are active at any time of the day. For instance, the geckoes are predominately nocturnal but the skinks and monitor lizards are active during the day (i.e., diurnal). The same can be said for snakes, with different species active at different periods. While snakes are often feared for their venomous nature, only a handful of species are highly venomous in Singapore (including



cobras, pit vipers, coral snakes, and some species of keelbacks). It is, therefore, unnecessary to kill them on sight. Snakes also do humans the service of preying on unwanted pests like pest rodents.

This chapter will catalogue the recruitment of amphibians and reptiles over an eight month period, through a survey conducted at the Native Garden @ HortPark. This survey will ascertain how effective a well-vegetated, artificially created habitat in an urban setting is in attracting amphibians and reptiles, from the initial stages of being set up and over an eight month maturation phase of the system.

## METHODS

From 10 May to 9 December 2010, visits were made to the Native Garden @ HortPark. A visual daytime census was then made for about 30 minutes to an hour, by walking around the plot. Surveys were also conducted at night for nocturnal frogs and geckos. Besides nocturnal visual surveys, frogs were also located and identified from their nocturnal calls and from daytime tadpole surveys in water bodies (the pond and stream areas). Gecko surveys were done mainly around lighting fixtures at night, where the light attracts insects and, indirectly, the geckos that prey on them. The small gazebo was also observed during the day and night periods for geckos that hide in the joints near the supporting beams. Snakes, on the other hand, were mainly chance encounters during sporadic visits to the plots, and which were duly noted.

Each herptile description includes its scientific name, common name, scientific family name, common family name, adult description, tadpole description (for amphibians only), diet, typical behaviour, habitat, natural distribution, and national conservation status. A measure of body size that is widely used in herpetology is the snout-vent length (SVL), that is, the length from the tip of the snout to the posterior opening of the animal. The other common measure that is used is the tail length, simply the length of the part of the body after the posterior opening. This set of simple measures does not imply that amphibians and reptiles have similar body forms. In fact, their body forms are diverse, particularly within the reptiles. In the figure legends, the following abbreviations are used: SVL = snout to vent length, and TL = total length from the snout to the tip of the tail.

## OBSERVATIONS

A total of 16 herptiles, comprising four amphibians (Table 4.1), seven lizards (Table 4.2), and five snakes (Table 4.3) were recorded from the Native Garden @ HortPark during the period of survey. The annotated lists of amphibians, lizards, and snakes follow.

Table 4.1. Native amphibians of the Native Garden @ HortPark.

S/No.	Scientific Name	Common Name	Family	Local Status
1.	<i>Duttaphrynus melanostictus</i>	Asian toad	Bufonidae	Widespread and common
2.	<i>Fejervarya limnocharis</i>	field frog, grass frog	Dicroglossidae	Widespread and common
3.	<i>Microhyla heymonsi</i>	dark-sided chorus frog	Microhylidae	Widespread and common
4.	<i>Polypedates leucomystax</i>	four-lined tree frog, common tree frog	Rhacophoridae	Widespread and common

Table 4.2. Native lizards of the Native Garden @ HortPark.

S/No.	Scientific Name	Common Name	Family	Local Status
1.	<i>Cosymbotes platyurus</i>	flat-tailed gecko	Gekkonidae	Widespread and common
2.	<i>Draco sumatranus</i>	common flying dragon, Sumatran flying dragon	Agamidae	Widespread and common
3.	<i>Eutropis multifasciatus</i>	common sun skink, many-lined sun skink	Scincidae	Widespread and common
4.	<i>Gehyra mutilata</i>	four-clawed gecko	Gekkonidae	Widespread and common
5.	<i>Gekko monarchus</i>	spotted house gecko	Gekkonidae	Widespread and common
6.	<i>Hemidactylus frenatus</i>	spiny-tailed gecko, common house gecko	Gekkonidae	Widespread and common
7.	<i>Lepidodactylus lugubris</i>	maritime gecko, mourning gecko	Gekkonidae	Widespread and restricted

Table 4.3. Native snakes of the Native Garden @ HortPark.

S/No.	Scientific Name	Common Name	Family	Local Status
1.	<i>Ahaetulla prasina</i>	Oriental whip snake	Colubridae	Widespread and common
2.	<i>Chrysopelea paradisi</i>	paradise tree snake	Colubridae	Widespread and common
3.	<i>Dendrelaphis kopsteini</i>	red-necked bronzeback, Kopstein's bronzeback	Colubridae	Widespread and restricted
4.	<i>Dendrelaphis pictus</i>	painted bronzeback	Colubridae	Widespread and common
5.	<i>Lycodon capucinus</i>	house snake, common wolf snake	Colubridae	Widespread and common



**ANNOTATED LIST OF AMPHIBIAN SPECIES**

**Scientific name:** *Duttaphrynus melanostictus* (Schneider, 1799) (Fig. 4.1)

**Common name:** Asian toad

**Scientific family name:** Bufonidae

**Common family name:** true toad family

**Adult description:** The body is stout and warty, with SVL about 11 cm. The dorsal side and limbs are grey to yellow-brown, and its belly is whitish. The head possesses two black low ridges on top, and a raised, oval-shaped poison gland at the sides. The hind limbs are rather short and slender, with webbing between the digits of the feet.

**Tadpole description:** The body is black throughout and moderately flattened, ovoid from above, with SVL up to 2.5 cm. The tail is about the same length as the body, with a broadly rounded tip.

**Diet:** It is insectivorous.

**Typical behaviour:** This is a terrestrial and nocturnal toad.

**Habitat:** It inhabits disturbed forests, agricultural lands, urban areas, and coastal areas. This is the most common amphibian of urban Singapore.

**Natural distribution:** Southwestern and southern China (including Taiwan and Hainan), throughout South Asia from northern Pakistan and Nepal through India to Sri Lanka, Andaman Islands, Maldives, and Peninsular Malaysia, Sumatra, Java, Borneo, and Bali, from sea level up to 2000 m

**National conservation status:** widespread and common

**References:** Lim & Lim (1992); Leong & Chou (1999); Baker & Lim (2008)



Fig. 4.1. *Duttaphrynus melanostictus* (Schneider, 1799). SVL = 11 cm. (Photograph by: Norman Lim T-Lon).





Fig. 4.2. *Fejervarya limnocharis* (Gravenhorst, 1829). SVL = 6 cm. (Photograph by: Norman Lim T-Lon).

**Scientific name:** *Fejervarya limnocharis* (Gravenhorst, 1829) (Fig. 4.2)

**Common name:** field frog, grass frog

**Scientific family name:** Dicroglossidae

**Common family name:** true frog family

**Adult description:** The body is warty, and SVL up to 6 cm. The head is elongated, and the dorsal side is greyish or brown with irregular dark patches and ridges. The hind legs are long and muscular. Adult males possess a dark band across the throat between the corners of the jaw.

**Tadpole description:** The body is olive-green to grey, with brown or black speckles on the dorsal side, while the belly is silver. The body is moderately flattened, ovoid from above, and the SVL up to 4 cm. The tail is about 1.5 times to twice the length of the body.

**Diet:** This is a carnivorous frog.

**Typical behaviour:** This is a terrestrial, nocturnal frog.

**Habitat:** It inhabits forest clearings, agricultural land, road ditches, urban parks, and other human disturbed habitats.

**Natural distribution:** Sri Lanka, India, Myanmar, through Indochina to southern China, Taiwan and Japan, south to the Philippines, Peninsular Malaysia, Singapore, to Sumatra, Java, and Borneo

**National conservation status:** widespread and common

**References:** Lim & Lim (1992); Leong & Chou (1999); Baker & Lim (2008)





Fig. 4.3. *Microhyla heymonsi* Vogt, 1911. SVL = 2.5 cm. (Photograph by: Norman Lim T-Lon).

**Scientific name:** *Microhyla heymonsi* Vogt, 1911 (Fig. 4.3)

**Common name:** dark-sided chorus frog

**Scientific family name:** Microhylidae

**Common family name:** narrow-mouthed frog family

**Adult description:** The body has a SVL up to 2.5 cm, with a white belly. The head is small. The dorsal side is yellow-brown, while the lateral sides are black, with a thin white line between dorsal and lateral sides. The hind legs are long and slim, with brown bands.

**Tadpole description:** The body is pale brown and ovoid, and the SVL about 1 cm. The dorsal side bears a distinct white iridescent band between the eyes. The tail is about twice the length of the body.

**Diet:** It is insectivorous.

**Typical behaviour:** This is a terrestrial, nocturnal frog.

**Habitat:** It inhabits disturbed forests, agricultural lands, and urban areas.

**Natural distribution:** Southern China and Taiwan, through Indochina to Peninsular Malaysia, Singapore, and Sumatra

**National conservation status:** widespread and common

**References:** Lim & Lim (1992); Leong & Chou (1999); Baker & Lim (2008)



Fig. 4.4. *Polypedates leucomystax* (Gravenhorst, 1829). SVL = 7.5 cm. (Photograph by: Norman Lim T-Lon).

**Scientific name:** *Polypedates leucomystax* (Gravenhorst, 1829) (Fig. 4.4)

**Common name:** four-lined tree frog, common tree frog

**Scientific family name:** Rhacophoridae

**Common family name:** Afro-Asian tree frog family

**Adult description:** The body smooth, brown, grey or yellow on the dorsal side and the SVL is up to 7.5 cm. The body has four thin blackish stripes on its dorsal surface, although it is sometimes absent. The limbs are long and slim, with the digits on the feet possessing expanded tips.

**Tadpole description:** The body has a SVL up to 5 cm. Its dorsal side is greyish green to brown, mottled and flattened. The ventral side is silvery white and rounded. The tail is about twice the length of the body, and narrowly pointed.

**Diet:** This is an insectivorous frog.

**Typical behaviour:** This is an arboreal, nocturnal species.

**Habitat:** It inhabits disturbed forests, agricultural lands, and urban areas.

**Natural distribution:** Southern China through Indochina to Peninsular Malaysia, Singapore, Sumatra, Java, Borneo, and the Philippines

**National conservation status:** widespread and common

**References:** Lim & Lim (1992); Leong & Chou (1999); Baker & Lim (2008)



**ANNOTATED LIST OF LIZARD SPECIES**

**Scientific name:** *Cosymbotes platyurus* (Schneider, 1972) (Fig. 4.5)

**Common name:** flat-tailed gecko

**Scientific family name:** Gekkonidae

**Common family name:** gecko family

**Adult description:** The body has TL of up to 12 cm, with a fringe of skin along the sides of the body. The tail is relatively flat with serrated edges. The body colour is variable, ranging from uniform pale grey to grey with dark grey streaks and mottles.

**Diet:** This is an insectivorous lizard.

**Typical behaviour:** This is an arboreal, nocturnal species.

**Habitat:** It inhabits urban or wooded areas.

**Natural distribution:** Peninsular Malaysia, Singapore, Sumatra, Java, Borneo, and the Philippines

**National conservation status:** widespread and common

**References:** Lim & Lim (1992); Baker & Lim (2008)



Fig. 4.5. *Cosymbotes platyurus* (Schneider, 1972). TL = 12 cm. (Photograph by: Norman Lim T-Lon).

**Scientific name:** *Draco sumatranus* Schlegel, 1844 (Fig. 4.6)

**Common name:** common flying dragon, Sumatran flying dragon

**Scientific family name:** Agamidae

**Common family name:** agamid lizard family

**Adult description:** The body is slender with long slender limbs, and has a TL up to 22 cm. A broad flap of skin (the patagium, or gliding membrane) supported by ribs extends from both sides of the body. The dorsal side is light brown with whitish and dark brown spots. The patagium is black with irregular brownish and greenish blotches. Males have bluish heads and a large yellow throat flap, while females have a small blue throat flap.

**Diet:** It is insectivorous, and it includes ants and termites in its diet.

**Typical behaviour:** This is an arboreal, diurnal lizard.

**Unique characteristics:** The flying dragons are named for their ability to glide from tree to tree by extending the patagium on both sides of their bodies like “wings”.

**Habitat:** It inhabits forest edges and urban gardens.

**Natural distribution:** Malay Peninsula, including Singapore, Borneo, Sumatra, and Palawan

**National conservation status:** widespread and common

**References:** Lim & Lim (1992); Baker & Lim (2008)



Fig. 4.6. *Draco sumatranus* Schlegel, 1844. TL = 22 cm. (Photograph by: Alvin Francis Lok Siew Loon).





Fig. 4.7. *Eutropis multifasciatus* (Kuhl, 1820). TL = 35 cm. (Photograph by: Norman Lim T-Lon).

**Scientific name:** *Eutropis multifasciatus* (Kuhl, 1820) (Fig. 4.7)

**Common name:** common sun skink, many-lined sun skink

**Scientific family name:** Scincidae

**Common family name:** skink family

**Adult description:** The body is robust, bronze-brown, with or without a series of fine black stripes along the back, and has shiny scales. It has a TL of up to 35 cm. Both sides of the body are either blackish with white spots or with a patch of orange from ear to hind legs.

**Diet:** It is insectivorous.

**Typical behaviour:** This is a terrestrial, diurnal lizard.

**Habitat:** It inhabits wooded areas, mangrove forests, and parkland.

**Natural distribution:** Southern China, north-eastern India, and throughout Southeast Asia

**National conservation status:** widespread and common

**References:** Lim & Lim (1992); Baker & Lim (2008)

**Scientific name:** *Gehyra mutilata* (Wiegmann, 1835) (Fig. 4.8)

**Common name:** four-clawed gecko

**Scientific family name:** Gekkonidae

**Common family name:** gecko family

**Adult description:** The body has a TL of up to 12 cm, with no spines or serrations on the tail, and only four-clawed digits on the fore feet. The body colour is variable, but is generally translucent pinkish brown.

**Diet:** It is insectivorous.

**Typical behaviour:** This is an arboreal, nocturnal lizard.

**Habitat:** It inhabits urban areas, wooded areas.

**Natural distribution:** Southeast Asia and Oceania

**National conservation status:** widespread and common

**References:** Lim & Lim (1992); Baker & Lim (2008)

**Scientific name:** *Gekko monarchus* Duméril & Bibron, 1836 (Fig. 4.9)

**Common name:** spotted house gecko

**Scientific family name:** Gekkonidae

**Common family name:** gecko family

**Adult description:** The body is relatively robust and covered with warts. It has a TL of up to 22 cm. The body colour is pale greyish-brown with seven to nine pairs of blackish blotches along the back and has blackish bars on the tail.

**Diet:** It is insectivorous.

**Typical behaviour:** This is an arboreal, nocturnal lizard.

**Habitat:** It inhabits disturbed forests, scrubland, and park areas.

**Natural distribution:** Peninsular Malaysia, Singapore, Sumatra, Java, Borneo, and the Philippines

**National conservation status:** widespread and common

**References:** Lim & Lim (1992); Baker & Lim (2008)

**Scientific name:** *Hemidactylus frenatus* Duméril & Bibron, 1836 (Fig. 4.10)

**Common name:** spiny-tailed gecko, common house gecko

**Scientific family name:** Gekkonidae

**Common family name:** gecko family

**Adult description:** The body has a TL of up to 13 cm. The tail has a series of spiky tubercles along its length. The body colour is variable, but is generally pale greyish-brown with irregular dark grey streaks and mottles.

**Diet:** It is insectivorous.

**Typical behaviour:** This is an arboreal, nocturnal lizard.

**Habitat:** It inhabits urban or wooded areas.

**Natural distribution:** Tropical Asia

**National conservation status:** widespread and common

**References:** Lim & Lim (1992); Baker & Lim (2008)





Fig. 4.8. *Gehyra mutilata* (Wiegmann, 1835). TL = 12 cm. (Photograph by: Norman Lim T-Lon).



Fig. 4.9. *Gekko monarchus* Duméril & Bibron, 1836. TL = 22 cm. (Photograph by: Norman Lim T-Lon).



Fig. 4.10. *Hemidactylus frenatus* Duméril & Bibron, 1836. TL = 13 cm. (Photograph by: Norman Lim T-Lon).



Fig. 4.11. *Lepidodactylus lugubris* (Duméril & Bibron, 1836). TL = 10 cm. (Photograph by: Norman Lim T-Lon).

**Scientific name:** *Lepidodactylus lugubris* (Duméril & Bibron, 1836) (Fig. 4.11)

**Common name:** maritime gecko, mourning gecko

**Scientific family name:** Gekkonidae

**Common family name:** gecko family

**Adult description:** The body is slender, with a pair of black spots on the nape and a TL of up to 10 cm. The body colour is pale greyish-brown with black flecks and it has irregular black-edged yellowish bands on the tail.

**Diet:** It is insectivorous.

**Typical behaviour:** This is an arboreal, nocturnal lizard.

**Unique characteristics:** This is an all-female species that reproduces asexually via parthenogenesis.

**Habitat:** It inhabits coastal forests, scrubland, mangrove forests, and urban areas.

**Natural distribution:** Sri Lanka to Maldives, and Southern China, throughout Southeast Asia, New Guinea, and the tropical South Pacific Islands

**National conservation status:** widespread and restricted

**References:** Lim & Lim (1992); Baker & Lim (2008)



**ANNOTATED LIST OF SNAKE SPECIES**

**Scientific name:** *Ahaetulla prasina* (Boie, 1827) (Fig. 4.12)

**Common name:** Oriental whip snake

**Scientific family name:** Colubridae

**Common family name:** rear-fanged snake family

**Adult description:** The body is very slender and has a TL of up to 1.9 m. The head has a pointed snout (about twice as long as the width of the eye). The pupil of the eye is horizontally elongated. Juveniles are yellow to pale brown, becoming fluorescent green above when adult. The ventrum is pale green with a pair of yellow stripes. It is very similar in appearance to *Ahaetulla myerizans*, which occurs in forest interiors and has a snout about 1.5 times the width of the eye.

**Diet:** It is carnivorous, and its diet includes frogs, lizards, and small birds.

**Typical behaviour:** This is an arboreal, diurnal snake.

**Unique characteristics:** This snake gives birth to live young.

**Habitat:** It inhabits wooded areas, and suburban parks, and gardens.

**Natural distribution:** Eastern India, Myanmar, southern China, Thailand and Indochina, the Philippines, Peninsular Malaysia, Singapore, Borneo, Sumatra, Java, and Sulawesi

**National conservation status:** widespread and common

**References:** Lim & Lim (1992); Baker & Lim (2008)

**Scientific name:** *Chrysopelea paradisi* Boie, 1827 (Fig. 4.13)

**Common name:** paradise tree snake

**Scientific family name:** Colubridae

**Common family name:** rear-fanged snake family

**Adult description:** The body is black above with a green or yellow spot on each dorsal scale and has TL to 1.3 m. Some individuals also have a row of red spots along the middle of the back. The head is relatively flat, with five yellow bands on the head and snout.

**Diet:** It is carnivorous and its diet includes lizards and small birds.

**Typical behaviour:** This is an arboreal, diurnal snake.

**Unique characteristics:** This is one of the two “flying snakes” in Singapore, where the snake can flatten its ribcage and increase its ventral surface area for gliding.

**Habitat:** It inhabits forests, scrubland, mangrove forests, and urban gardens.

**Natural distribution:** Malay Peninsula, including Singapore, Borneo, Sumatra, Java, Sulawesi, and the Philippines

**National conservation status:** widespread and common

**References:** Lim & Lim (1992); Baker & Lim (2008)

**Scientific name:** *Dendrelaphis kopsteini* Vogel & van Rooijen, 2007 (Fig. 4.14)

**Common name:** red-necked bronzeback, Kopstein’s bronzeback

**Scientific family name:** Colubridae

**Common family name:** rear-fanged snake family

**Adult description:** The body is slender with a TL of up to about 1.4 m, and a pair of large eyes. The body is bronze brown above, with a orange-red neck region. A black streak runs from the side of the head and ends at the fore part of the neck. The underside is yellowish green on the front half and dull green to brown on the rear.

**Diet:** It is carnivorous and its diet includes frogs and lizards.

**Typical behaviour:** This is an arboreal, diurnal snake.

**Habitat:** It inhabits forests, scrubland, and gardens.

**Natural distribution:** Malay Peninsula, including Singapore, and Sumatra

**National conservation status:** widespread and restricted

**References:** Lim & Lim (1992); Baker & Lim (2008)



Fig. 4.12. *Ahaetulla prasina* (Boie, 1827). TL = 1.9 m. (Photograph by: Alvin Francis Lok Siew Loon).





Fig. 4.13. *Chrysopelea paradisi* Boie, 1827. TL = 1.3 m. (Photographs by: Nick Baker).



Fig. 4.14. *Dendrelaphis kopsteini* Vogel & van Rooijen, 2007. TL = 1.4 m. (Photograph by: Norman Lim T-Lon).





Fig. 4.15. *Dendrelaphis pictus* (Gmelin, 1789). TL = 1 m. (Photograph by: Norman Lim T-Lon).

**Scientific name:** *Dendrelaphis pictus* (Gmelin, 1789) (Fig. 4.15)

**Common name:** painted bronzeback

**Scientific family name:** Colubridae

**Common family name:** rear-fanged snake family

**Adult description:** The body is bronze-brown above with a yellowish-white stripe on both sides and has a TL of up to approximately 1 m. A black stripe begins on the snout, passes through the eye, and runs along the side of the body above the top margin of the whitish stripe. The underside is yellow or greenish.

**Diet:** This is carnivorous and its diet includes frogs and lizards.

**Typical behaviour:** This is an arboreal, diurnal snake.

**Habitat:** It inhabits forests, agricultural lands, urban areas.

**Natural distribution:** Southern China, through Indochina, Peninsular Malaysia, Singapore, Sumatra, Borneo, Java, Sulawesi, to Timor, and the Philippines

**National conservation status:** widespread and common

**References:** Lim & Lim (1992); Baker & Lim (2008)





Fig. 4.16. *Lycodon capucinus* Boie, 1827. TL = 76 cm. (Photograph by: Norman Lim T-Lon).

**Scientific name:** *Lycodon capucinus* Boie, 1827 (Fig. 4.16)

**Common name:** house snake, common wolf snake

**Scientific family name:** Colubridae

**Common family name:** rear-fanged snake family

**Adult description:** This species has a TL of up to 76 cm. It has a relatively flat and dark brown head. The dorsal part of the body is dark purplish brown with numerous yellowish spots and a yellowish collar with a white underside.

**Diet:** It is a carnivorous snake with a diet that includes geckos.

**Typical behaviour:** Arboreal and terrestrial, nocturnal.

**Habitat:** It inhabits suburban and rural areas.

**Natural distribution:** Southeast Asia

**National conservation status:** widespread and common

**References:** Lim & Lim (1992); Baker & Lim (2008)

## DISCUSSION

During our eight-month survey of the Native Garden @ HortPark, we recorded four amphibian and 12 reptilian species. The amphibian fauna consisted of three frogs and one toad, while the reptilian fauna consisted of seven species of lizard and five snakes. All the frog species encountered are commonly recorded in suburban and urban areas and are nocturnal. In the plot, their initial presence was ascertained from eggs and tadpoles seen in the plot's water bodies. The adults were mainly encountered at night, but also during the day in thicker vegetation and in the stream itself (over the course of the survey when the plantings became mature and more emergent aquatic plants were added). The Asian toad (*Duttaphrynus melanostictus*; Fig. 4.1) was mainly encountered in the open on the grass at night, or under thick vegetation or rocks during the day. The field frog (*Fejervarya limnocharis*; Fig. 4.2), like the Asian toad, was also encountered on the grass at night, especially after rain, but was also often encountered near plants around the stream or amongst the emergent aquatic plants during the day. The four-lined tree frog (*Polypedates leucomystax*; Fig. 4.4) was usually encountered during the day, resting curled up amongst plant foliage in the denser parts of the landscape. The dark-sided chorus frog (*Microhyla heymonsi*; Fig. 4.3) was never seen as an adult in the plot, but their tadpoles were present.

Out of the seven lizards encountered at the plot, five were nocturnal geckos, while the remaining two were commonly encountered during the day. The common sun skink (*Eutropis multifasciatus*; Fig. 4.7) was frequently detected from the rustling in the undergrowth as its noisy foraging revealed its location. The common flying dragon (*Draco sumatranus*; Fig. 4.6) was also commonly encountered during the day on the trunks of the trees planted in the plot, but it is most likely that these individuals arrived in the plot after gliding in from the large trees to the northeast. The five geckos were mainly encountered during the night near light fixtures within the landscape, as well as in the gazebo, hunting for insects that were attracted to the lights. Geckos were also seen among plants, but these were more difficult to observe.

Lastly, the snakes recorded in the plot were usually single observations, and they usually moved away quickly after being encountered. This was especially so for the two bronzebacks, the red-necked bronzeback (*Dendrelaphis kopsteini*; Fig. 4.14) and the painted bronzeback (*Dendrelaphis pictus*; Fig. 4.15), which were encountered actively foraging for food both on the ground and in low shrubs within the plot. Other species such as the Oriental whip snake (*Ahaetulla prasina*; Fig. 4.12), on the other hand, are usually observed on low branches, lying in wait to ambush their prey. They will usually remain motionless unless severely harassed. The house snakes (*Lycodon capucinus*; Fig. 4.16), unlike the other species seen at the plot, were usually encountered by overturning rocks, where they were found resting singly or sometimes in pairs. The paradise tree snake (*Chrysopelea paradisi*; Fig. 4.13), like the common flying dragon, is believed to be an 'accidental' that arrived in the plot after gliding off course from the large trees to the northeast, as these creatures prefer taller trees compared to the short, newly planted trees in the plot. However, it is highly likely that both the paradise tree snake and *Draco sumatranus* will become residents in the plot as the trees grow and mature in size.

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## LEPIDOPTERANS: BUTTERFLIES AND MOTHS

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### INTRODUCTION

Butterflies and moths belong to the insect order Lepidoptera, which is characterised by flying insects possessing fine, minute scales on their wings. While the vast majority of moths are nocturnal in habit, butterflies and skippers are active by day instead.

Throughout the world, the diversity of moths is known to outnumber that of butterflies many times over and the figures continue to climb with each passing year. In Australia alone, the 400 documented species of butterflies is dwarfed by a staggering 20,000 to 30,000 species of moths (Zborowski & Edwards, 2007)! In Singapore, butterflies have been well-documented and the total has reached 301 species with the recent rediscovery of the Malayan birdwing (*Troides amphrysus*) (Khew, 2011). This is a great increase from the 236 species known back in 1997 (Khew & Neo, 1997). However, the true diversity of local moth species is far from being documented, as research attention and public admiration have been traditionally skewed towards the more brilliantly coloured butterflies. Nevertheless, initial estimates of Singapore's moth diversity have resulted in at least 700 species thus far (Leong, 2008a). With sustained research, this number will certainly exceed 1,000 species in future. Systematic attempts have been made to better understand certain prominent groups of moths locally, such as the hawkmoths (family Sphingidae) and the pyraloid moths (superfamily Pyraloidea) (Leong, 2008b, 2008c).

Butterflies and moths generally differ from each other morphologically and behaviourally, although there are exceptions to each characteristic. Generally, butterflies possess club-shaped antennae, while the antennae of moths are very varied (e.g., feathery or straight) but not club-shaped, with the exception of moths of the genus *Synemon* (sun moths) which possess similar antennae to butterflies. Butterflies are relatively well-studied and are typically differentiated based on their myriad markings and colours, and the position of these patterns on their wings. Some Lepidoptera families and species also have very characteristic caterpillars that can be readily classified based on their morphology. Hence, a basic understanding of the terminology applied here is needed (Figs. 5.1, 5.2).

At present, proper identification for the moth species remains a fundamental objective and an uphill challenge. Nevertheless, the widespread distribution of many species in Singapore and the surrounding region indicates their adaptability to a broad spectrum of habitats and even larval host plants, on which their survival and reproduction depend. At the Native Garden @ HortPark, concerted attempts have been made to establish a healthy population of a highly diverse and heterogeneous composition of native plants. Various known native host plants were introduced into the landscape to provide shade and sunlit spots. As a result, a number of butterflies and moths have been naturally drawn to reside there, if not temporarily, and have even deposited eggs onto selected larval host plants.



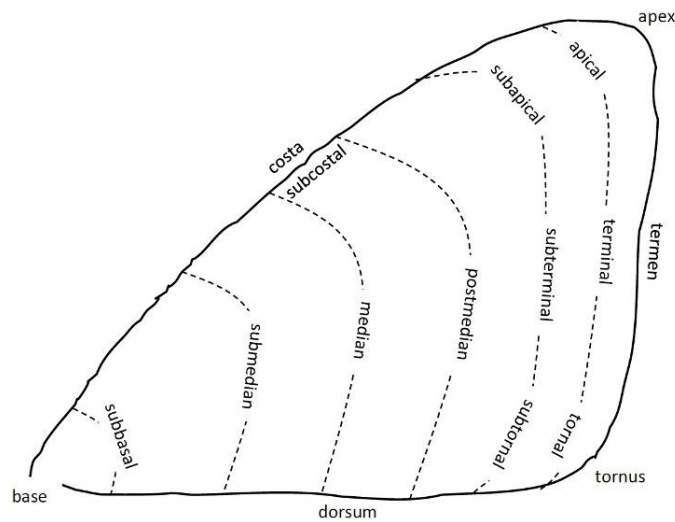


Fig. 5.1. Structure of forewing of adult Lepidoptera. (Adapted from Common & Waterhouse [1981]).

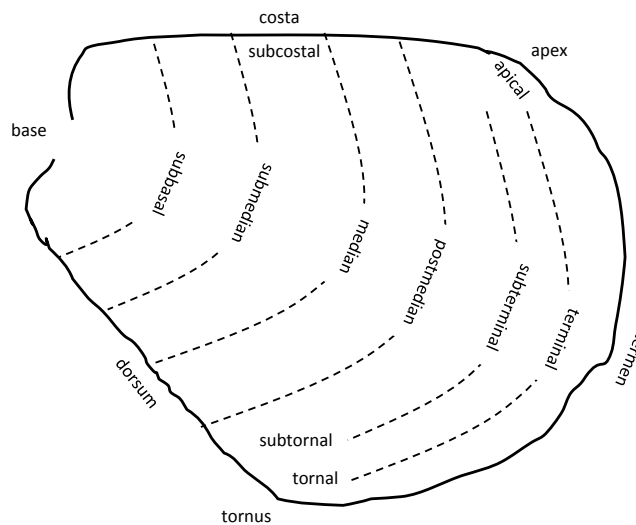


Fig. 5.2. Structure of hindwing of adult Lepidoptera. (Adapted from Common & Waterhouse [1981]).

## METHODS

To determine the number of butterfly and moth species present in the Native Garden @ HortPark, diurnal and nocturnal surveys were conducted to allow for the different behavioural patterns of these organisms. Visual surveys during the day were conducted by a slow walk along the paths and around the perimeter of the plot, stopping every three metres for five minutes to look for species. Species that could not be identified immediately were photographed or collected for proper identification. The behaviours and activities of the individuals seen (e.g., feeding on nectar, puddling, resting) were also recorded. Night surveys were conducted in the same way as the day surveys, with the additional use of a headlamp and a stopping time of 10 minutes to look for moths. The survey period was from 10 May 2010 to 9 December 2010, at 0800–1100 hours and 1900–2100 hours. Butterfly or moth caterpillars were also collected and brought back to the laboratory for rearing to maturity for species identification.

Descriptions of each of these species are provided. Each description includes its scientific name, common name, scientific family name, common family name, adult description, caterpillar description, host plants, typical behaviour (for butterflies only), habitat, natural distribution, and national conservation status. In the figure legends, the following abbreviation is used: WS = total length from tip to tip of forewings when wings are fully extended.

**OBSERVATIONS**

A total of 38 lepidopterans, comprising 26 butterflies (Table 5.1) and 12 moth species (Table 5.2) were recorded from the Native Garden @ HortPark. The annotated lists of butterflies and moths follow.

Table 5.1. Butterflies of the Native Garden @ HortPark.

S/No.	Scientific Name	Common Name	Family	Local Status
1.	<i>Abisara saturata kausambioides</i>	Malayan plum judy	Riodinidae	Moderately common
2.	<i>Ancistroides nigrita maura</i>	chocolate demon	Hesperiidae	Common
3.	<i>Anthene emolus goberus</i>	ciliate blue	Lycaenidae	Common
4.	<i>Catopsilia pomona pomona</i>	lemon emigrant	Pieridae	Common
5.	<i>Chilades pandava pandava</i>	cycad blue	Lycaenidae	Common
6.	<i>Danaus chrysippus chrysippus</i>	plain tiger	Nymphalidae	Common
7.	<i>Delias hyparete metarete</i>	painted jezebel	Pieridae	Common
8.	<i>Doleschallia bisaltide</i>	autumn leaf	Nymphalidae	Common
9.	<i>Elymnias hypermnestra agina</i>	common palmfly	Nymphalidae	Common
10.	<i>Euploea mulciber mulciber</i>	striped blue crow	Nymphalidae	Common
11.	<i>Eurema hecabe contubernalis</i>	common grass yellow	Pieridae	Common
12.	<i>Graphium sarpedon luctatius</i>	common bluebottle	Papilionidae	Common
13.	<i>Iambrix salsala salsala</i>	chestnut bob	Hesperiidae	Common
14.	<i>Junonia hedonia ida</i>	chocolate pansy	Nymphalidae	Common
15.	<i>Junonia orithya wallacei</i>	blue pansy	Nymphalidae	Common
16.	<i>Mycalesis mineus macromalayana</i>	dark brand bush brown	Nymphalidae	Common
17.	<i>Papilio clytia clytia</i>	common mime	Papilionidae	Common
18.	<i>Papilio demoleus malayanus</i>	lime butterfly	Papilionidae	Common
19.	<i>Papilio polytes romulus</i>	common mormon	Papilionidae	Common
20.	<i>Phaedyra columella singa</i>	short banded sailor	Nymphalidae	Common
21.	<i>Phalanta phalantha phalantha</i>	leopard	Nymphalidae	Common
22.	<i>Polyura hebe plautus</i>	plain nawab	Nymphalidae	Common
23.	<i>Prosotas dubiosa lumpura</i>	tailless line blue	Lycaenidae	Common
24.	<i>Suastus gremius gremius</i>	palm bob	Hesperiidae	Common
25.	<i>Zizina otis lampa</i>	lesser grass blue	Lycaenidae	Common
26.	<i>Zizula hylax pygmaea</i>	pygmy grass blue	Lycaenidae	Common

Table 5.2. Moths of the Native Garden @ HortPark.

S/No.	Scientific Name	Common Name	Family	Local Status
1.	<i>Adoxophyes privatana</i>	—	Tortricidae	Uncommon
2.	<i>Asota plana</i>	—	Erebidae	Common
3.	<i>Attacus atlas</i>	atlas moth	Saturniidae	Common
4.	<i>Chalcocelis albiguttatus</i>	—	Limacodidae	Common
5.	<i>Darna trima ajavana</i>	—	Limacodidae	Uncommon
6.	<i>Eterusia risa</i>	—	Zygaenidae	Uncommon
7.	<i>Eupanacra mydon</i>	—	Sphingidae	Common
8.	<i>Glyphodes bivitalis</i>	leafroller moth	Pyalidae	Common
9.	<i>Olene mendosa</i>	—	Erebidae	Common
10.	<i>Parapoynx</i> sp.	—	Pyalidae	Common
11.	<i>Parasa lepida</i>	nettle caterpillar, blue-striped nettle grub	Limacodidae	Common
12.	<i>Spodoptera picta</i>	lily caterpillar moth	Noctuidae	Common



**ANNOTATED LIST OF BUTTERFLY SPECIES**

**Scientific name:** *Abisara saturata kausambioides* (de Nicéville, 1896) (Figs. 5.3, 5.4)

**Common name:** Malayan plum Judy

**Scientific family name:** Riodinidae

**Common family name:** metalmarks family

**Adult description:** This butterfly has a wing span of 35–45 mm. Male topside: The fore and hindwing are dark crimson brown, with a deep purple-blue tinge. Male underside: The forewing is brown, with a pair of faint purple postmedian bands (Fig. 5.3). The hindwing is similar to the forewing, except that the outer band bears a series of black subterminal spots with white edges, and the wing is angled at the mid termen. Female topside: Similar to that of the male. Female underside: Similar to that of the male, except for a faint white subapical patch on the forewing (Fig. 5.4a). The hindwing is also more prominently angled.



Fig. 5.3. *Abisara saturata kausambioides* (de Nicéville, 1896). Adult male, WS = 35–45 mm. (Photograph by: Horace Tan Hwee Huat).



Fig. 5.4. *Abisara saturata kausambioides* (de Nicéville, 1896): a, adult female, WS = 35–45 mm; b, caterpillar. (Photographs by: Horace Tan Hwee Huat).

**Caterpillar description:** The body is lime-green and rounded, with numerous setae throughout. The head capsule is greenish yellow (Fig. 5.4b).

**Host plants:** *Ardisia elliptica* (Primulaceae), *Embelia dasythyrsa* (Primulaceae)

**Typical behaviour:** Adult butterflies are rather slow in flight, often flying from leaf to leaf and perching with half-opened wings.

**Habitat:** It inhabits inland forests, parks, and gardens.

**Natural distribution:** Indo-China, Thailand, Peninsular Malaysia, Singapore, Sumatra, Borneo, Sulawesi, and the Philippines

**National conservation status:** moderately common

**References:** Corbet & Pendlebury (1992); Khew (2010)





Fig. 5.5. *Ancistroides nigrita maura* (Snellen, 1880): a, adult, WS = 42–50 mm; b, caterpillar. (Photographs by: Horace Tan Hwee Huat).

**Scientific name:** *Ancistroides nigrita maura* (Snellen, 1880) (Fig. 5.5)

**Common name:** chocolate demon

**Scientific family name:** Hesperiiidae

**Common family name:** skipper family

**Adult description:** This butterfly has a wing span of 42–50 mm (Fig. 5.5a). Male topside: The fore and hindwings are dark brown. Male underside: The fore and hindwings are dark brown, while the margins are paler in colour. Female topside and underside: Similar to those of the male, but paler in colour.

**Caterpillar description:** The body is pale green. The head capsule is black (Fig. 5.5b).

**Host plants:** *Alpinia aquatica* (Zingiberaceae), *Cheilocostus speciosus* (Costaceae), *Etlingera elatior* (Zingiberaceae), *Zingiber officinale* (Zingiberaceae)

**Typical behaviour:** The adult butterfly is fast in flight, often perching on leaves.

**Habitat:** It inhabits inland forests, parks, and gardens.

**Natural distribution:** North India to Myanmar, Thailand, Indo-China, Peninsular Malaysia, Indonesia, and the Philippines

**National conservation status:** common

**References:** Corbet & Pendlebury (1992); Khew (2010)



Fig. 5.6. *Anthene emolus goberus* (Fruhstorfer, 1916): a, adult, WS = 24–30 mm; b, caterpillar. (Photographs by: Horace Tan Hwee Huat).

**Scientific name:** *Anthene emolus goberus* (Fruhstorfer, 1916) (Fig. 5.6)

**Common name:** ciliate blue

**Scientific family name:** Lycaenidae

**Common family name:** gossamer-winged butterfly family

**Adult description:** This butterfly has a wing span of 24–30 mm (Fig. 5.6a). Male topside: The fore and hindwings are deep purplish blue. Male underside: The forewing is brown, with a series of postmedian dark brown spots that are white-edged at both inner and outer sides. The hindwing is similar to the forewing, but with an orange-edged black spot in the mid termen and a black subterminal margin. The hindwing also bears a short fine tail extensions at the tornus. Female topside: The fore and hindwings are dull brown with a purplish wing base. Female underside: Similar to that of the male.

**Caterpillar description:** The body is green with a black dorsal stripe from behind the head capsule to the thorax and gradually thinning out to the last few segments of the abdomen. The third last abdomen bears a prominent dorsal spot (Fig. 5.6b).

**Host plants:** *Cassia fistula* (Fabaceae), *Saraca cauliflora* (Fabaceae), *Smilax bracteata* (Smilacaceae), *Syzygium myrtifolium* (Myrtaceae)

**Typical behaviour:** The adult butterfly is moderately fast in flight.

**Habitat:** It inhabits inland forests, parks, and gardens.

**Natural distribution:** India to China, south to Thailand, Indo-China, Peninsular Malaysia, Singapore, and Indonesia

**National conservation status:** common

**References:** Corbet & Pendlebury (1992); Khew (2010)





Fig. 5.7. *Catopsilia pomona pomona* (Fabricius, 1775) f. *alcmeone* (Cramer, 1777). Adult female, WS = 50–70 mm. (Photograph by: Horace Tan Hwee Huat).

**Scientific name:** *Catopsilia pomona pomona* (Fabricius, 1775) f. *alcmeone* (Cramer, 1777) (Figs. 5.7, 5.8)

**Common name:** lemon emigrant

**Scientific family name:** Pieridae

**Common family name:** pierids family (whites, sulphurs, and yellows)

**Adult description:** This butterfly has a wingspan about 50–70 mm. Male topside: The forewing is lemon-yellow throughout, with a thin black border at the apex. The hindwing is lemon-yellow. Male underside: The fore and hindwings are lemon-yellow throughout (Fig. 5.8a). Female topside and underside: Similar to those of the male (Fig. 5.7).

**Caterpillar description:** The body is green or yellowish green, with a black-edged, cream-coloured lateral band, and occasionally with a diffused, dark green, middorsal line. The head capsule is pale green, with many small black spots (Fig. 5.8b).

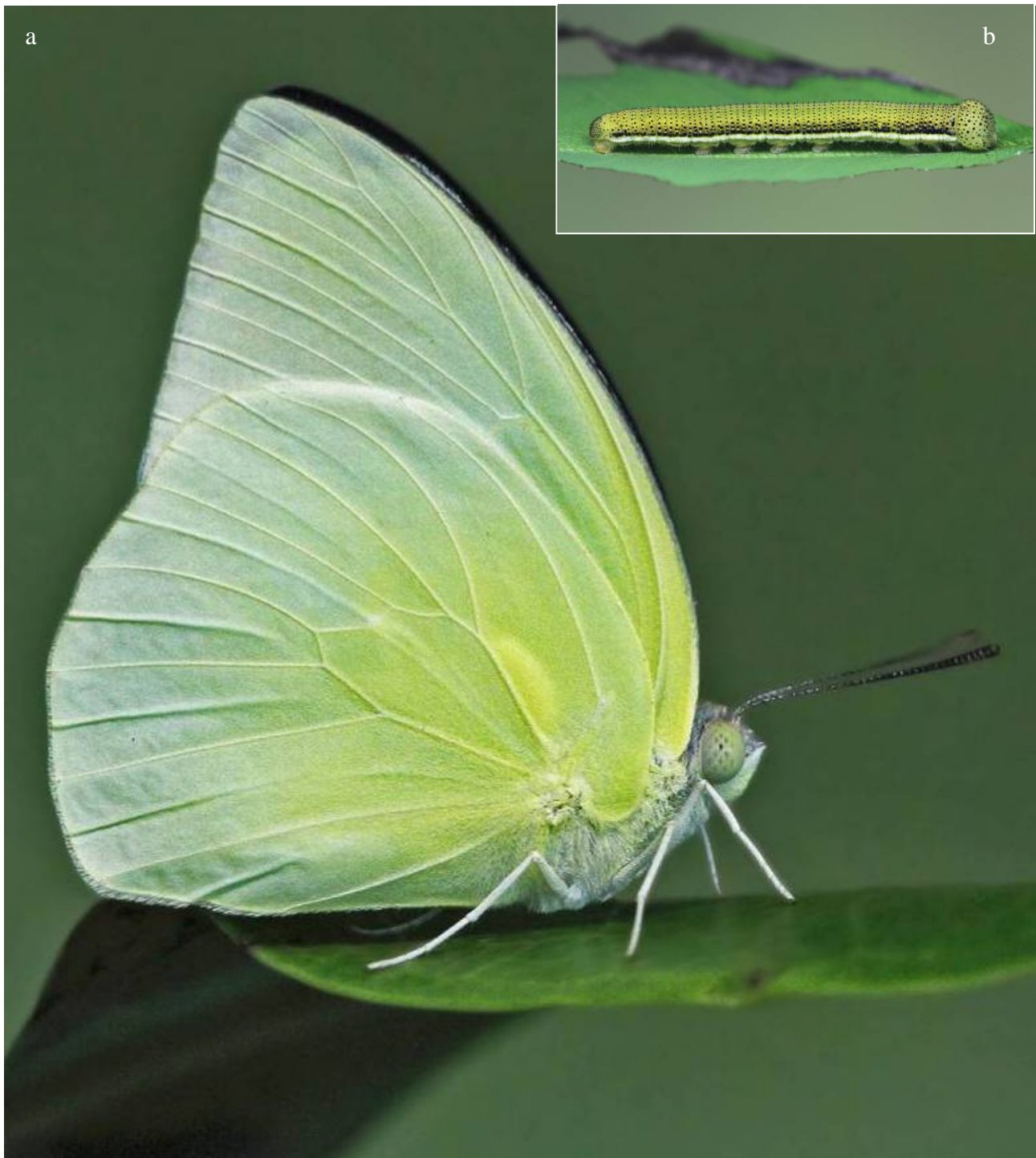


Fig. 5.8. *Catopsilia pomona pomona* (Fabricius, 1775) f. *alcmeone* (Cramer, 1777): a, adult male, WS = 50–70 mm; b, caterpillar. (Photographs by: Horace Tan Hwee Huat).

**Host plants:** *Senna* species (Fabaceae)

**Typical behaviour:** The adult butterfly is fast in flight.

**Habitat:** It inhabits inland forests, parks, gardens, and urban areas.

**Natural distribution:** Sri Lanka, India, China, Taiwan, Japan, south to Myanmar, Thailand, Indo-China, Peninsular Malaysia, Singapore, Indonesia, New Guinea, and Australia

**National conservation status:** common

**References:** Corbet & Pendlebury (1992); Bascombe et al. (1999); Braby (2000); Khew (2010)





Fig. 5.9. *Chilades pandava pandava* (Horsfield, 1829): a, adult, WS = 22–26 mm; b, caterpillar. (Photographs by: Horace Tan Hwee Huat).

**Scientific name:** *Chilades pandava pandava* (Horsfield, 1829) (Fig. 5.9)

**Common name:** cycad blue

**Scientific family name:** Lycaenidae

**Common family name:** gossamer-winged butterfly family

**Adult description:** This butterfly has a wing span of 22–26 mm (Fig. 5.9a). Male topside: The forewing is purplish blue with narrow black borders. The hindwing is purplish blue with narrow black borders and a black tornal spot. Male underside: The forewing is pale brown with deep brown markings that are white edged at both the inner and outer sides. The hindwing is pale brown with similar deep brown markings. The tornal region is orange with a prominent black spot. The hindwing is tailed at the tornus. Female topside: The forewing is pale purplish blue with broad black borders. The hindwing is pale purplish blue with broad black borders, a black tornal spot, and a series of subterminal spots. Female underside: Similar to that of the male.

**Caterpillar description:** The body is woodlouse-like, in green or reddish brown forms, with white dorso-ventral markings throughout. The body is also covered with numerous short setae (Fig. 5.9b).

**Host plants:** *Cycas edentata* (Cycadaceae), *Cycas revoluta* (Cycadaceae)

**Typical behaviour:** The adult butterfly is moderately fast in flight, often found around larval hostplant (*Cycas* spp.).

**Habitat:** It inhabits inland forests, parks, gardens, and urban areas.

**Natural distribution:** Sri Lanka, India, east to China, Taiwan, south through Indo-China, Peninsular Malaysia, Singapore, Sumatra, and Java

**National conservation status:** common

**References:** Corbet & Pendlebury (1992); Bascombe et al. (1999); Khew (2010)

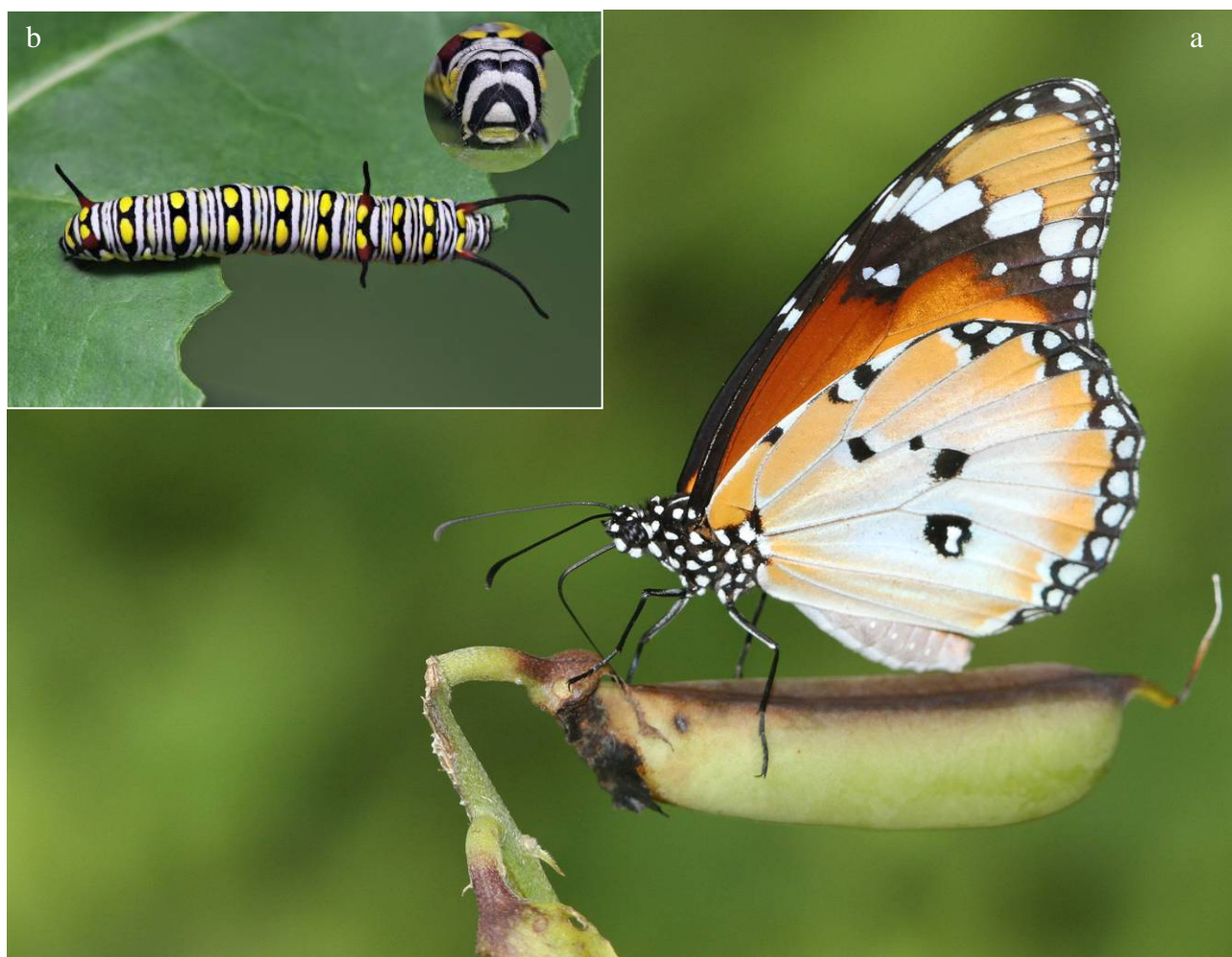


Fig. 5.10. *Danaus chrysippus chrysippus* (Linnaeus, 1758): a, adult, WS = 55–65 mm; b, caterpillar. (Photographs by: Horace Tan Hwee Huat).

**Scientific name:** *Danaus chrysippus chrysippus* (Linnaeus, 1758) (Fig. 5.10)

**Common name:** plain tiger

**Scientific family name:** Nymphalidae

**Common family name:** brush-footed butterfly family

**Adult description:** The wing span is 55–65 mm (Fig. 5.10a). Male topside: The forewing is tawny orange with a black margin that originates as a thin strip at the base, extends along the costa, and widens into a broad black band at the median, round the apex, and gradually narrowing at three-quarters down the termen to the tornus. A broad white subapical band is present, with a few scattered white costal, sub-terminal, and terminal spots. In form *chrysippus*, the hindwing is orange with black spots along the median. The margin is broad and black with white terminal spots. In form *alcippoides*, the hindwing is white with black spots along the median. The margin is broad and black with a thin orange subterminal strip. White terminal spots are also present on the black margin. A small, dull grey patch of sex-scales is present around the central region of the hindwing. Male underside: The forewing is similar to that of the topside, except that the black margin is narrower and there is a dull yellow patch at the apical region bordered by a white subapical band and a black margin, and numerous white terminal and subterminal spots. The hindwing is similar to that of the topside except for a narrower black margin, a few black spots being present in the centre, and that there are numerous white terminal and subterminal spots. Female topside: Similar to that of the male, except for the absence of sex-scales. Female underside: Similar to that of the male.

**Caterpillar description:** The body is white-based; the segments are each with a broad black transverse band and a large yellow dorsolateral spot in the middle. Three narrow black transverse





Fig. 5.11. *Delias hyparete metarete* (Butler, 1879): a, adult, WS = 65–75 mm; b, caterpillars. (Photographs by: Horace Tan Hwee Huat).

bands and two yellow lateral spots are also present at each segment. The thorax bears a pair of long black fleshy protrusions with a reddish base. The mid and near-rear abdomen bears a pair of shorter black fleshy protrusions with reddish base (Fig. 5.10b).

**Host plants:** *Asclepias curassavica* (Apocynaceae), *Caltropis gigantea* (Apocynaceae)

**Typical behaviour:** The adult butterfly is slow in flight, often flying close to the ground and visiting flowers.

**Habitat:** It inhabits mangrove and inland forests, parks, and gardens.

**Natural distribution:** Throughout Old World tropics, extending north to north Africa, southern Europe, Middle East and Japan, south to Australia, and also present in many Pacific and Atlantic oceanic islands

**National conservation status:** common

**References:** Corbet & Pendlebury (1992); Bascombe et al. (1999); Braby (2000); Khew (2010)

**Scientific name:** *Delias hyparete metarete* (Butler, 1879) (Fig. 5.11)

**Common name:** painted Jezebel

**Scientific family name:** Pieridae

**Common family name:** pierid family

**Adult description:** The wingspan is about 65–75 mm (Fig. 5.11a). Male topside: The forewing is white from the base to the subterminal region, with dark grey to black margins. The hindwing is white from the base to the subterminal region, with dark grey to black margins. The wing cells are outlined black. Male underside: The forewing is similar to that of the topside but whiter. The hindwing is bright yellow at the base, with a broad, red border at the tornal region. The veins and



Fig. 5.12. *Doleschallia bisaltide* (Eliot, 2006): a, adult, WS = 60–70 mm; b, caterpillar. (Photographs by: Horace Tan Hwee Huat).

margins of the wings are black. Female topside: The forewing is white from the base to the postmedian region, with dark grey to black margins. The hindwing is white from the base to the postmedian region, with dark grey to black margins. The wing cells are outlined black. Female underside: Similar to that of the male.

**Caterpillar description:** The body is yellow to orange and sparsely hairy. The head capsule is round and black (Fig. 5.11b).

**Host plant:** *Dendrophthoe pentandra* (Loranthaceae)

**Typical behaviour:** This butterfly usually flies at treetop level.

**Habitat:** It inhabits mangrove and inland forests, parks, gardens, and urban areas.

**Natural distribution:** South and east India, Nepal, northeast India, east to southern China, Taiwan, south to the Philippines, Indo-China, Peninsular Malaysia, Singapore, Sumatra, Java, Borneo, and Bali

**National conservation status:** common

**References:** Corbet & Pendlebury (1992); Bascombe et al. (1999); Khew (2010)

**Scientific name:** *Doleschallia bisaltide* Cramer 1779 (Fig. 5.12)

**Common name:** autumn leaf

**Scientific family name:** Nymphalidae

**Common family name:** brush-footed butterfly family

**Adult description:** It has a wing span of 60–70 mm (Fig. 5.12a). Male topside: The forewing is orange at the median region, darkening to orange-brown at the base. The rest of the forewing is black, a broad orange band is present at the costa from the subapical to the subterminal region. A





Fig. 5.13. *Elymnias hypermnestra agina* (Fruhstorfer, 1902): a, adult, WS = 50–60 mm; b, caterpillar. (Photographs by: Horace Tan Hwee Huat).

short series of white spots is present at the apical region. The hindwing is orange-brown, with a black submarginal and terminal margin. The hindwing bears a short blunt tail. Male underside: The fore and hindwings are rusty brown with greenish purple or grey patches. The forewing bears a dark median line that runs down vertically through the hindwing. A small series of eyespots is present in the outer half of the hindwing. The inner halves of the wings have a few scattered white spots. Female topside and underside: Similar to those of the male.

**Caterpillar description:** The body is black, with a series of cream, subdorsal and lateral lines and spots along the length of the body. A series of bright orange spots run along the lateral side of the body. Metallic blue dorsolateral spots are also present along the body. Numerous branched, black spines arise from these metallic blue and orange spots. The head capsule is black with two branched spikes at the top (Fig. 5.12b).

**Host plants:** *Asystasia gangetica* (Acanthaceae), *Pseuderanthemum* sp. (Acanthaceae)

**Typical behaviour:** The adult butterfly has a strong, rapid flight.

**Habitat:** It inhabits mangrove and inland forests, parks, gardens, and urban areas.

**Natural distribution:** India, Sri Lanka, east to the Philippines, Indo-China, south to Peninsular Malaysia, Singapore, Indonesia, east to New Guinea, New Caledonia, Vanuatu, Fiji, and south to Australia

**National conservation status:** common

**References:** Corbet & Pendlebury (1992); Braby (2000); Eliot (2006); Khew (2010)

**Scientific name:** *Elymnias hypermnestra agina* (Fruhstorfer, 1902) (Fig. 5.13)

**Common name:** common palmfly

**Scientific family name:** Nymphalidae

**Common family name:** brush-footed butterfly family



Fig. 5.14. *Euploea mulciber mulciber* (Cramer, 1777). Adult male, WS = 80–90 mm. (Photograph by: Horace Tan Hwee Huat).

**Adult description:** It has a wing span of 50–60 mm (Fig. 5.13a). Male topside: The forewing is bluish black with a series of bluish white spots along the subapical to the subternal. The hindwing is bluish black. Male underside: The forewing is speckled brown. The hindwing is speckled brown with a bright white spot just below the centre of the costa. Female topside: Similar to that of the male, but paler in colour. The hindwings have a few whitish submarginal spots. Female underside: Similar to that of the male.

**Caterpillar description:** The body is green, covered with setae, with two prominent, yellow, dorsolateral stripes. Two faint, longitudinal stripes are present along the lateral side of the body and in between the dorsolateral stripes. The head capsule bears two brown horns, extending downwards. The area between the horns and sides of head capsule are yellow. The rear end of the body bears two pinkish protrusions (Fig. 5.13b).

**Host plants:** Palms (Arecaceae)

**Typical behaviour:** The adult butterfly is slow in flight, often flying in shaded areas.

**Habitat:** It inhabits mangrove and inland forests, parks, gardens, and urban areas.

**Natural distribution:** Sri Lanka and India, east to China, Taiwan, south to Indo-China, Peninsular Malaysia, Singapore, south to Sumatra, Java, Borneo, Lesser Sundas, and Timor

**National conservation status:** common

**References:** Corbet & Pendlebury (1992); Bascombe et al. (1999); Khew (2010)

**Scientific name:** *Euploea mulciber mulciber* (Cramer, 1777) (Figs. 5.14, 5.15)

**Common name:** striped blue crow

**Scientific family name:** Nymphalidae

**Common family name:** brush-footed butterfly family



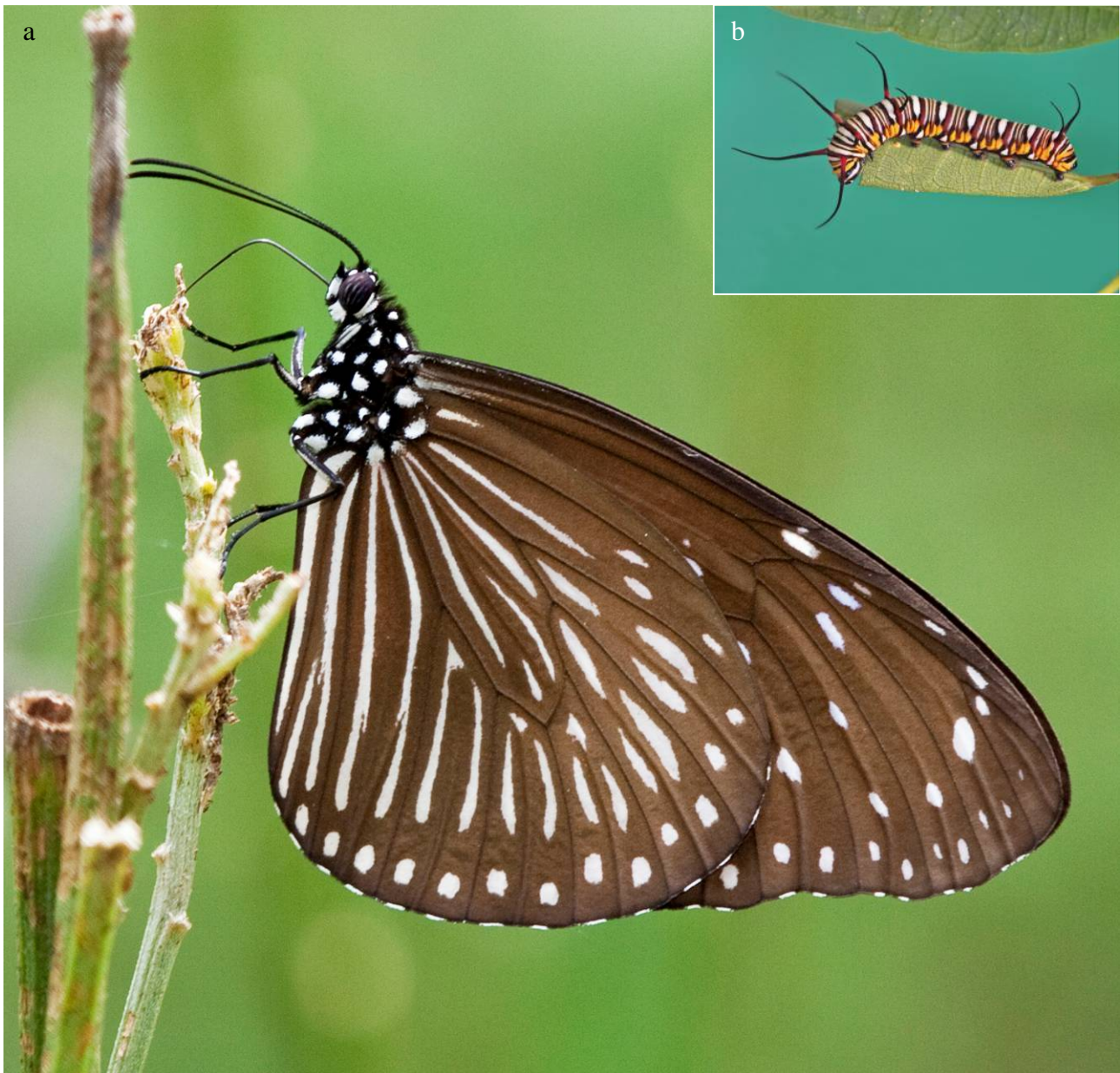


Fig. 5.15. *Euploea mulciber mulciber* (Cramer, 1777): a, adult female, WS = 80–90 mm; b, caterpillar. (Photographs by: Horace Tan Hwee Huat).

**Adult description:** This butterfly has a wing span of 80–90 mm. Male topside: The forewing is black with a bright metallic violet-blue region from the postmedian to the subterminal. White spots are scattered from the median to subterminal region. The hindwing is black. Male underside: Similar to that of the topside but without the blue colouration (Fig. 5.14). Female topside: The forewing is dark brown with a metallic violet-blue region from the postmedian to subterminal portion. White spots are scattered from the median to the subterminal region. The hindwing is dark brown with white streaks. The termen of the fore and hindwings bear a series of subterminal white spots. Female underside: Similar to that of the topside but without the blue colouration (Fig. 5.15a).

**Caterpillar description:** The body is reddish brown and the segments have a broad dorsolateral black band and a large white dorsolateral spot in the middle. Three narrow white transverse bands and two yellow lateral spots are also present at each segment. The thorax bears two pairs of long, black, fleshy protrusions with a reddish base. The front and near-rear abdomen bears a pair of shorter black fleshy protrusions with a reddish base (Fig. 5.15b).

**Host plants:** *Ficus heteropleura* (Moraceae), *Ficus globosa* (Moraceae), *Ficus microcarpa* (Moraceae), *Nerium oleander* (Apocynaceae)

**Typical behaviour:** The adult butterfly is slow in flight.

**Habitat:** It inhabits mangrove and inland forests, parks, and gardens.

**Natural distribution:** India, north to China, Taiwan, south through the Philippines, Indo-China, Peninsular Malaysia, Singapore, south to Sumatra, Java, Borneo, and the Lesser Sundas

**National conservation status:** common

**References:** Corbet & Pendlebury (1992); Bascombe et al. (1999); Khew (2010)

**Scientific name:** *Eurema hecabe contubernalis* (Moore, 1886) (Fig. 5.16)

**Common name:** common grass yellow

**Scientific family name:** Pieridae

**Common family name:** pierid family

**Adult description:** This butterfly has a wing span of 35–45 mm (Fig. 5.16a). Male topside: The forewing is yellow with a black border which originates as a thin strip from the base, along the costa to the postmedian region where it thickens into a broad black terminal band round the apex and along the termen to the tornus. The hindwing is yellow with a narrow black terminal band. Male underside: The forewing is yellow with two cell spots. Other spots are present variably throughout the fore and hindwings. Female topside: The forewing is usually of a paler yellow with a thicker black border that originates as a thin strip from the base, along the costa to the postmedian region where it thickens into a broad black terminal band round the apex and along the termen to the tornus. The hindwing is yellow with a thick black terminal band. Female underside: Similar to that of the male.

**Caterpillar description:** The body is 24–30 mm long, 0.5-mm wide, yellowish or pale dull green with a white lateral line that is yellow-edged dorsally. The body is also covered with numerous setae. The head capsule is round and green (Fig. 5.16b).

**Host plants:** *Breynia disticha* (Phyllanthaceae), *Caesalpinia bonduc* (Fabaceae), *Caesalpinia pulcherrima* (Fabaceae), *Cratoxylum cochinchinense* (Hypericaceae), *Paraserianthes falcataria* (Fabaceae), *Pithecellobium dulce* (Fabaceae), *Senna* spp. (Fabaceae)

**Typical behaviour:** The adult butterfly is slow and erratic in flight, often flying close to the ground and visiting flowers.

**Habitat:** It inhabits mangrove and inland forests, parks, gardens, and urban areas.

**Natural distribution:** Tropical Africa, Middle East, Sri Lanka, India, China, Korea, Japan, south to the Philippines, Myanmar, Indo-China, Peninsular Malaysia, Singapore, south to Sumatra, east to Borneo, Sulawesi, New Guinea, East Australia, New Caledonia, Fiji, and Tonga

**National conservation status:** common

**References:** Corbet & Pendlebury (1992); Bascombe et al. (1999); Braby (2000); Khew (2010)

**Scientific name:** *Graphium sarpedon luctatus* (Fruhstorfer, 1907) (Fig. 5.17)

**Common name:** common bluebottle

**Scientific family name:** Papilionidae

**Common family name:** swallow-tail butterfly family

**Adult description:** It has a wing span of 60–70 mm (Fig. 5.17a). Male topside: The forewing is black-based, having a pale bluish-green macular band running from the apex to the inner margin of the hindwing, with the band narrowing and breaking into a series of spots near the apex. The hindwing is also black-based, but with a series of blue, crescent-shaped spots present near the outer margin. A tuft of white, hair-like scales occurs along the dorsum of the hindwing. Male underside: Similar to that of the topside, but the basal wing colour is dark brown. Red spots are present on the hindwing. Female topside: Similar to that of the male, except for the absence of the tuft of white, hair-like scales along the dorsum of the hindwing. Female underside: Similar to that of the male.





Fig. 5.16. *Eurema hecabe contubernalis* (Moore, 1886): a, mating pair, WS = 35–45 mm; b, caterpillar. (Photographs by: Horace Tan Hwee Huat).



Fig. 5.17. *Graphium sarpedon luctatius* (Fruhstorfer, 1907): a, adult, WS = 60–70 mm; b, caterpillar. (Photographs by: Horace Tan Hwee Huat).

**Caterpillar description:** The body is about 44 mm long, with the body colour varying from yellowish green, green to bluish green, and is finely speckled with minute yellow spots, and a cream-coloured ventrolateral line. The thorax is slightly humped with a yellow band across. Three pairs of short, dorsolateral spines are present from the head to the thorax. The anal segment bears two short, white, dorsal spines (Fig. 5.17b).

**Host plants:** *Cinnamomum iners* (Lauraceae), *Neolitsea cassia* (Lauraceae)

**Typical behaviour:** The adult butterfly is swift in flight. Male adults are often seen puddling singly or in groups.

**Habitat:** It inhabits inland forests, parks, gardens, and urban areas.

**Natural distribution:** Sri Lanka and India, to China, Taiwan, south Japan, south to the Philippines, Indo-China, Peninsular Malaysia, Singapore, to Sulawesi and Lesser Sundas, east to New Guinea, Solomon Islands and east Australia

**National conservation status:** common

**References:** Corbet & Pendlebury (1992); Bascombe et al. (1999); Braby (2000); Khew (2010)





Fig. 5.18. *Iambrix salsala salsala* (Moore, 1866): a, adult, WS = 20–22 mm (Photograph by: Alvin Francis Lok Siew Loon); b, caterpillar (Photograph by: Horace Tan Hwee Huat).

**Scientific name:** *Iambrix salsala salsala* (Moore, 1866) (Fig. 5.18)

**Common name:** chestnut bob

**Scientific family name:** HesperIIDae

**Common family name:** skipper family

**Adult description:** It has a wing span of 20–22 mm (Fig. 5.18a). Male topside: The forewing is dark brown with a series of yellow-brown spots that forms a band in the median region. The hindwing is dark brown. Male underside: The forewing is rusty brown with white spots in the median region. The hindwing is similar to forewing. Female topside: The forewing is dark brown with a series of whitish spots in the median region. The hindwing is dark brown. Female underside: Similar to that of the male.

**Caterpillar description:** The body is pale yellowish green, with dark dorsal and dorso-lateral bands, and pale yellow transverse stripes across the dorso-ventral at the thorax and beginning of the abdomen. The head capsule is brown (Fig. 5.18b).

**Host plants:** Grasses (Poaceae)

**Typical behaviour:** The adult butterfly is fast in flight, often found in open sunlit places.

**Habitat:** It inhabits mangrove and inland forests, parks, and gardens.

**Natural distribution:** Sri Lanka, India, Myanmar, Thailand to China, south to the Philippines, Indo-China, Peninsular Malaysia, Singapore, Sumatra, and Java

**National conservation status:** common

**References:** Corbet & Pendlebury (1992); Bascombe et al. (1999); Khew (2010)

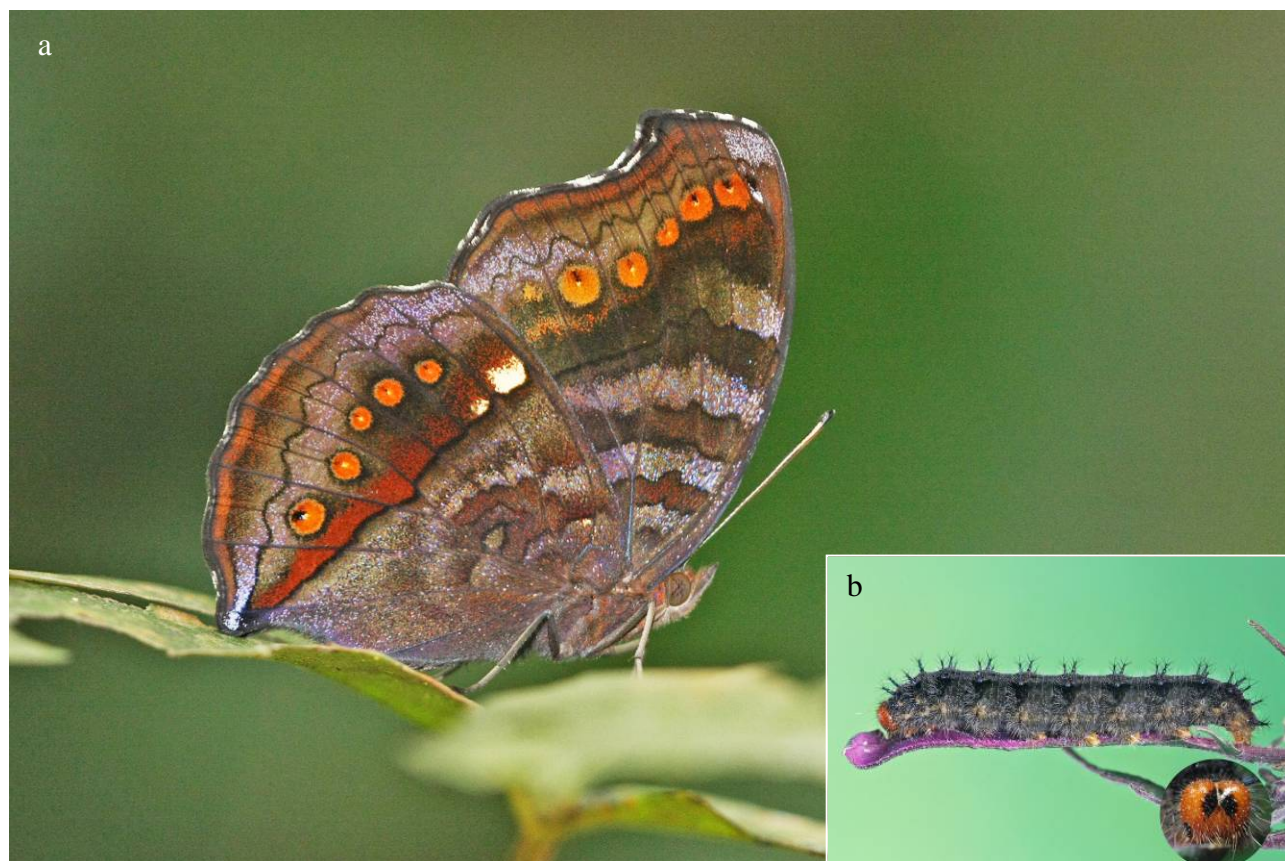


Fig. 5.19. *Junonia hedonia ida* (Cramer, 1775): a, adult, WS = 50–60 mm; b, caterpillar. (Photographs by: Horace Tan Hwee Huat).

**Scientific name:** *Junonia hedonia ida* (Cramer, 1775) (Fig. 5.19)

**Common name:** chocolate pansy

**Scientific family name:** Nymphalidae

**Common family name:** brush-footed butterfly family

**Adult description:** It has a wing span of 50–60 mm (Fig. 5.19a). Male topside: The forewing is brown, being darker from the base to the postmedian region, with few dark lines within the upper half of the darker region. A small, white spot is present near the apex, also with a series of faint subterminal eye-spots along the termen. A faint subterminal line runs along the termen. The hindwing is similar to the forewing, except for the absence of a white spot near apex, and eye-spots and submarginal lines are darker and clearer. Male underside: Similar to that of the topside, but much darker brown and suffused with greyish brown. The eyespots are reddish orange. The hindwing bears a prominent white spot past three quarters of the costa. Female topside and underside: Similar to those of the male.

**Caterpillar description:** The body is black with numerous, black, branched spines throughout body. The head capsule is reddish orange (Fig. 5.19b).

**Host plants:** *Ruellia repens* (Acanthaceae), *Hemigraphis reptans* (Acanthaceae)

**Typical behaviour:** The adult butterfly glides in flight, often flying close to the ground.

**Habitat:** It inhabits inland forests, parks, gardens, and urban areas.

**Natural distribution:** Peninsular Malaysia, Singapore, through Indonesia to New Guinea, Australia, and Solomon Islands

**National conservation status:** common

**References:** Corbet & Pendlebury (1992); Braby (2000); Khew (2010)





Fig. 5.20. *Junonia orithya wallacei* (Distant, 1883). Adult male, WS = 50–60 mm. (Photograph by: Horace Tan Hwee Huat).

**Scientific name:** *Junonia orithya wallacei* (Distant, 1883) (Figs. 5.20, 5.21)

**Common name:** blue pansy

**Scientific family name:** Nymphalidae

**Common family name:** brush-footed butterfly family

**Adult description:** It has a wing span of 45–55 mm. Male topside: The forewing is black from the base to median region, while the rest brown with a broad cream subapical band (Fig. 5.20). Two subterminal, orange-ringed eyespots are present near the termen. Faint orange subcostal markings are also present in the black region along the costa. The hindwing is bright blue, with the base along the dorsum broadly black, and with two subterminal eyespots. The termen bears black and white submarginal lines. Male underside: The forewing markings are similar to the topside, except that the ground colour is pale brown, discal cell is orange with white bands, and a large black subterminal eyespot. The hindwing is pale brown with darker brown markings and two subterminal eyespots.

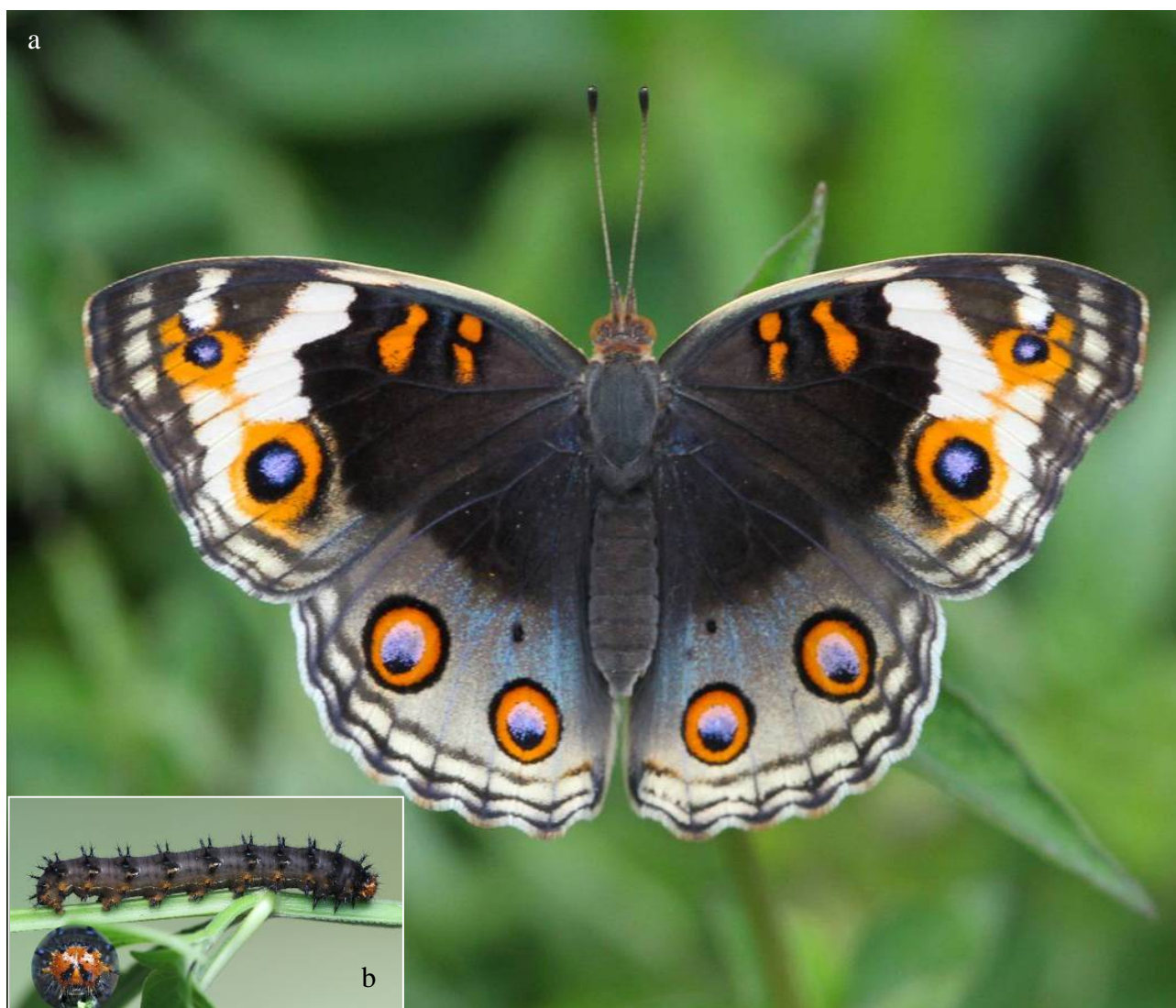


Fig. 5.21. *Junonia orithya wallacei* (Distant, 1883): a, adult female, WS = 50–60 mm; b, caterpillar. (Photographs by: Horace Tan Hwee Huat).

**Female topside:** The forewing is similar to the male, but broader and dark brown instead of black, and with two subcostal orange bars (Fig. 5.21a). The hindwing is similar to the male but is broader, with the termen more rounded, blue area reduced, and is predominantly dark brown. **Female underside:** Similar to that of the male.

**Caterpillar description:** The body is black, with small yellow spots and short branched spikes throughout. The head capsule is orange with two black patches (Fig. 5.21b).

**Host plant:** *Asystasia gangetica* (Acanthaceae)

**Typical behaviour:** The adult butterfly glides in flight, often flying close to the ground.

**Habitat:** It inhabits inland forests, parks, gardens, and urban areas.

**Natural distribution:** Africa, through the Arabian peninsula to Sri Lanka, India, to Myanmar, Thailand, China, Japan, south to the Philippines, Indo-China, Peninsular Malaysia, Singapore, Indonesia, east to New Guinea, and Australia

**National conservation status:** common

**References:** Corbet & Pendlebury (1992); Bascombe et al. (1999); Braby (2000); Khew (2010)





Fig. 5.22. *Mycalesis mineus macromalayana* (Fruhstorfer, 1911): a, adult, WS = 40–50 mm; b, caterpillar. (Photographs by: Horace Tan Hwee Huat).

**Scientific name:** *Mycalesis mineus macromalayana* (Fruhstorfer, 1911) (Fig. 5.22)

**Common name:** dark brand bush brown

**Scientific family name:** Nymphalidae

**Common family name:** brush-footed butterfly family

**Adult description:** It has a wing span of 40–50 mm (Fig. 5.22a). Male topside: The forewing is dull greyish brown with a subterminal eye spot while the hindwing is dull greyish brown. Male underside: The forewing is pale brown with two subterminal eye spots, with the top eye spot smaller than the one below, and a vertical white band at the postmedian region. The hindwing is pale brown with a series of subterminal eye spots of various sizes, and a vertical white band at the postmedian region. A series of dark brown and light brown margins is present at the termen of both wings. Female topside and underside: Similar to those of the male, but eye spots and wings are larger.

**Caterpillar description:** The body pale is green to brown, with a dorsal stripe. The head capsule is dark brown with two short horns (Fig. 5.22b).

**Host plants:** Grasses (Poaceae)

**Typical behaviour:** The adult butterfly is moderately fast in flight, flying often among grasses or low to the ground.

**Habitat:** It inhabits inland forests, parks, and gardens.

**Natural distribution:** Sri Lanka, India, China, Taiwan, south to the Philippines, Indo-China, Peninsular Malaysia, Singapore, Sumatra, Java, and Borneo

**National conservation status:** common

**References:** Corbet & Pendlebury (1992); Bascombe et al. (1999); Khew (2010)



Fig. 5.23. *Papilio clytia clytia* (Linnaeus, 1758): a, adult, WS = 75–95 mm; b, caterpillar. (Photographs by: Horace Tan Hwee Huat).

**Scientific name:** *Papilio clytia clytia* (Linnaeus, 1758) (Fig. 5.23)

**Common name:** common mime

**Scientific family name:** Papilionidae

**Common family name:** swallow-tail butterfly family

**Adult description:** It has a wing span of 75–95 mm (Fig. 5.23a). Male topside: The fore and hindwings are black-based with extensive white streaks and spots throughout. Male underside: Similar to that of the topside. Female topside and underside: Similar to those of the male.

**Caterpillar description:** The early instar caterpillars are brown and cream in colour, resembling bird droppings. Late instar caterpillars are black with cream patches, with red spots and black spines throughout the body (Fig. 5.23b).

**Host plant:** *Cinnamomum iners* (Lauraceae)

**Typical behaviour:** The adult butterfly is slow in flight, often visiting flowers.

**Habitat:** It inhabits inland forests, parks, and gardens.

**Natural distribution:** Sri Lanka and India, through Myanmar and Thailand, to south China, south to the Philippines, Indo-China, Peninsular Malaysia, Singapore, and Borneo

**National conservation status:** common

**References:** Corbet & Pendlebury (1992); Bascombe et al. (1999); Khew (2010)





Fig. 5.24. *Papilio demoleus malayanus* (Wallace, 1865): a, adult, WS = 60–80 mm; b, caterpillar. (Photographs by: Horace Tan Hwee Huat).

**Scientific name:** *Papilio demoleus malayanus* (Wallace, 1865) (Fig. 5.24)

**Common name:** lime butterfly

**Scientific family name:** Papilionidae

**Common family name:** swallow-tail butterfly family

**Adult description:** It has a wingspan of 60–80 mm (Fig. 5.24a). Male topside: The forewing is predominantly black with large cream markings that form an irregular spotted band from the tip of the forewing to the mid-dorsum of the hindwing. A series of cream-coloured submarginal spots and a red tornal spot are present on both fore- and hindwings. Male underside: Similar to that of the topside but predominantly cream in colour, with orange-red post-discal bars on the hindwings. Female topside and underside: Similar to that of the male.

**Caterpillar description:** Early instar caterpillars are dark brown with white markings that resemble bird droppings. Later instar caterpillars are green, with a few dark brown markings throughout the body. A black eye-spot is present on either side of the third thoracic segment. Caterpillars extrude a pair of orange-yellow osmeterium from the segment behind the head when disturbed (Fig. 5.24b).

**Host plants:** *Citrus* spp. (Rutaceae), *Merope angulata* (Rutaceae)

**Typical behaviour:** The butterfly is a fast flyer and often observed to puddle in the plot and visit flowers of *Melastoma malabathricum*.

**Habitat:** It inhabits mangrove and inland forests, parks, gardens, and urban areas.

**Natural distribution:** Northeast Arabian peninsula, east through Sri Lanka and India to China from Yunnan to Zhejiang and Taiwan, south to the Philippines, Indo-China, Peninsular Malaysia, Singapore, Sumatra, Lesser Sundas, New Guinea, and Australia

**National conservation status:** common

**References:** Corbet & Pendlebury (1992); Bascombe et al. (1999); Braby (2000); Khew (2010)

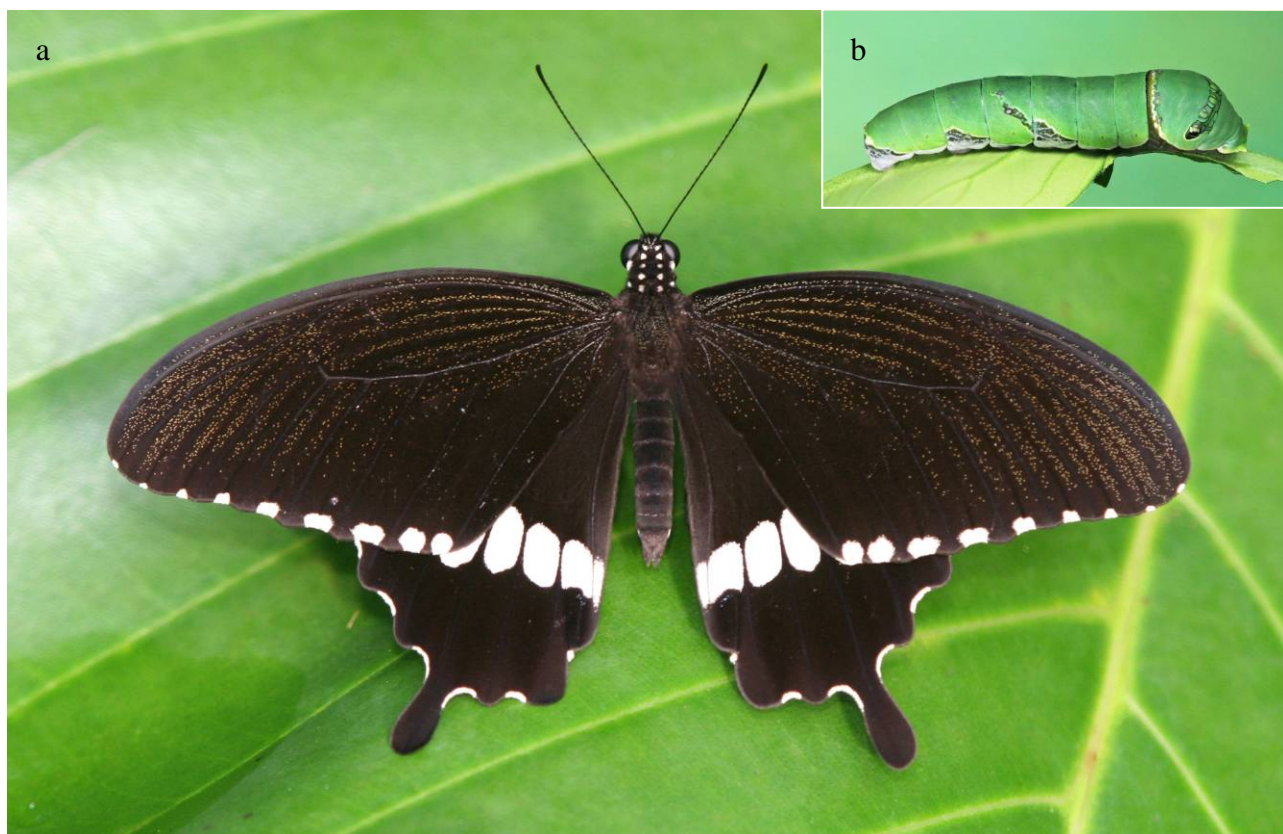


Fig. 5.25. *Papilio polytes romulus* (Cramer, 1775): a, adult, WS = 70–85 mm; b, caterpillar. (Photographs by: Horace Tan Hwee Huat).

**Scientific name:** *Papilio polytes romulus* (Cramer, 1775) (Fig. 5.25)

**Common name:** common mormon

**Scientific family name:** Papilionidae

**Common family name:** swallow-tail butterfly family

**Adult description:** It has a wing span of 70–85 mm (Fig. 5.25a). Male topside: The forewing is black, with a series of small cream dots on the distal margin which join to the spots on the hindwing to form a central band when the wings are at resting position. The hindwing bears a series of large cream oval or rectangular spots from the mid costa to the mid dorsum. The hindwing also bears a spatulate tail. Male underside: Similar to that of the topside. Female topside: The forewing is black at the basal area, while other areas are dark brown based with black central streaks in the middle of the cells. The hindwing is black based, with a spatulate tail. A cluster of white cells is present at the median area, with another red patch beside it at the inner margin. A series of red crescents runs along the subterminal margins from the mid costa to the tornus. Female underside: Similar to that of the topside.

**Caterpillar description:** Early instar caterpillars are dark brown with white markings and resemble bird droppings. Later instar caterpillars are green, with a few dark brown markings throughout the body. A black eye-spot is present on either side of the third thoracic segment. Caterpillars extrude a pair of orange-yellow osmeterium from the segment behind the head when disturbed (Fig. 5.25b).

**Host plants:** *Murraya koenigii* (Rutaceae), *Citrus grandis* (Rutaceae)

**Typical behaviour:** This butterfly is a fast flyer. It is often observed puddling in the plot, and visiting flowers of *Melastoma malabathricum*.

**Habitat:** It inhabits mangrove and inland forests, parks, gardens, and urban areas.

**Natural distribution:** Sri Lanka and India, east to China, Taiwan, Ryukyu Islands, south to Indo-China and Peninsular Malaysia, Singapore, Sulawesi, and Lesser Sundas to Tanimbar

**National conservation status:** common

**References:** Corbet & Pendlebury (1992); Bascombe et al. (1999); Khew (2010)





Fig. 5.26. *Phaedyman columella singa* (Fruhstorfer, 1899): a, adult, WS = 55–65 mm; b, caterpillar. (Photographs by: Horace Tan Hwee Huat).

**Scientific name:** *Phaedyman columella singa* (Fruhstorfer, 1899) (Fig. 5.26)

**Common name:** short banded sailor

**Scientific family name:** Nymphalidae

**Common family name:** brush-footed butterfly family

**Adult description:** It has a wing span of 55–65 mm (Fig. 5.26a). Male topside: The forewing is black, with a thin, white subcostal band arising from the base to median, followed by a disjointed white spot near the end of the band. Four white spots are present along the subapical, followed by a series of white spots along the apical. A short white band is also present midway at the dorsum which joins to the white band of the hindwing when the butterfly is at resting position. The hindwing is black, with a white bar across from mid dorsum to mid costa. A series of white apical spots is also present. Male underside: Markings are similar to the topside but the ground colour is brown. Female topside and underside: Similar to those of the male.

**Caterpillar description:** The body is brown, covered with short setae. Two pairs of forward pointing, branched spikes are present at the dorsal region of the torso, with the shorter pair near the head capsule, followed by the longer pair behind. The abdomen bears a short pair of dorsal spikes near the front of the abdomen and another short, backward pointing pair at the rear. The head capsule is rhomboid, with two pointed tips on top (Fig. 5.26b).

**Host plants:** *Pterocarpus indicus* (Fabaceae), *Cratoxylum cochinchinense* (Hypericaceae), *Hibiscus tiliaceus* (Malvaceae), *Chorisia speciosa* (Malvaceae)

**Typical behaviour:** The adult butterfly is slow in flight, often gliding. It is frequently observed flying in sunlit spots.

**Habitat:** It inhabits mangrove and inland forests, parks, gardens, and urban areas.

**Natural distribution:** India, Myanmar, Thailand, Vietnam to China, south to the Philippines, Indo-China, Peninsular Malaysia, Singapore, Sumatra, and Java to Flores

**National conservation status:** common

**References:** Corbet & Pendlebury (1992); Bascombe et al. (1999); Khew (2010)

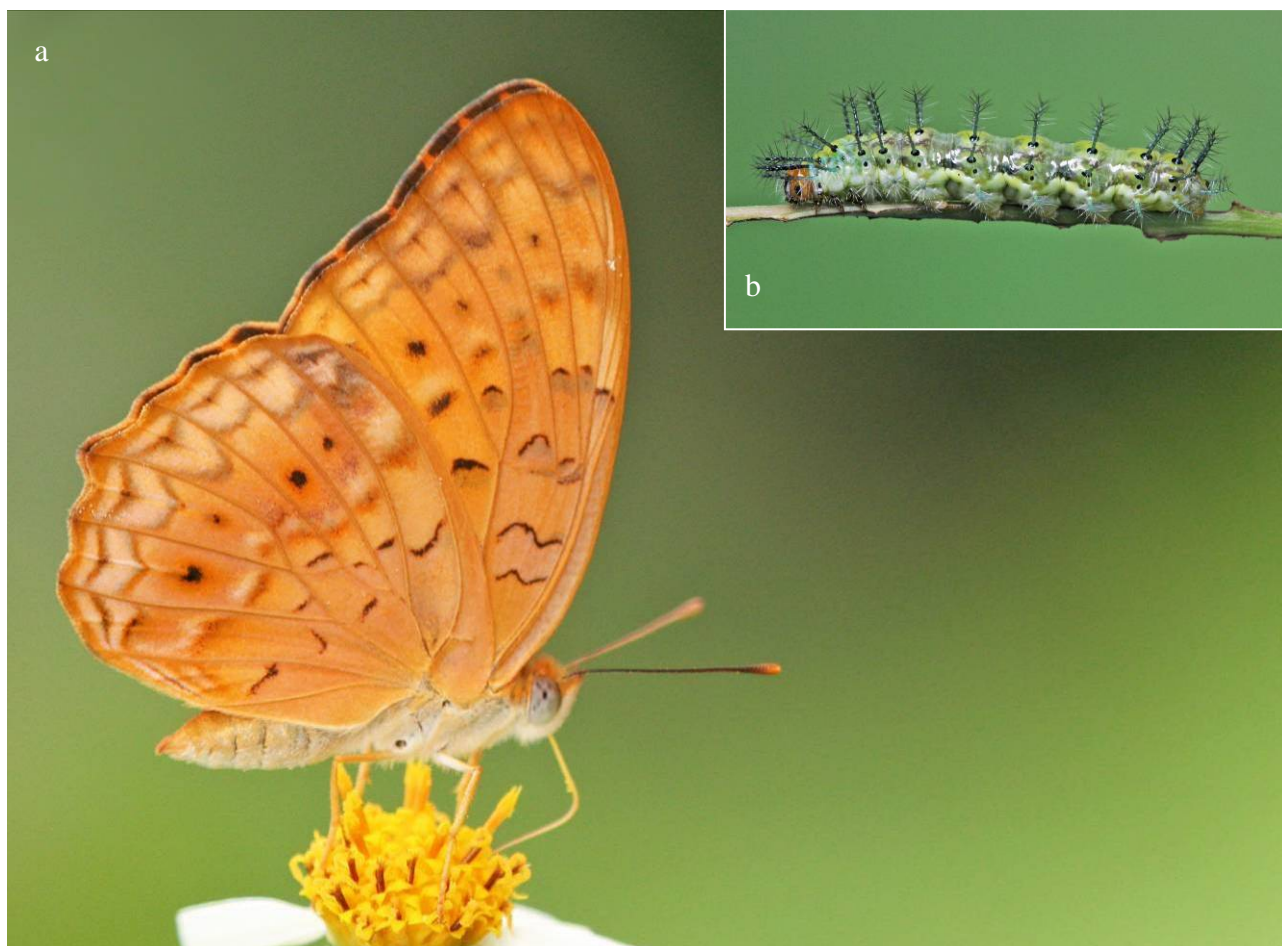


Fig. 5.27. *Phalanta phalantha phalantha* (Drury, 1773): a, adult, WS = 45–55 mm; b, caterpillar. (Photographs by: Horace Tan Hwee Huat).

**Scientific name:** *Phalanta phalantha phalantha* (Drury, 1773) (Fig. 5.27)

**Common name:** leopard

**Scientific family name:** Nymphalidae

**Common family name:** brush-footed butterfly family

**Adult description:** It has a wing span of 45–55 mm (Fig. 5.27a). Male topside: The fore and hindwings are bright orange with numerous black markings and subterminal and terminal lines. Male underside: The fore and hindwings are orange brown with brown and light brown markings. Female topside and underside: Similar to those of the male.

**Caterpillar description:** The body is greenish with minute white spots and black spots with faint orange outline throughout the body from which long branched spines arise from. The head capsule is orange and smooth (Fig. 5.27b).

**Host plants:** *Flacourtia inermis* (Salicaceae), *Flacourtia rukam* (Salicaceae), *Salix babylonica* (Salicaceae)

**Typical behaviour:** The adult butterfly is moderately fast in flight, often flying close to ground or near host plant.

**Habitat:** It inhabits mangrove and inland forests, parks, gardens, and urban areas.

**Natural distribution:** Madagascar and islands in Indian Ocean, Sri Lanka, India, Myanmar, Thailand, China, Japan, south to the Philippines, Indo-China, Peninsular Malaysia, Singapore, Sumatra, Java, Borneo, and south to Australia

**National conservation status:** common

**References:** Corbet & Pendlebury (1992); Bascombe et al. (1999); Braby (2000); Khew (2010)





Fig. 5.28. *Polyura hebe plautus* (Fruhstorfer, 1898): a, adult, WS = 60–70 mm; b, caterpillar. (Photographs by: Horace Tan Hwee Huat).

**Scientific name:** *Polyura hebe plautus* (Fruhstorfer, 1898) (Fig. 5.28)

**Common name:** plain nawab

**Scientific family name:** Nymphalidae

**Common family name:** brush-footed butterfly family

**Adult description:** It has a wing span of 60–70 mm (Fig. 5.28a). Male topside: The forewing is black with a white patch from the base to the median, with a thick black subcostal margin. A prominent white subapical spot is also present. The hindwing is similar to the forewing, except that the white spot is absent, and is forked at the tornus. A series of white subterminal crescent spots and faint terminal white bars are also present. Male underside: Similar to the topside, except that the ground colour is brown and the central patch is lime green with a thick dark brown outline. Female topside and underside: Similar to that of the male.

**Caterpillar description:** The body is green with pale green dorso-ventral crescent patches throughout the body. The head capsule has pale green and green vertical stripes, and four sparsely spiked horns emerging from the top (Fig. 5.28b).

**Host plants:** *Adenanthera pavonina* (Fabaceae), *Paraserianthes falcataria* (Fabaceae), *Parkia speciosa* (Fabaceae)

**Typical behaviour:** The adult butterfly is strong and fast in flight, often perching high up in tree canopy.

**Habitat:** It inhabits mangrove and inland forests, parks, gardens, and urban areas.

**Natural distribution:** South Myanmar, Thailand, Peninsular Malaysia, and Singapore

**National conservation status:** common

**References:** Corbet & Pendlebury (1992); Khew (2010)

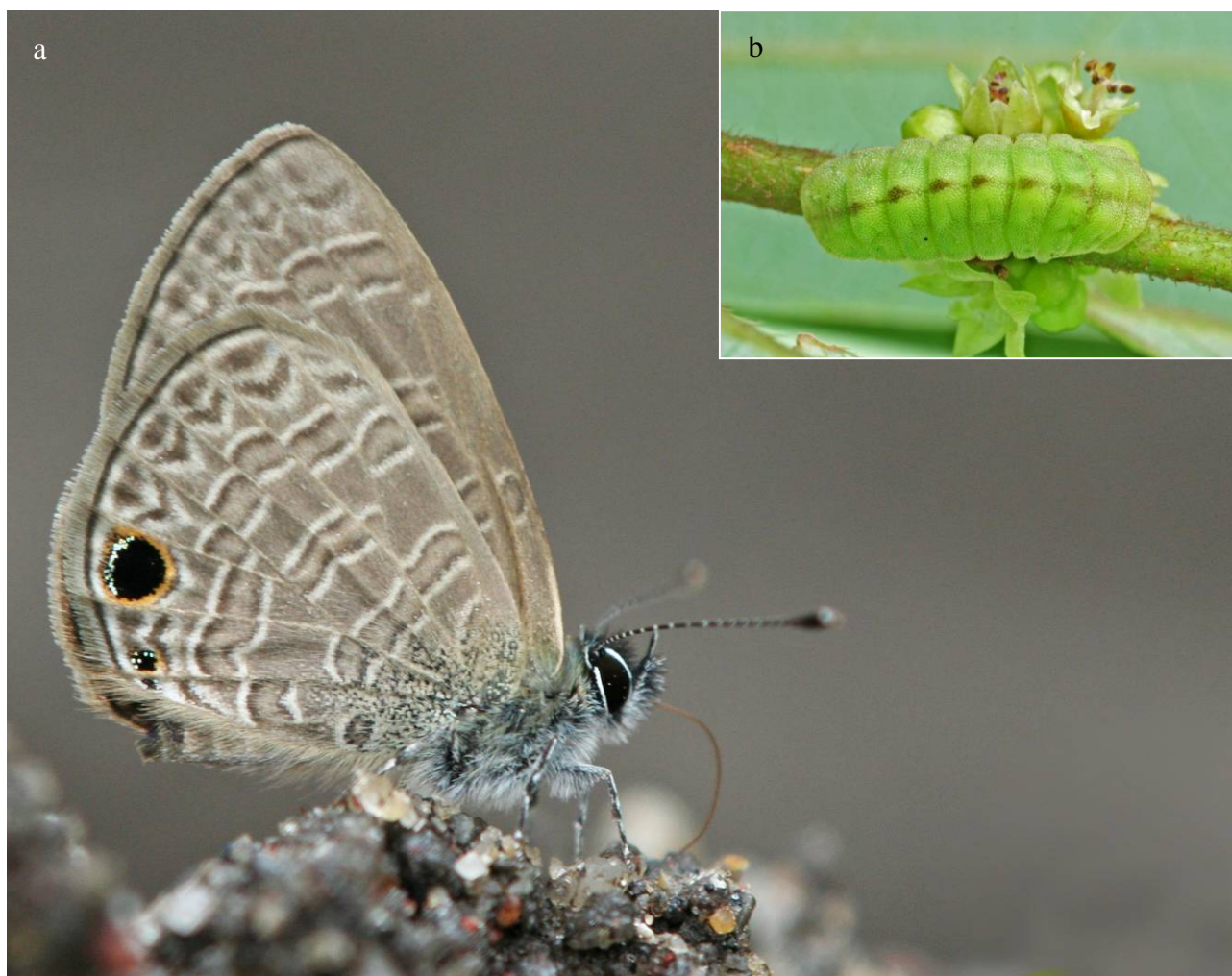


Fig. 5.29. *Prosotas dubiosa lumpura* (Corbet, 1938): a, adult, WS = 18–22 mm; b, caterpillar. (Photographs by: Horace Tan Hwee Huat).

**Scientific name:** *Prosotas dubiosa lumpura* (Corbet, 1938) (Fig. 5.29)

**Common name:** tailless line blue

**Scientific family name:** Lycaenidae

**Common family name:** gossamer-winged butterflies family

**Adult description:** It has a wing span of 18–22 mm (Fig. 5.29a). Male topside: The fore and hindwings are purple with a narrow dark brown termen. Male underside: The forewing is pale grey-brown, with a series of pale brown and white bands and spots. The hindwing is pale grey-brown, with a prominent black subterminal spot and a smaller black terminal spot. Both spots are orange-edged. Female topside: The forewing is brown with a slight bluish area in the middle to the base. The hindwing is brown with a series of dull white subterminal rings. A large brown-black terminal spot and a smaller black terminal spot are also present. Female underside: Similar to that of the male.

**Caterpillar description:** The body is green, with a series faint black dorsal spots (Fig. 5.29b).

**Host plants:** *Ardisia elliptica* (Primulaceae), *Syzygium myrtifolium* (Myrtaceae)

**Typical behaviour:** The adult butterfly is weak and erratic in flight, and often observed in grassy and open areas.

**Habitat:** It inhabits inland forests, parks, gardens, and urban areas.

**Natural distribution:** India and Sri Lanka, through Thailand, Peninsular Malaysia, Singapore, Indonesia, New Guinea, and Australia

**National conservation status:** common

**References:** Corbet & Pendlebury (1992); Braby (2000); Khew (2010)



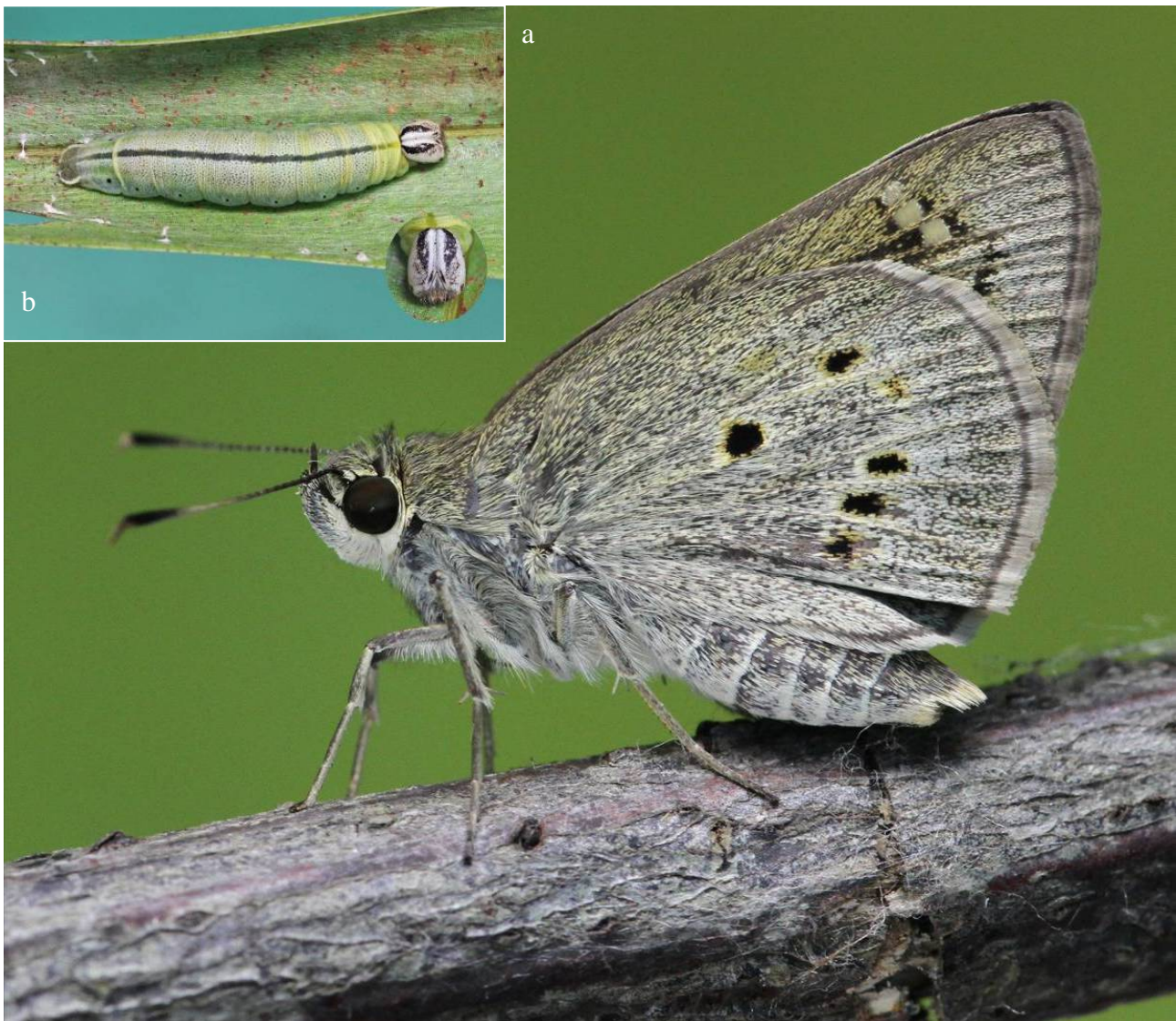


Fig. 5.30. *Suastus gremius gremius* (Fabricius, 1798): a, adult, WS = 34–36 mm; b, caterpillar. (Photographs by: Horace Tan Hwee Huat).

**Scientific name:** *Suastus gremius gremius* (Fabricius, 1798) (Fig. 5.30)

**Common name:** palm bob

**Scientific family name:** HesperIIDae

**Common family name:** skipper family

**Adult description:** It has a wing span of 34–36 mm (Fig. 5.30a). Male topside: The forewing is brown with yellow spots, while the hindwing is brown. Male underside: Similar to the topside, except that wings are paler brown. The hindwing has black spots. Female topside: Similar to that of the male, but paler. Female underside: Similar to that of the male, but paler.

**Caterpillar description:** The body is pale green with a black dorsal stripe. The head capsule is whitish with two dark brown and diffused lateral stripes (Fig. 5.30b).

**Host plants:** palms (Arecaceae)

**Typical behaviour:** The adult butterfly is fast in flight.

**Habitat:** It inhabits mangrove and inland forests, parks, and gardens.

**Natural distribution:** Sri Lanka, India, Myanmar, Thailand, China, Taiwan, south through Indo-China, Peninsular Malaysia, Singapore, and Indonesia

**National conservation status:** common

**References:** Corbet & Pendlebury (1992); Bascombe et al. (1999); Khew (2010)

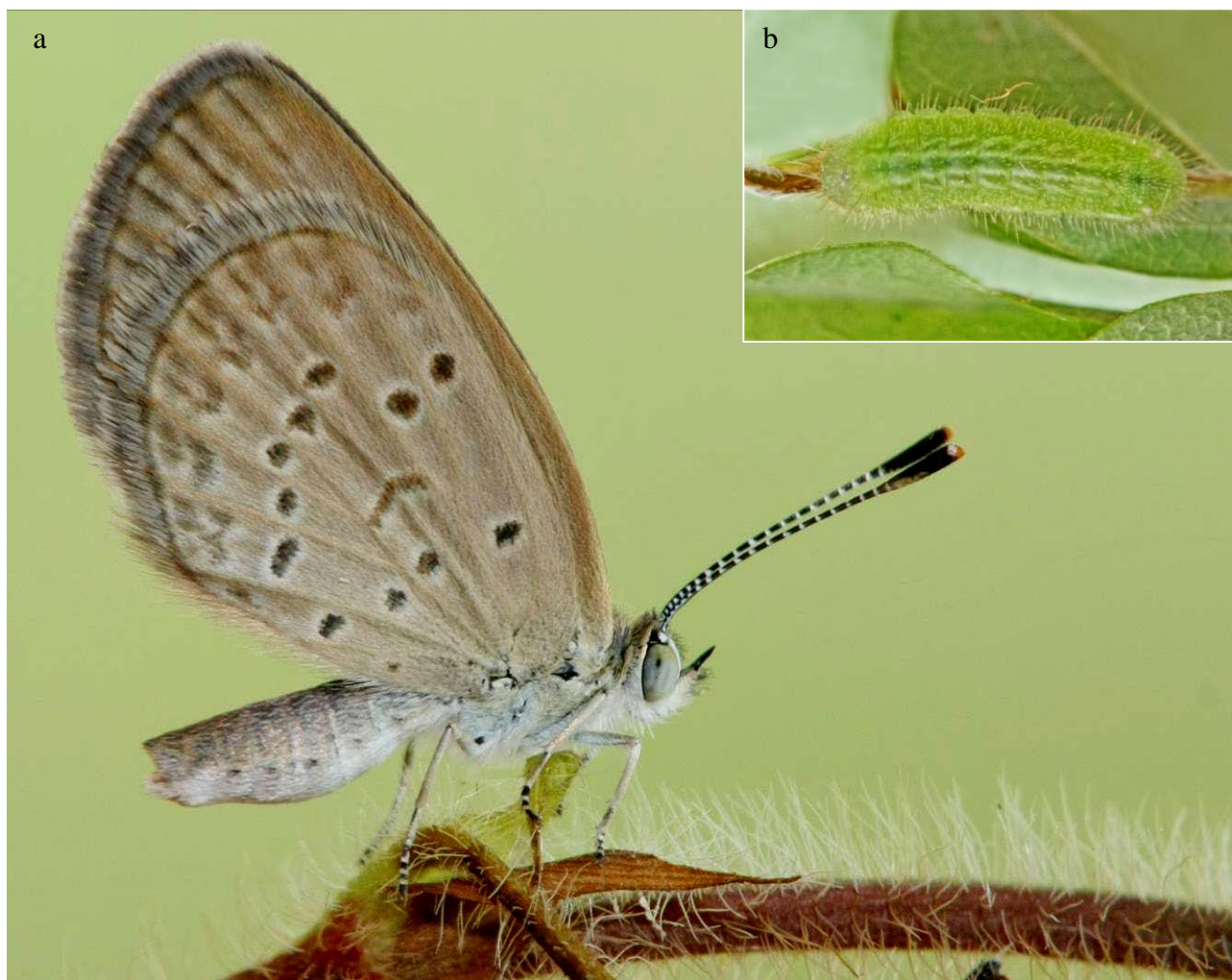


Fig. 5.31. *Zizina otis lampa* (Corbet, 1940): a, adult, WS = 14–20 mm; b, caterpillar. (Photographs by: Horace Tan Hwee Huat).

**Scientific name:** *Zizina otis lampa* (Corbet, 1940) (Fig. 5.31)

**Common name:** lesser grass blue

**Scientific family name:** Lycaenidae

**Common family name:** gossamer-winged butterflies family

**Adult description:** It has a wing span of 14–20 mm. Male topside: The fore and hindwings are dull purplish blue with broad black borders. Male underside: The fore and hindwings are pale grey with scattered small black spots and a short mid-angled band in the centre. Dark brown subterminal spots are present along with a dark brown terminal margin on fore and hindwings. Female topside: The fore and hindwings are dark brown to black. Female underside: Similar to that of the male.

**Caterpillar description:** The body is green with numerous setae throughout body (Fig. 5.31b).

**Host plants:** *Mimosa pudica* (Fabaceae), *Ruellia repens* (Acanthaceae)

**Typical behaviour:** The adult butterfly is rather slow and erratic in flight and often observed in sunny open places on grasses.

**Habitat:** It inhabits inland forests, parks, gardens, and urban areas.

**Natural distribution:** North India to China, Taiwan, Japan, south to the Philippines, Myanmar, Thailand, Indo-China, Peninsular Malaysia, Singapore, Sumatra, Java, Borneo, and Sulawesi

**National conservation status:** common

**References:** Corbet & Pendlebury (1992); Bascombe et al. (1999); Khew (2010)





Fig. 5.32. *Zizula hylax pygmaea* (Snellen, 1876): a, mating pair, WS = 8–10 mm; b, caterpillar. (Photographs by: Horace Tan Hwee Huat).

**Scientific name:** *Zizula hylax pygmaea* (Snellen, 1876) (Fig. 5.32)

**Common name:** pygmy grass blue

**Scientific family name:** Lycaenidae

**Common family name:** gossamer-winged butterflies family

**Adult description:** It has a wing span of 8–10 mm (Fig. 5.32a). Male topside: The forewing is lilac with a thick brown margin at the termen. The hindwing is lilac with a thin brown margin at the termen. Male underside: The fore and hindwings are pale grey with a series of small brown and black spots scattered throughout. Submarginal markings are present in both fore and hindwings. Female topside: Fore and hindwings are dark brown. Female underside: Similar to that of the male.

**Caterpillar description:** The body is green, with a reddish brown dorsal stripe across the body. It is also covered with numerous setae (Fig. 5.32b).

**Host plants:** *Desmodium trifolium* (Fabaceae), *Ruellia repens* (Acanthaceae), *Mimosa pudica* (Fabaceae)

**Typical behaviour:** The adult butterfly is rather slow and erratic in flight and often observed in sunny open places on grasses.

**Habitat:** It inhabits inland forests, parks, gardens, and urban areas.

**Natural distribution:** Afrotropical, Oriental and Australian regions to Solomon Islands, and Vanuatu

**National conservation status:** common

**References:** Corbet & Pendlebury (1992); Braby (2000); Khew (2010)

ANNOTATED LIST OF MOTH SPECIES

**Scientific name:** *Adoxophyes privatana* (Walker, 1863) (Fig. 5.33)

**Common name:** none

**Scientific family name:** Tortricidae

**Common family name:** tortrix moth family

**Adult description:** It has a wing span of 15–19 mm (Fig. 5.33). Male topside: The forewing is brownish yellow with thick, dark brown markings throughout and a characteristic dark spot at the base of the dorsum. The hindwing is pale brownish yellow. Female topside: The forewing is brownish yellow with brown markings outlined with cream, a median band forked at the dorsum, a small broken subapical spot, with fine transverse lines extending to the tornus, and another thinner transverse line parallel to the termen.

**Caterpillar description:** The body is about 18 mm long and is pale green.

**Host plants:** This moth is known to be polyphagous. Its hostplants include *Calophyllum inophyllum* (Calophyllaceae).

**Habitat:** It inhabits secondary forests and forest edges.

**Natural distribution:** China (Hainan), Hong Kong, Taiwan, Nepal, India, Sri Lanka, Thailand, West Malaysia, Singapore, Sumatra, Java, Borneo, and the Philippines

**National conservation status:** uncommon

**Reference:** Robinson et al. (1994)



Fig. 5.33. *Adoxophyes privatana* (Walker, 1863). Adult, WS = 15–19 mm. (Photograph by: Alvin Francis Lok Siew Loon).





Fig. 5.34. *Asota plana* (Walker, 1854): a, adult, WS = 56–65 mm (Photograph by: Ang Wee Foong); b, caterpillar (Photograph by: Alvin Francis Lok Siew Loon).

**Scientific name:** *Asota plana* (Walker, 1854) (Fig. 5.34)

**Common name:** none

**Scientific family name:** Erebidae

**Common family name:** erebid family

**Adult description:** It has a wing span of 56–65 mm. Male topside: The forewing is black, the base is orange with black spots, central region with a white longitudinal zone that spans from the subbasal to postmedian region, and a white spot at the postmedian region below the costa. The hindwing is white, with black margin from the base to the apex and terminating at the tornus. A black spot is present in the central region, and three more are present along the subterminal region. Female: Similar to that of the male.

**Caterpillar description:** The body is black, with a series of transverse yellow bands throughout the body. The head capsule is black, and the segment behind it is red. The body is covered with sparse hairs (Fig. 5.34b).

**Host plants:** *Ficus* spp. (Moraceae)

**Habitat:** It inhabits primary forests to rural environments.

**Natural distribution:** Oriental tropics east to New Guinea

**National conservation status:** common

**References:** Barlow (1982); Holloway (1988)



Fig. 5.35. *Attacus atlas* (Linnaeus, 1758): a, adult, WS = 250–300 mm (Photograph by: Leong Tzi Ming); b, caterpillar (Photograph by: Alvin Francis Lok Siew Loon).

**Scientific name:** *Attacus atlas* (Linnaeus, 1758) (Fig. 5.35)

**Common name:** atlas moth

**Scientific family name:** Saturniidae

**Common family name:** emperor moth family

**Adult description:** It has a wing span of 250–300 mm (Fig. 5.35a). Male topside: The forewing's apex is extended and curved downwards. The base colour of the wings is brown, with the base of the wing powdery black with a three-tiered angular subbasal outline. The innermost line is orange-brown, followed by white and black. A black-outlined, white triangular patch is present at the median region, and a black-outlined, white, ovoid patch above it, closer to the postmedian region. The postmedian region bears a similar three-tiered line running across it. The costa has a powdery black line from the base to near the apex and capped with a thin white outline. The apex is light brown, with dark brown streaks and an outward pointing reddish brown streak in the middle of the apex, making the apex look like the head of a snake. The termen is pale brown with a black wavy line. The hindwing base colour is brown, with a similar three-tiered line that forms a loop from the subbasal to the mid-costa region, down the median to the subterminal region. The middle of the loop is outlined in black with a white triangular patch. The postmedian region has powdery black vertical streak. The subterminal region has a series of pale brown circular to triangular patches that are light brown outlined. The termen is pale brown dark brown with black lines. Female topside: Similar to that of the male, but larger in size and the extended apex is shorter. The white patches are larger and rounder in shape.

**Caterpillar description:** The body is covered with a powdery white substance when young but disappears when mature to reveal a pale green to brown body with brownish speckles. It is also heavily armed with multiple spines throughout (Fig. 5.35b).

**Host plants:** This moth is known to be polyphagous. Its hostplants include *Ardisia elliptica* (Primulaceae) and *Fagraea auriculata* (Gentianaceae).

**Habitat:** It inhabits gardens and parks, rural scrubland, and forest edges.

**Natural distribution:** India and Southeast Asia

**National conservation status:** common

**References:** Barlow (1982); Holloway (1987)





Fig. 5.36. *Chalcocelis albiguttatus* (Snellen, 1879): a, adult female; b, adult male, WS = 25 mm (Photographs by: Buck Richardson); c, caterpillar (Photograph by: Alvin Francis Lok Siew Loon).

**Scientific name:** *Chalcocelis albiguttatus* (Snellen, 1879) (Fig. 5.36)

**Common name:** none

**Scientific family name:** Limacodidae

**Common family name:** slug moth family

**Adult description:** It has a wing span of 25 mm. Male topside: The forewing is mottled brown with dark brown and black patches (Fig. 5.36b). The median region has a black-brownish patch and a white spot in the middle. The hindwing is dark brown. Female topside: The forewing is light brown with a black strip originating from the base to sub-basal (Fig. 5.36a). The median region has a black spot, and near dorsum with white-edged brown patch and suffused black and dark brown mottling around. The subterminal region has a dark brown wavy streak. The hindwing is light brown.

**Caterpillar description:** The body is convex, ovoid and gelatinous, transparent bluish to yellowish green with five indistinct lighter longitudinal stripes. The caterpillars in this family do not have the usual prolegs as seen in other caterpillars. Instead, the undersurface of their abdomen is modified into a smooth, flexible plate with adhesive, sucker-like zones that enable the larva to move in a slug-like manner, leaving behind a trail of the adhesive substance (Fig. 5.36c).

**Host plants:** This moth is known to be polyphagous. Its host plants include *Ilex cymosa* (Aquifoliaceae).

**Habitat:** It inhabits lowland dipterocarp forests, kerangas forests, and coastal vegetation.

**Natural distribution:** South Thailand, Sundaland, Sulawesi, Moluccas, New Guinea, and Queensland (Australia)

**National conservation status:** common

**Reference:** Holloway (1986)



Fig. 5.37. *Darna trima ajavana* Holloway, 1986: a, adult, WS = 25 mm; b, caterpillar. (Photographs by: Alvin Francis Lok Siew Loon).

**Scientific name:** *Darna trima ajavana* Holloway, 1986 (Fig. 5.37)

**Common name:** none

**Scientific family name:** Limacodidae

**Common family name:** slug moth family

**Adult description:** It has a wing span of 25 mm (Fig. 5.37a). Male topside: The forewing is brown with black stripes parallel to the termen across on its wings. The hindwing is brown. In males, the bipectinate antennae may be easily observed. Female topside: Similar to that of the male.

**Caterpillar description:** The body is predominantly dark brown with pinkish white along its flanks for the posterior half. Rows of protrusions that are covered with stinging spines are present on both sides of the body, with the lateral spines being longer than the dorsal ones (Fig. 5.37b).

**Host plant:** *Fagraea auriculata* (Gentianaceae)

**Habitat:** This species inhabits agricultural areas, to dry heath and hill dipterocarps forests.

**Natural distribution:** Borneo, Peninsular Malaysia, and Sumatra

**National conservation status:** uncommon

**References:** Barlow (1982); Holloway (1986)





Fig. 5.38. *Eterusia risa* (Doubleday, 1844): a, adult, WS = 55–65 mm (Photograph by: Leong Tzi Ming); b, caterpillar (Photograph by: Alvin Francis Lok Siew Loon).

**Scientific name:** *Eterusia risa* (Doubleday, 1844) (Fig. 5.38)

**Common name:** none

**Scientific family name:** Zygaenidae

**Common family name:** burnet moth family

**Adult description:** It has a wing span of 55–65 mm (Fig. 5.38a). Male topside: The head and thorax are black with traces of metallic blue, and a red collar behind the head. The abdomen is blue with yellow laterals and longitudinal row of dark blue spots in it. The forewing is black with traces of metallic blue while the hindwing is black. Male underside: The forewing is black with a yellow band at the subbasal region and white streak at the postmedian to subterminal region. The hindwing is black with a broad yellow band at the subbasal to median region and a white streak at the subterminal region. Female topside: Larger in size. The head and thorax are black, with the absence of the red collar behind the head. The first abdominal segment is metallic blue, followed by five yellow segments and the last segment is black. The forewing is black with a yellow band at the subbasal. The hindwing is black, with a orange-yellow region from the subbasal to postmedian. Female underside: Similar to that of the male. The adults exhibit sexual dimorphism, but both sexes have attractive markings on the underwings which serve as a form of aposematic colouration to ward off potential predators.

**Caterpillar description:** The body is short and stout, with a gummy appearance. The body is translucent orange with black on the flanks along the mid-segments (Fig. 5.38b).

**Host plants:** *Melastoma malabathricum* (Melastomaceae), *Barringtonia racemosa* (Lecythidaceae)

**Habitat:** It inhabits secondary forests and forest edges.

**Natural distribution:** Borneo, Malay Peninsula, Singapore, Sumatra, and Java

**National conservation status:** uncommon

**Reference:** Leong (2009)



Fig. 5.39. *Eupanacra mydon* (Walker, 1856): a, adult, WS = 52–63 mm (Photograph by: Leong Tzi Ming); b, caterpillar (Photograph by: Alvin Francis Lok Siew Loon).

**Scientific name:** *Eupanacra mydon* (Walker, 1856) (Fig. 5.39)

**Common name:** none

**Scientific family name:** Sphingidae

**Common family name:** hawk moth family

**Adult description:** It has a wing span of 52–63 mm (Fig. 5.39a). Male topside: The forewing is brown, with suffused patches of whitish brown and black spots. The median region has an oblique, black stripe and suffused dark brown triangular patch at the termen. The hindwing is brown with suffused patches of whitish brown. Female topside: Similar to that of the male, but brown in colour with suffused patches of pale brown.

**Caterpillar description:** The body is pale yellowish green to brown, with a conspicuous pair of ocelli (eye-spots) on the first abdominal segment. The abdomen has a series of dark brown triangular dorsal patches and a wavy, dark brown lateral stripe on both sides. The rear end is pale green with a vertical dark brown band on both sides of the body that joins to an orange to brown, backward pointing, curved tail horn on the rear dorsal region. When disturbed, the larva may withdraw its head and enlarge the first abdominal segment to give the impression of a small snake-like creature, thus warding off any possible predators (Fig. 5.39b).

**Host plants:** aroids (Araceae), e.g., *Alocasia longiloba* and *Epipremnum pinnatum*

**Habitat:** Its habitats include forest edges to gardens and parks landscaped with aroids.

**Natural distribution:** Northeast India, Myanmar, Nepal, Thailand, Malay Peninsula, Vietnam, and South China

**National conservation status:** common

**References:** Barlow (1982); Holloway (1987); Inoue et al. (1997)





Fig. 5.40. *Glyphodes bivitalis* (Guenée, 1854): a, adult, WS = 30 mm; b, caterpillar. (Photographs by: Alvin Francis Lok Siew Loon).

**Scientific name:** *Glyphodes bivitalis* (Guenée, 1854) (Fig. 5.40)

**Common name:** leafroller moth

**Scientific family name:** Pyralidae

**Common family name:** none

**Adult description:** This moth has a wing span of 30 mm (Fig. 5.40a). Male topside: The forewing is brown, with a thin, curved, white subbasal line, a white comma-shaped spot between subbasal and median region, a white-outlined black spot at median region, thin, a white irregular streak along costa which ends with a white oblique postmedian streak, and a larger triangular spot from postmedian to subterminal region. The hindwing is white from the base to the postmedian region, and the rest is brown. Female topside: Similar to that of the male.

**Caterpillar description:** The body is about 25 mm long, pale translucent green, with white-edged black dorsoventral spot on both sides of the last two thoracic segments. Near rear-end of the abdomen bears more black dorsoventral spots. The head capsule is brown, with a dark brown spot behind on the first segment of the thorax (Fig. 5.40b).

**Host plants:** *Ficus* spp. (Moraceae)

**Natural distribution:** From India to Myanmar, Thailand, Hong Kong, Taiwan, Japan, throughout Southeast Asia, and Australia

**National Conservation Status:** common

**Reference:** Robinson et al. (1994)



Fig. 5.41. *Olene mendosa* (Hübner, 1823): a, adult, WS = 30–40 mm (Photograph by: Buck Richardson); b, caterpillar (Photograph by: Alvin Francis Lok Siew Loon).

**Scientific name:** *Olene mendosa* (Hübner, 1823) (Fig. 5.41)

**Common name:** none

**Scientific family name:** Erebididae

**Common family name:** erebid family

**Adult description:** It has a wing span of 30–40 mm (Fig. 5.41a). Male topside: The forewing's top-half along the costa is greyish white to the subterminal, while the bottom-half along dorsum is greyish brown, with a wavy line across the subbasal and postmedian, and a greyish white spot near the tornus. The hindwing is light brown. Female topside: The forewing is brown, with an irregular longitudinal dark brown zone in the centre. The costal margin is thick and white, tapering towards the postmedian region. The hindwing is light brown.

**Caterpillar description:** The body is black with small white spots, with a series of maroon spots on each segment from which tufts of greyish white hairs arise. The first four abdominal segments have thick dorsal tufts of golden yellow hairs. Additionally, thick lateral tufts of black and white hairs are present on the first three abdominal segments. Near the rear abdominal segment is a thick dorsal tuft of grey hair. The head capsule is red, with two dorsolateral tufts of long black hairs behind it (Fig. 5.41b).

**Host plants:** This moth is known to be polyphagous. Hostplants include *Bruguiera cylindrica* (Rhizophoraceae), *Bruguiera gymnorhiza* (Rhizophoraceae), *Syzygium myrtifolium* (Myrtaceae), and *Tristellateia australasiae* (Malpighiaceae).

**Habitat:** It inhabits undisturbed forests, to grassland and gardens.

**Natural distribution:** Oriental tropics to New Guinea and Australia

**National conservation status:** common

**References:** Barlow (1982); Holloway (1999)





Fig. 5.42. *Parapoynx* species caterpillars feeding on *Nymphoides indica* leaves underwater. (Photograph by: Alvin Francis Lok Siew Loon).

**Scientific name:** *Parapoynx* species (Fig. 5.42)

**Common name:** none

**Scientific family name:** Pyralidae

**Common family name:** pyralid family

**Adult description:** It has a wing span of 20 mm. Male topside: The fore and hindwings are generally with a chalky white background, augmented variously with brown and yellow markings. Female topside: Similar to that of the male.

**Caterpillar description:** The body is pale green with extensive series of external filamentous gills along the length of the body to maximise extraction of dissolved oxygen from the water.

**Host plant:** *Nymphoides indica* (Menyanthaceae)

**Habitat:** Stagnant or slow-flowing water bodies in gardens, parks, and forest edges.

**Natural distribution:** Southeast Asia

**National conservation status:** common

**Reference:** Robinson et al. (1994)



Fig. 5.43. *Parasa lepida* (Cramer, 1799): a, adult, WS = 45 mm (Photograph by: Shouma Sejima); b, caterpillar (Photograph by: Alvin Francis Lok Siew Loon).

**Scientific name:** *Parasa lepida* (Cramer, 1799) (Fig. 5.43)

**Common name:** nettle caterpillar, blue-striped nettle grub

**Scientific family name:** Limacodidae

**Common family name:** slug moth family

**Adult description:** It has a wing span of 45 mm (Fig. 5.43a). Male topside: The forewing base is dark brown, the subbasal to postmedian regions are apple-green, and the postmedian to termen regions are dark brown. The hindwing is yellowish, light brown from the base to median region, and the rest is brown. Female topside: Similar to that of the male.

**Caterpillar description:** The body is light green, with a blue dorsal stripe, two black lateral lines on each side, and armed with clusters of radiating stinging spines along the dorso- and ventrolateral sides of the body. The spiny clusters near the head and rear are armed with orange-red spines in the middle (Fig. 5.43b).

**Host plants:** This moth is known to be polyphagous. Hostplants include *Cyrtostachys renda* (Arecaceae) and *Ilex cymosa* (Aquifoliaceae).

**Habitat:** It inhabits secondary forests and forest edges.

**Natural distribution:** India to Japan, and most of Southeast Asia

**National conservation status:** common

**Reference:** Holloway (1986)





Fig. 5.44. *Spodoptera picta* (Guerin-Meneville, 1838): a, adult, WS = 40–45 mm (Photograph by: Buck Richardson); b, caterpillar (Photograph by: Alvin Francis Lok Siew Loon).

**Scientific name:** *Spodoptera picta* (Guerin-Meneville, 1838) (Fig. 5.44)

**Common name:** lily caterpillar moth

**Scientific family name:** Noctuidae

**Common family name:** owl moth family

**Adult description:** It has a wing span of 40–45 mm (Fig. 5.44a). Male topside: The forewing's ground colour is cream, the basal area is black reticulate-patterned and the postmedian to subterminal regions have dark red markings. The median region has a clear, oblique zone of a cream ground colour. Female topside: Similar to that of the male.

**Caterpillar description:** The body is up to about 46 mm long, smooth, black with white markings and streaks. The dorsal and flanks of the body have a distinctive bright yellow line extending from the rear to the red head capsule (Fig. 5.44b).

**Host plant:** *Crinum asiaticum* (Amaryllidaceae)

**Natural distribution:** Indo-Australian tropics, China, Japan, and Borneo

**National Conservation Status:** common

**References:** Holloway (1989); Ang et al. (2010)

## DISCUSSION

Butterflies and moths are holometabolous, that is, they undergo complete metamorphosis from their larval stage to the adult stage. They therefore have four stages in their life cycle—from the egg to the caterpillar (larva), which later becomes a pupa before emerging as an adult butterfly or moth. The adults mate and the females lay their eggs on suitable host plants for the caterpillars to feed on, and the whole life cycle continues. Hence, the planting of suitable host plants in the Native Garden @ HortPark is one of the key factors in attracting butterflies and moths to breed and reside within it. Some species have specific hostplants which their caterpillar must feed on in order to survive. On the other hand, there are those that are polyphagous (eating many plant species), and are not that fastidious when it comes to the selection of host plants. These are usually moth species.

Other than providing a source of larval food, plants that provide food for the adult Lepidoptera are essential as well. Flowering plants in the plot that produce nectar, such as *Clerodendrum inerme*, *Fagraea racemosa*, *Leea* species, *Lumnitzera racemosa*, and *Melanthera biflora*, attract many butterfly and moth species to visit their flowers. In addition, rotting fruits that are fleshy and high in sugar content also provide an alternative food source to adult butterflies and moths. These include those of *Melastoma malabathricum* and *Rhodomyrtus tomentosa*.

Landscaping using plants of different heights and shapes to create a densely grown garden reduces high wind velocity within the plot and also provides shade, pockets of open areas, and different microhabitats to facilitate the perching and flying needs of butterflies and moths.

The newly completed freshwater mangrove extension of the Native Garden @ HortPark provides many bare, exposed, shallow, and muddy areas for butterfly species to land and puddle. This behaviour of puddling is commonly observed in male butterflies in order to acquire water and, more importantly, natural salts from the ground for reproduction (Khew, 2010). The common bluebottle (*Graphium sarpedon luctatius*; Fig. 5.17a) and the lemon emigrant (*Catopsilia pomona pomona*; Figs. 5.7, 5.8a) were commonly observed to be puddling during the survey period (Fig. 5.45).



Fig. 5.45. A pair of lemon emigrants (*Catopsilia pomona pomona*) puddling on wet ground for salt. (Photograph by: Ang Wee Foong).



With preliminary observations of at least 10 moth and 26 butterfly species inhabiting the Native Garden @ HortPark, either as caterpillars and/or adults, we are convinced that the careful selection and propagation of native plant species can adequately provide larval and adult food sources for a potentially broader spectrum of butterfly and moth species. Continued monitoring of this site will undoubtedly lead to an increase in the number of butterfly and moth species observed. A deeper understanding of caterpillar biology and development, and better identification of caterpillars will be possible with a concerted effort to rear and document caterpillar development and metamorphosis.

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## ODONATES: DAMSELFLIES AND DRAGONFLIES

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### INTRODUCTION

Modern-day odonates (Order Odonata of the insects) are divided into two main suborders, namely Anisoptera (true dragonflies) and Zygoptera (damselflies) (Silsby, 2001; Orr, 2003). There is also a third suborder, Anisozygoptera, which consists of only two living members showing both dragonfly and damselfly characters (Silsby, 2001). A total of about 124 species of odonates have been recorded here in Singapore and these inhabit a myriad of natural habitats including marshes, streams, rivers, and swamp forests. Today many species have adapted to the ever-changing Singapore environment and have utilised man-made habitats such as ponds, reservoirs, canals, drains, and even periodically flooded fields (Tang et al., 2010).

An odonate's body is divided into three main parts—the head, thorax, and abdomen (Silsby, 2001; Orr, 2003; Tang et al., 2010) (Fig. 6.1). The head for all odonates is the business end of the insect, making them ferocious aerial predators. Apart from the menacing mandibles (jaws), the head also contains all the important sensory organs such as a pair of antennae on the forehead, a pair of large compound eyes, and three simple eyes (ocelli). The back of the head is called the occiput, while the top of the head is called the vertex. The head joins the thorax via two chitinous plates (sclerites) that allows a great deal of head mobility. The thorax is the locomotory centre for the insect and consists of three segments, each bearing a pair of legs. The first segment (closest to the head) is small and is called the prothorax. The two posterior segments (meso- and metathorax) are fused to form the synthorax and carry the two pairs of wings. The legs are well developed and are used for perching and seizing prey while in flight. Each leg consists of the three sections, namely the femur, tibia, and the tarsus (with a pair of tiny claws). The wings are usually hyaline (transparent) although some

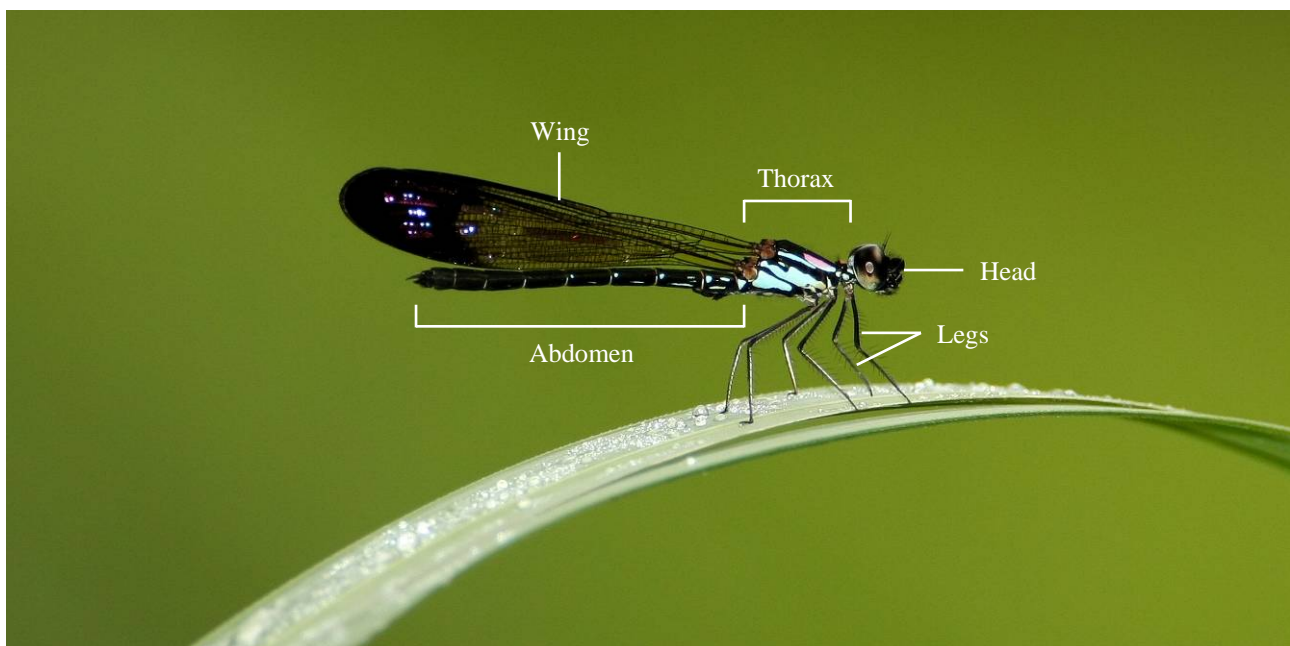


Fig. 6.1. General parts of an odonate. (Photograph by: Alvin Francis Lok Siew Loon).

species have coloured or partially coloured patches on their wings. The membrane of the wings are strengthened and supported by longitudinal veins, which are linked by a multitude of crossveins. The venation is also a useful diagnostic feature in distinguishing the families and subfamilies. The abdomen is the last section of the odonate body and it is divided into 10 segments, with the dorsal (upper) surface frequently coloured or patterned with spots or lines. The abdomen is usually long and narrow. At the tip of the male's abdomen are the anal appendages which are used to clasp a female round her prothorax in the case of damselflies or at the back of the head for dragonflies during the mating process. The sperm is then transferred from the male's genitalia under abdominal segment 9, near the tip of its abdomen, to its secondary genitalia at segment 2. The female's genitalia are located on the underside of the segments 8 and 9, and in all damselflies as well as some dragonflies (Aeshnidae), these are modified into ovipositors with complicated structures to insert eggs into plant tissue, mud, or other substrates.

Dragonflies and damselflies show morphological differences and can be easily distinguished from each other (Silsby, 2001). Dragonflies are strongly built and look more robust while damselflies are slender and graceful-looking (Tang et al., 2010). The compound eyes in dragonflies are never separated by more than their own width or appear almost touching each other, while damselflies' eyes appear to be separated by more than their own width. In dragonflies the two pairs of wings are not similar in shape, with the hindwings much broader at the base than at the tip. Also, while at rest, the wings are held flat or depressed downwards. In damselflies, however, the hindwings and forewings are similar and are held together over the body when at rest.

Dragonflies have three developmental stages in their life cycle: the egg, the larva, and the adult (Silsby, 2001; Orr, 2003; Tang et al., 2010). The egg and larval stages are aquatic, while the adult is terrestrial. Eggs are laid in vegetation, mud, or directly in the water of ponds, streams, and swamps. Depending on the species, the eggs take a few weeks or months to develop before hatching into larvae.

Odonate larvae breathe using gills (Silsby, 2001; Orr, 2003; Tang et al., 2010). The gills of dragonflies take the form of projections into an expanded chamber within the rectum, while those of damselflies are external and generally take the form of three flat caudal appendages at the tip of the abdomen. The most peculiar feature of the larva is its labium, a lower lip that has been modified to form a long, hinged apparatus with sharp teeth at its extremity. It is used to capture live prey such as larvae of mosquitoes, aquatic insects, tadpoles, and even small fishes. The larvae moult 8–15 times as they grow, developing 'wing buds' which can be seen as they near maturity. The larval stage varies from several months to well over a year, depending on species and environmental conditions such as the water temperature and availability of food.

When fully developed, the larva climbs out of the water onto a twig, stem, or rock, and begins its "emergence". Its skin splits behind the head and on top of the thorax (Silsby, 2001; Orr, 2003; Tang et al., 2010). With a slight struggle, the young adult will emerge from the old larval skin, which is left behind. The freshly-emerged dragonfly is pale in colour, weak, and cannot fly very well. The adult dragonflies are predators and capture live prey on the wing. Its diet consists mainly of small insects such as flies and mosquitoes. Some species are capable of taking larger prey such as moths, butterflies, other dragonflies, and occasionally even those of their own kind.

In this chapter, we seek to catalogue the recruitment of damselfly and dragonfly species over an eight month period, through a survey conducted at the Native Garden @ HortPark from 10 May to 9 December 2010. This survey would help ascertain how effective a well-vegetated, artificially-created habitat in an urban setting would be in the recruitment of odonates, from the initial stages of being established and over an eight month maturation phase of the system.



## METHODS

From 10 May to 9 December 2010, visits were made to the Native Garden @ HortPark. A visual census was then made for about 30 minutes to an hour, by walking around the plot, spending an equal amount of time in both the stream and pond areas. Surveys were conducted in the morning and afternoon, starting mainly from around 0930 hours and ending at around 1230 hours in the morning, and then starting again at 1400 hours and ending around 1745 hours in the afternoon. Only a visual census was made with no specimens collected. However, photographs were taken to catalogue the species encountered. The specimens were photographed using a Canon EOS 50D digital SLR camera with a Canon telephoto-macro lens EF 180 mm f/3.5 L and a Canon Speedlite 580EX II flash.

Each damselfly or dragonfly species description includes its scientific name, common name, scientific family name, common family name, morphology, typical behaviour, habitat, natural distribution, and national conservation status. In the descriptions and figure legends, the following abbreviations are used: TBL = total body length from the tip of head to the tip abdomen; and HWL = hindwing length.

## OBSERVATIONS

A total of 25 odonates were recorded (Table 6.1). The annotated list of odonates follow.

Table 6.1. Native damselflies and dragonflies of the Native Garden @ HortPark.

S/No.	Scientific Name	Common Name	Family	Local Status
1.	<i>Aethriamanta aethra</i>	blue adjutant	Libellulidae	Rare
2.	<i>Aethriamanta brevipennis</i>	scarlet adjutant	Libellulidae	Rare
3.	<i>Aethriamanta gracilis</i>	pond adjutant	Libellulidae	Common
4.	<i>Agriocnemis femina</i>	variable wisp	Channidae	Widespread and common
5.	<i>Anax guttatus</i>	emperor	Aeshnidae	Uncommon
6.	<i>Brachydiplax chalybea</i>	blue dasher	Libellulidae	Widespread and common
7.	<i>Ceriagrion cerinorubellum</i>	ornate coraltail	Coenagrionidae	Widespread and common
8.	<i>Crocothemis servilia</i>	common scarlet	Libellulidae	Widespread and common
9.	<i>Ictinogomphus decoratus melaenops</i>	common flangtail	Gomphidae	Widespread and common
10.	<i>Ishnura senegalensis</i>	common bluetail	Coenagrionidae	Widespread and common
11.	<i>Neurothemis fluctuans</i>	common parasol	Libellulidae	Widespread and common
12.	<i>Orthetrum chrysis</i>	spine-tufted skimmer	Libellulidae	Widespread and common
13.	<i>Orthetrum glaucum</i>	common blue skimmer	Libellulidae	Common
14.	<i>Orthetrum sabina</i>	green skimmer	Libellulidae	Widespread and common
15.	<i>Orthetrum testaceum</i>	scarlet skimmer	Libellulidae	Common
16.	<i>Pantala flavescens</i>	wandering glider	Libellulidae	Common
17.	<i>Potamarcha congener</i>	common chaser	Libellulidae	Common
18.	<i>Pseudagrion microcephalum</i>	blue sprite	Coenagrionidae	Widespread and common
19.	<i>Rhyothemis phyllis</i>	yellow-barred flutter	Libellulidae	Widespread and common
20.	<i>Tholymis tillarga</i>	white-barred duskhawk	Libellulidae	Widespread and common
21.	<i>Tramea transmarina euryale</i>	saddlebag glider	Libellulidae	Common
22.	<i>Trithemis aurora</i>	crimson dropwing	Libellulidae	Widespread and common
23.	<i>Trithemis festiva</i>	indigo dropwing	Libellulidae	Common
24.	<i>Trithemis pallidinervis</i>	dancing dropwing	Libellulidae	Uncommon migrant
25.	<i>Urothemis signata insignata</i>	scarlet basker	Libellulidae	Widespread and common

ANNOTATED LIST OF ODONATE SPECIES

**Scientific name:** *Aethriamanta aethra* Ris, 1912 (Fig. 6.2)

**Common name:** blue adjutant

**Scientific family name:** Libellulidae

**Common family name:** skimmer family

**Description:** A small-sized blue dragonfly. The male total body length is 27–30 mm and the hindwing length is 23–25 mm. Both males and females have black hairs on the thorax and a conspicuous dark brown patch at the base of the hindwings. The males differ from the females by having their last four segments darkened compared to the females, which have their last five segments darkened.

**Typical behaviour:** This is a shy, inconspicuous dragonfly that is often overlooked.

**Habitat:** It inhabits marshes, open swamp forests, and well-vegetated ponds.

**Natural distribution:** Southeast Asia

**National conservation status:** rare

**Reference:** Tang et al. (2010)



Fig. 6.2. *Aethriamanta aethra* Ris, 1912. Adult male, TBL = 27–30 mm, HWL = 23–25 mm. (Photograph by: Norman Lim T-Lon).





Fig. 6.3. *Aethriamanta brevipennis* (Rambur, 1842). Adult male, TBL = 26–28 mm, HWL = 22–23 mm. (Photograph by: Norman Lim T-Lon).

**Scientific name:** *Aethriamanta brevipennis* (Rambur, 1842) (Fig. 6.3)

**Common names:** scarlet adjutant

**Scientific family name:** Libellulidae

**Common family name:** skimmer family

**Description:** A small-sized red dragonfly. The male total body length is 26–28 mm and the hindwing length is 22–23 mm. It is easily distinguished from other red dragonfly species by its small size, short and broad abdomen, dark brown hairy thorax, and dark brown eyes. The wings have an open venation with a dark brown patch with yellow edging at the base of the hindwings. The females, on the other hand, are light golden brown, with dark brown rings on the abdomen demarcating each segment. The distal end of the hind thighs is reddish in males and yellowish in the females.

**Typical behaviour:** This dragonfly is a wary species, often perching away from the water's edge. It shows strong territorial behaviour despite their rather small size, often fighting off larger species.

**Habitat:** It inhabits weedy ponds near forest.

**Natural distribution:** South and Southeast Asia; increasing in abundance in Singapore after its first record in 2004

**National conservation status:** rare

**Reference:** Tang et al. (2010)

**Scientific name:** *Aethriamanta gracilis* (Brauer, 1878) (Fig. 6.4)

**Common name:** pond adjutant

**Scientific family name:** Libellulidae

**Common family name:** skimmer family

**Description:** A small-sized dragonfly. The male total body length is 26–28 mm and the hindwing length is 22–23 mm. It has a whitish-blue body with the last two segments of the abdomen dark. The base of the hindwing is tinted brown. The female is brown with black markings.



Fig. 6.4. *Aethriamanta gracilis* (Brauer, 1878). Adult male, TBL = 26–28 mm, HWL = 22–23 mm. (Photograph by: Tang Hung Bun).





Fig. 6.5. *Agriocnemis femina* (Brauer, 1868): a, mature adult male, TBL = 20–22 mm, HWL = 9–10 mm; b, immature adult female, TBL = 20–22 mm, HL = 9–10 mm. (Photographs by: Norman Lim T-Lon).

**Typical behaviour:** The males are territorial and can often be seen chasing away rival males at high speed in their breeding grounds.

**Habitat:** It occurs around open grassy water-bodies and some reservoir inlets.

**Natural distribution:** Thailand, Malay Peninsula, Sumatra, Java, Borneo, Sulu Islands, and the Moluccas

**National conservation status:** common

**References:** Tang et al. (2010); Orr (2003)

**Scientific name:** *Agriocnemis femina* (Brauer, 1868) (Fig. 6.5)

**Common names:** variable wisp

**Scientific family name:** Coenagrionidae

**Common family name:** pond damsel family

**Description:** Difficult to identify, this is a tiny damselfly, which undergoes colour changes as it matures. Young males are light mint-green and black with an orange tip on the abdomen, later turning to a frosty white on the thorax and losing its orange tip on the abdomen (Fig. 6.5a). The immature females, in contrast, are bright cherry-red (Fig. 6.5b), maturing to an olive colour with

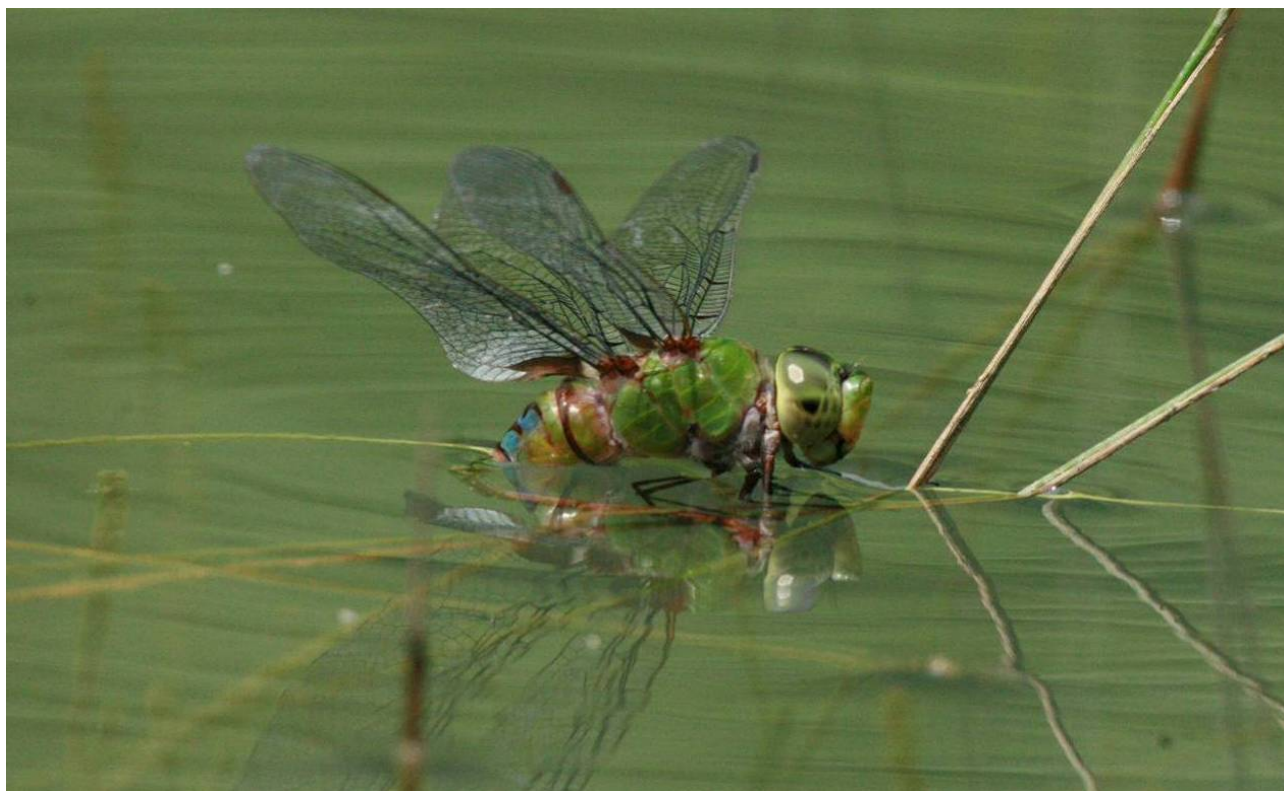


Fig. 6.6. *Anax guttatus* (Burmeister, 1839). Adult female ovipositing; TBL = 80–86 mm, HWL = 52–56 mm. (Photograph by: Norman Lim T-Lon).

dark brown markings on the dorsal side. The male total body length is 20–22 mm and the hindwing length is 9–10 mm.

**Typical behaviour:** This tiny damselfly prefers well-vegetated water edges where they perch amongst grass and foliage.

**Habitat:** Almost always found in open country in grassy areas near drains, ponds, and reservoirs, but also found in nearby swamps.

**Natural distribution:** Sri Lanka, West Bengal eastwards to Japan, Guam, New Guinea, Australia, and the Pacific Islands

**National conservation status:** widespread and common

**References:** Silsby (2001); Orr (2003); Tang et al. (2010)

**Scientific name:** *Anax guttatus* (Burmeister, 1839) (Fig. 6.6)

**Common name:** emperor

**Scientific family name:** Aeshnidae

**Common family name:** hawk family

**Description:** A large-sized dragonfly. The male total body length is 80–86 mm and the hindwing length is 52–56 mm. The thorax is green, while the second and third abdominal segments are blue and slightly swollen. The other segments of the abdomen are strongly spotted. The inner half of the hindwing is slightly tinted brown. The male and female are similarly marked.

**Typical behaviour:** This is a large and robust dragonfly. Males can sometimes be seen patrolling a pond or stream by flying along the margin at great speed, defending their territories. Females oviposit by inserting their eggs into plant tissues below the water surface.

**Habitat:** Occurs in open habitats with standing or slow-flowing water, such as drains and ponds.

**Natural distribution:** South and Southeast Asia, Australia, and the Pacific Islands

**National conservation status:** uncommon

**References:** Orr (2003); Tang et al. (2010)





Fig. 6.7. *Brachydiplax chalybea* Brauer, 1868. Adult male, TBL = 33–35 mm, HWL = 24–27 mm. (Photograph by: Norman Lim T-Lon).

**Scientific name:** *Brachydiplax chalybea* Brauer, 1868 (Fig. 6.7)

**Common name:** blue dasher

**Scientific family name:** Libellulidae

**Common family name:** skimmer family

**Description:** This is a medium-sized blue dragonfly. The male body length is 33–35 mm and the hindwing length is 24–27 mm. Males are powdery light blue on the abdomen and thorax, with the last three of the abdominal segments darkened to almost black. The sides of the thorax and the first three adjoining abdominal segments are light golden brown. The hindwings show a slight brownish yellow tint, which separates it from other similar-looking species. The female, on the other hand, has a brownish-yellow body with dark markings on the dorsal surface of the abdominal segments, and has a totally transparent hindwing base.

**Typical behaviour:** Males are highly territorial with territories of a few square metres, and are often observed chasing away other males. Mating and ovipositing occurs in the early afternoon. Females lay their eggs by flicking the tip of their abdomen on the water surface.

**Habitat:** It can be found on almost any body of standing or slow-flowing water such as ponds, drains, disturbed open habitats, and reservoirs.

**Natural distribution:** Asia

**National conservation status:** widespread and common

**References:** Silsby (2001); Orr (2003); Tang et al. (2010)

**Scientific name:** *Ceriagrion cerinorubellum* (Brauer, 1865) (Fig. 6.8)

**Common name:** ornate coraltail

**Scientific family name:** Coenagrionidae

**Common family name:** pond damsel family



Fig. 6.8. *Ceriagrion cerinorubellum* (Brauer, 1865). Tandem pair; TBL = 35–38 mm, HWL = 17–18 mm. (Photograph by: Norman Lim T-Lon).





Fig. 6.9. *Crocothemis servilia* (Drury, 1773): a, adult male, TBL = 40–43 mm, HWL = 31–33 mm; b, female, TBL = 40–43 mm, HWL = 31–33 mm. (Photographs by: Norman Lim T-Lon).

**Description:** The male total body length is 35–38 mm and the hindwing length is 17–18 mm. Males are pale bluish green on the head and thorax. The base and tip of the abdomen are a dull red-orange. The females are somewhat similar in appearance but are paler and duller in colour and lack the orange abdominal tip, which in their case, is usually a light brownish grey.

**Typical behaviour:** The damselfly is a fierce predator for its size and is often seen preying on resting insects from vegetation surrounding their breeding habitats.

**Habitat:** It is usually found around ponds, drains in disturbed areas, urban gardens, and reservoirs.

**Natural distribution:** South and Southeast Asia

**National conservation status:** widespread and common

**References:** Orr (2003); Tang et al. (2010)

**Scientific name:** *Crocothemis servilia* (Drury, 1773) (Fig. 6.9)

**Common name:** common scarlet

**Scientific family name:** Libellulidae

**Common family name:** skimmer family

**Description:** A medium-sized red dragonfly. The male total body length is 40–43 mm and the hindwing length is 31–33 mm. Males are entirely red from the eyes to the abdomen (Fig. 6.9a). Males also have a light reddish patch at the base of the hindwings. Females, in contrast to the males, are light yellow brown (Fig. 6.9b). The base of the hindwing is yellow. Both sexes have a dark brown to blackish stripe down the dorsal abdominal surface. This dragonfly is often confused with red *Orthetrum* species, but can be distinguished by the presence of an incomplete distal antenodal crossvein on the forewing.

**Habitat:** It can be observed around disturbed open habitats as well as grassy marshes, and are normally found around artificial water bodies.



Fig. 6.10. *Ictinogomphus decoratus melaenops* (Selys, 1858). Adult male, TBL = 40–43 mm, HWL = 31–33 mm. (Photograph by: Norman Lim T-Lon).

**Natural distribution:** Middle East, tropical and subtropical Asia, to New Guinea

**National conservation status:** widespread and common

**References:** Orr (2003); Tang et al. (2010)

**Scientific name:** *Ictinogomphus decoratus melaenops* (Selys, 1858) (Fig. 6.10)

**Common name:** common flangtail

**Scientific family name:** Gomphidae

**Common family name:** clubtail family

**Description:** This is a heavily-built and large-sized dragonfly. The male total body length is 64–68 mm and the hindwing length is 37–40 mm. The thorax and abdomen are black with greenish yellow bands. The eyes are greyish green. Females are similarly coloured and patterned as the males.

**Typical behaviour:** This dragonfly is often observed perching very conspicuously in direct sunlight on emergent vegetation or exposed fallen branches by the edges of reservoirs or lakes. It is a strong flyer like most members of its family, and often observed gliding over exposed bodies of water, with few wing beats.

**Habitat:** This species inhabits open habitats such as drains, ponds, and reservoirs.

**Natural distribution:** Southeast Asia

**National conservation status:** widespread and common

**References:** Orr (2003); Tang et al. (2010)





Fig. 6.11. *Ishnura senegalensis* (Rambur, 1842). Adult mating pair; TBL = 28–30 mm, HWL = 14–15 mm. (Photograph by: Tang Hung Bun).

**Scientific name:** *Ishnura senegalensis* (Rambur, 1842) (Fig. 6.11)

**Common name:** common bluetail

**Scientific family name:** Coenagrionidae

**Common family name:** pond damsel family

**Description:** This is a small, robust, and sexually-dimorphic damselfly. The male total body length is 28–30 mm and the hindwing length is 14–15 mm. Males are predominantly green on the lower thorax, with shiny metallic blue and black on segment 2 of the abdomen with darker blue on the segment 8 and sides of segment 9. Females are polymorphic, showing colour variations including orange and olive-green forms. Andromorphic (male-looking) females do occur but are rarer.

**Typical behaviour:** It is a ferocious killer, not hesitating to take on prey (other damselflies) as big as itself. It also exhibits cannibalism.

**Habitat:** It is very common around slow-flowing water bodies such as small drains, ponds, and lakes. It is usually absent from forest areas.

**Natural distribution:** It is probably the species with the widest distribution in the genus, ranging from Africa to New Guinea.

**National conservation status:** widespread and common

**References:** Silsby (2001); Orr (2003); Tang et al. (2010)

**Scientific name:** *Neurothemis fluctuans* (Fabricius, 1793) (Figs. 6.12, 6.13)

**Common name:** common parasol

**Scientific family name:** Libellulidae



Fig. 6.12. *Neurothemis fluctans* (Fabricius, 1793): a, adult mature male, TBL = 30–34 mm, HWL = 22–25 mm; b, adult juvenile male, TBL = 30–34 mm, HWL = 22–25 mm. (Photographs by: Norman Lim T-Lon).



Fig. 6.13. *Neurothemis fluctans* (Fabricius, 1793). Adult female, TBL = 30–34 mm, HWL = 22–25 mm. (Photograph by: Tang Hung Bun).





Fig. 6.14. *Orthetrum chrysis* (Selys, 1891). Adult male, TBL = 41–48 mm, HWL = 31–34 mm. (Photograph by: Norman Lim T-Lon).

**Common family name:** skimmer family

**Description:** This is a medium-sized dragonfly. The male total body length is 30–34 mm and the hindwing length is 22–25 mm. Adult males have a reddish-brown thorax and abdomen, with most of their wings opaque red (Fig. 6.12a). The juvenile males are similarly patterned except the reddish brown and red are replaced with a light yellow brown (Fig. 6.12b). Females are similarly coloured to the immature males except that their wings are entirely transparent with no opaque patches (Fig. 6.13).

**Habitat:** This dragonfly is found in most habitats where there is a body of water, including ponds, drains, marshes, ditches, reservoirs, and even around temporarily waterlogged ground.

**Natural distribution:** Tropical Asia

**National conservation status:** widespread and common

**References:** Orr (2003); Tang et al. (2010)

**Scientific name:** *Orthetrum chrysis* (Selys, 1891) (Fig. 6.14)

**Common name:** spine-tufted skimmer

**Scientific family name:** Libellulidae

**Common family name:** skimmer family

**Description:** A medium-sized dragonfly. The male total body length is 41–48 mm and the hindwing length is 31–34 mm in length. Males have red mandibles with dark brown eyes. The thorax is dark rusty brown while the abdomen is bright red. The females are a light reddish brown with more prominent dark brown rings around the abdomen.

**Habitat:** It is most commonly encountered along old well-vegetated drains near forests and virtually any slow-flowing or standing water such as small streams and ponds, but is also occasionally encountered along pristine forest streams.

**Natural distribution:** Tropical Asia

**National conservation status:** widespread and common

**References:** Silsny (2001); Orr (2003); Tang et al. (2010)



Fig. 6.15. *Orthetrum glaucum* (Brauer, 1865). Adult male, TBL = 41–46 mm, HWL = 32–35 mm. (Photograph by: Tang Hung Bun).



Fig. 6.16. *Orthetrum glaucum* (Brauer, 1865). Adult female, TBL = 41–46 mm, HWL = 32–35 mm. (Photograph by: Tang Hung Bun).

**Scientific name:** *Orthetrum glaucum* (Brauer, 1865) (Figs. 6.15, 6.16)

**Common name:** common blue skimmer

**Scientific family name:** Libellulidae

**Common family name:** skimmer family

**Description:** This is a medium-sized dragonfly. The total body length is 41–46 mm and the hindwing length is 32–35 mm. The male has greenish-blue eyes, a dark blue thorax, and light blue





Fig. 6.17. *Orthetrum sabina* (Drury, 1773). Adult mating pair; TBL = 47–52 mm, HWL = 32–35 mm. (Photograph by: Norman Lim T-Lon).

abdomen with the last two segments darkened (Fig. 6.15). The female is light brown (Fig. 6.16). The young male resembles the female. In both males and females, blue pruinescence develops as the dragonfly ages, so that the body is covered with powdery blue.

**Habitat:** Streams and drains near the forests in and around the nature reserves. It can occasionally be seen outside the nature reserves.

**Natural distribution:** widespread in tropical Asia, reaching New Guinea in the east

**National conservation status:** common

**References:** Orr (2003); Tang et al. (2010)

**Scientific name:** *Orthetrum sabina* (Drury, 1773) (Fig. 6.17)

**Common name:** green skimmer

**Scientific family name:** Libellulidae

**Common family name:** skimmer family

**Description:** A medium- to large-sized dragonfly. The male total body length is 47–52 mm and the hindwing length is 32–35 mm in length. Males and females are similarly coloured and patterned. They have a pale mint green thorax and abdomen, with reticulated black markings on the thorax. The first three segments of the abdomen adjoining the thorax are swollen. Anal appendages are white to off-white.

**Typical behaviour:** This species is often inclined to fly far from their breeding sites and thus are often found far from water bodies. It is also one of the widest ranging species that is found from sea level to as high as 1000 m where breeding has been recorded. It is a very fierce predator and often preys on butterflies and other odonates, sometimes larger than itself.

**Habitat:** Degraded open habitats, drains, ponds, reservoirs, weedy marshes, as well as vegetation around coastal areas.

**Natural distribution:** Mediterranean to southern and eastern Asia, to Australia

**National conservation status:** widespread and common

**References:** Silsby (2001); Orr (2003); Tang et al. (2010)



Fig. 6.18. *Orthetrum testaceum* (Burmeister, 1839). Adult mating pair; TBL = 43–48 mm, HWL = 34–38 mm. (Photograph by: Norman Lim T-Lon).

**Scientific name:** *Orthetrum testaceum* (Burmeister, 1839) (Fig. 6.18)

**Common name:** scarlet skimmer

**Scientific family name:** Libellulidae

**Common family name:** skimmer family

**Description:** A medium- to large-sized dragonfly. The male total body length is 43–48 mm and the hindwing length is 34–38 mm. The male has an orange-brown thorax and red abdomen. The eyes are light brownish grey. There is an amber patch at the base of the hindwing. The female is yellowish brown with a transparent hindwing base.

**Habitat:** It is found in disturbed habitats such as drains, ponds, and mature gardens.

**Natural distribution:** Southeast Asia

**National conservation status:** common

**References:** Orr (2003); Tang et al. (2010)





Fig. 6.19. *Pantala flavescens* (Fabricius, 1798). Adult male, TBL = 45–47 mm, HWL = 39–41 mm. (Photograph by: Tang Hung Bun).

**Scientific name:** *Pantala flavescens* (Fabricius, 1798) (Fig. 6.19)

**Common name:** wandering glider

**Scientific family name:** Libellulidae

**Common family name:** skimmer family

**Description:** This is a medium-sized dragonfly. The male total body length is 45–47 mm and the hindwing length is 39–41 mm. Its body is predominantly yellowish brown, with a tapering abdomen and a series of long, diamond-shaped spots oriented along the dorsal line of the abdomen. The hindwings are very broad with a tiny but consistent dark mark at the tip. Males and females are similar in appearance.

**Typical behaviour:** *Pantala flavescens* are often seen in swarms of about 20–50 individuals, flying and gliding in a circular or figure-of-eight pattern about 1–10 m off the ground, never perching, and usually over a grassy area. The broad hindwings allow this dragonfly to glide long distances without flapping its wings. This energy-saving mode of flight facilitates its long migratory journeys across oceans.

**Habitat:** They can be seen in open areas throughout Singapore—in the city, parks, ponds, coastal areas, forest canopy, grassland, etc.

**Natural distribution:** It is the most widespread dragonfly species in the world, occurring in warm temperate and tropical zones in Asia, Africa, and the Americas, but is still only rarely seen in southern Europe.

**National conservation status:** common

**References:** Orr (2003); Tang et al. (2010)



Fig. 6.20. *Potamarcha congener* (Rambur, 1842). Adult male, TBL = 43–45 mm, HWL = 31–34 mm. (Photograph by: Tang Hung Bun).

**Scientific name:** *Potamarcha congener* (Rambur, 1842) (Fig. 6.20)

**Common name:** common chaser

**Scientific family name:** Libellulidae

**Common family name:** skimmer family

**Description:** This is a medium-sized dragonfly. The male total body length is 43–45 mm and the hindwing length is 31–34 mm in length. The thorax and first four segments of abdomen are coated with a bluish bloom. The rest of the abdomen is black with distinctive orange parallel streaks. The





Fig. 6.21. *Pseudagrion microcephalum* (Rambur, 1842). Adult mating pair; TBL = 30–34 mm, HWL = 16–18 mm. (Photograph by: Tang Hung Bun).

female thorax has yellow and black stripes on the sides. The abdomen is black with dull orange markings, and has prominent flaps on each side of segment 8.

**Habitat:** It is found in open ponds and disturbed habitats in standing and slow-flowing water.

**Natural distribution:** Tropical Asia to Australia

**National conservation status:** common

**References:** Orr (2003); Tang et al. (2010)

**Scientific name:** *Pseudagrion microcephalum* (Rambur, 1842) (Fig. 6.21)

**Common name:** blue sprite

**Scientific family name:** Coenagrionidae

**Common family name:** pond damsels

**Description:** The male total body length is 30–34 mm and the hindwing length is 16–18 mm in length. The male has a bright blue thorax, head, and eyes, with black stripes on the dorsal side of the synthorax. The abdomen is black with blue. Segments 8 and 9 are entirely blue. The female is light brown with blue and greenish markings on the thorax.

**Typical behaviour:** *Pseudagrion microcephalum* is sexually active in the afternoon, generally spending more than an hour in tandem. Often, the female exhibits underwater oviposition while still in tandem with a male, and the male would have its lower part of its abdomen submerged as well. The female places eggs in the tissues of underwater plants.

**Habitat:** Disturbed habitats such as drains and ponds in parks and gardens.

**Natural distribution:** Widely distributed from India to Australia, and the Solomon Islands

**National conservation status:** widespread and common

**References:** Orr (2003); Tang et al. (2010)

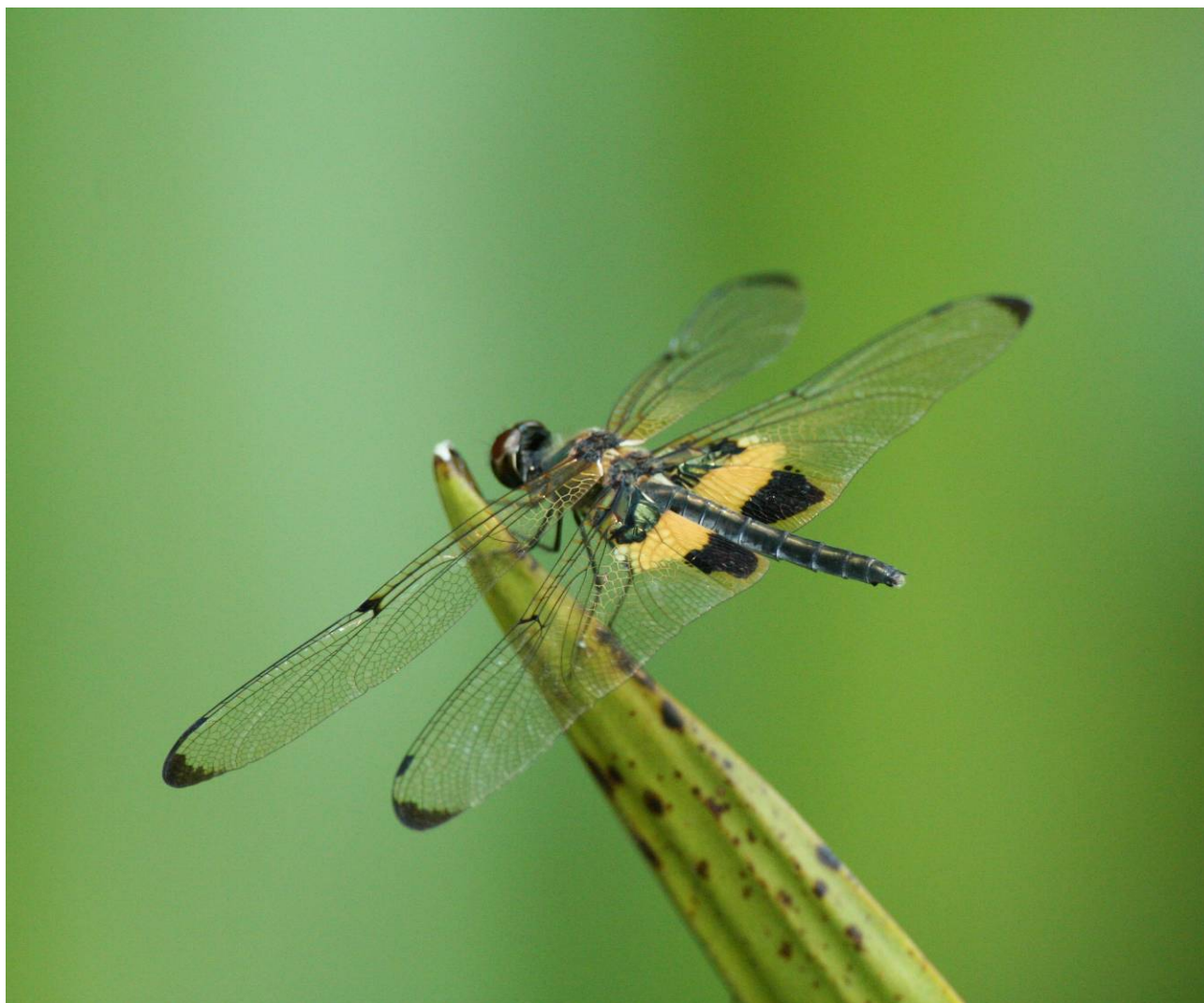


Fig. 6.22. *Rhyothemis phyllis* (Sulzer, 1776). Adult male, TBL = 39–41 mm, HWL = 33–37 mm. (Photograph by: Norman Lim T-Lon).

**Scientific name:** *Rhyothemis phyllis* (Sulzer, 1776) (Fig. 6.22)

**Common name:** yellow-barred flutter

**Scientific family name:** Libellulidae

**Common family name:** skimmer family

**Description:** A medium-sized dragonfly. The male total body length is 39–41 mm and the hindwing length is 33–37 mm. Males and females are very similar. The eyes are reddish brown above and dull brown below, with an almost black face. The thorax and abdomen are an iridescent metallic blackish green with distinctive metallic dark brown and yellow bars on the hindwing.

**Typical behaviour:** Sun-loving swarming species, spending much of the day on the wing, with a relaxed fluttering glide. Very often found near to the coast of reservoirs. This species are also sometimes found in forest clearings in large swarms, far from their breeding sites. This species is believed to feed largely on mosquitoes and midges. During breeding, males are observed to spend long periods perched over water. At night, they fly high to roost on top of nearby trees.

**Habitat:** This species inhabits marshes and ponds.

**Natural distribution:** Southern parts of Southeast Asia, ranging from Myanmar throughout Indonesia and New Guinea, and a few Pacific Islands

**National conservation status:** widespread and common

**References:** Silsby (2001); Orr (2003); Tang et al. (2010)





Fig. 6.23. *Tholymis tillarga* (Fabricius, 1798). Adult male, TBL = 44–47 mm, HWL = 34–35 mm. (Photograph by: Alvin Francis Lok Siew Loon).

**Scientific name:** *Tholymis tillarga* (Fabricius, 1798) (Fig. 6.23)

**Common name:** white-barred duskhawk

**Scientific family name:** Libellulidae

**Common family name:** skimmer family

**Description:** The male total body length is 44–47 mm and the hindwing length is 34–35 mm in length. The male has an orange-red thorax and abdomen. The eyes are also orange red above but pale greenish yellow below. The males also have a light brown bar and a bluish white patch on the hindwing. The female lacks the colour patches on the hindwing and is generally a light golden brown on both the abdomen and the thorax, with slightly more orange eyes.

**Typical behaviour:** *Tholymis tillarga* is mainly active in the late afternoon, spending much of the day perched on the undersides of leaves in the shade. During the late afternoon, males are usually seen patrolling a stretch of bank about half a metre above the water surface. This species is also often attracted to light during the night and has often been recorded flying into houses at night, attracted to the artificial light.

**Habitat:** Open habitats such as ponds, reservoirs, and slow-flowing water bodies.

**Natural distribution:** Widely distributed throughout tropical and subtropical Africa, Asia, Australia, and Micronesia

**National conservation status:** widespread and common

**References:** Orr (2003); Tang et al. (2010)



Fig. 6.24. *Tramea transmarina euryale* Selys, 1878. Adult male, TBL = 53–54 mm, HWL = 42–45 mm. (Photograph by: Tang Hung Bun).

**Scientific name:** *Tramea transmarina euryale* Selys, 1878 (Fig. 6.24)

**Common name:** saddlebag glider

**Scientific family name:** Libellulidae

**Common family name:** skimmer family

**Description:** A large-sized dragonfly. The male total body length is 53–54 mm and the hindwing length is 42–45 mm in length. The thorax is reddish-brown and the abdomen is red, with black markings on the dorsum of segments 8 and 9. The veins near the wing bases are red and there is an opaque brown patch at the base of the hindwing. The female is similar but duller.

**Typical behaviour:** It is often seen gliding 5–10 m above the ground, similar to *Pantala flavescens*, but does not congregate in large swarms.

**Habitat:** Occurs in well-vegetated ponds, drains, and coastal areas.

**Natural distribution:** Tropical Asia and Australasia

**National conservation status:** common

**References:** Orr (2003); Tang et al. (2010)

**Scientific name:** *Trithemis aurora* (Burmeister, 1839) (Figs. 6.25, 6.26)

**Common name:** crimson dropwing

**Scientific family name:** Libellulidae

**Common family name:** skimmer family

**Description:** Smaller than an average medium-sized dragonfly with male total body length 32–35 mm and the hindwing length 25–27 mm. It is an attractive dragonfly with crimson red face and eyes. The thorax and abdomen are beautifully hued in deep purplish-red to vibrant magenta pink (Fig. 6.25). The wings are transparent with red veins. The base of the hindwing is tinted amber brown. The female is light brown with black markings on the sides of the abdomen (Fig. 6.26). Immature males are like the females, but lack the black markings on the sides of the abdomen.





Fig. 6.25. *Trithemis aurora* (Burmeister, 1839). Adult male, TBL = 32–35 mm, HWL = 25–27 mm. (Photograph by: Tang Hung Bun).



Fig. 6.26. *Trithemis aurora* (Burmeister, 1839). Adult female, TBL = 32–35 mm, HWL = 25–27 mm. (Photograph by: Tang Hung Bun).



Fig. 6.27. *Trithemis festiva* (Rambur, 1842). Adult male, TBL = 33–37 mm, HWL = 26–28 mm. (Photograph by: Tang Hung Bun).

**Typical behaviour:** They will almost immediately lower their wings upon landing and very often perch in full sunlight in the obelisk position, which helps the dragonfly to keep cool by reducing the area of the body exposed to the sun's rays.

**Habitat:** It inhabits ponds, lakes, weedy drains, and streams.

**Natural distribution:** Tropical Asia

**National conservation status:** widespread and common

**References:** Orr (2003); Tang et al. (2010)

**Scientific name:** *Trithemis festiva* (Rambur, 1842) (Fig. 6.27)

**Common name:** indigo dropwing



**Scientific family name:** Libellulidae

**Common family name:** skimmer family

**Description:** This is a medium-sized dragonfly with a male total body length of 33–37 mm and a hindwing length of 26–28 mm. The thorax and the dorsal side of the first four segments of the abdomen are coated with a bluish bloom. The rest of the abdomen is dark with a few obscure brownish yellow markings. The female is brownish yellow with dark markings on the thorax and along the abdomen.

**Typical behaviour:** Males rest on boulders and gravel bars in mid-stream, or on the vegetation on the sides of the stream. Females are seldom seen and often range far from their breeding sites. Copulation occurs in flight with the pair forming a wheel while hovering above the water.

**Habitat:** It inhabits streams and rivers flowing through open areas.

**Natural distribution:** Ranges from the Moluccas in the east throughout tropical Asia, to the Mediterranean coast in Turkey

**National conservation status:** common

**References:** Orr (2003); Tang et al. (2010)

**Scientific name:** *Trithemis pallidinervis* (Kirby, 1889) (Fig. 6.28)

**Common name:** dancing dropwing

**Scientific family name:** Libellulidae

**Common family name:** skimmer family

**Description:** This is a medium-sized dragonfly. The male total body length is 41–44 mm and the hindwing length is 30–33 mm. Males and females are similar in appearance. This species is pale to dull yellowish brown with somewhat long legs. The thorax has a series of thin narrow strips and the abdomen is marked with black and dull yellow bands. Both the forewings and hindwings are tinged with an orange-brown at the base.

**Typical behaviour:** This species seldom drops its wings unlike others in the genus, and is often found perched on grass facing the wind.

**Habitat:** It is often found in open grassy areas especially along the coast, but occasionally inland.

**Natural distribution:** Mainland Asia, but also recorded in the Philippines and Taiwan

**National conservation status:** uncommon migrant

**References:** Silsby (2001); Orr (2003); Tang et al. (2010)

**Scientific name:** *Urothemis signata insignata* (Selys, 1872) (Fig. 6.29)

**Common name:** scarlet basker

**Scientific family name:** Libellulidae

**Common family name:** skimmer family

**Description:** This is a medium-sized dragonfly. The male total body length is 42–45 mm and the hindwing length is 34–35 mm. In males, the eyes and abdomen are bright red while the thorax is a reddish brown. The hindwings have a brownish patch, while the wing veins at the leading edges of both the forewings and hindwings are red. Two dark patches are also visible on the dorsal abdominal surface on segments 8 and 9. Females are light golden yellow with a yellow patch on the base of the hindwings. This yellow patch is centred with darker brown.

**Typical behaviour:** This dragonfly is often seen defending its territory against intruders, which include members of the same species as well as other dragonflies. Males are often seen resting for long periods in the ‘obelisk’ position, with wings depressed and abdomen held vertically.

**Habitat:** It inhabits marshes and ponds.

**Natural distribution:** South and Southeast Asia, to Australia

**National conservation status:** widespread and common

**References:** Silsby (2001); Orr (2003); Tang et al. (2010)



Fig. 6.28. *Trithemis pallidinervis* (Kirby, 1889). Adult male, TBL = 41–44 mm, HWL = 30–33 mm. (Photograph by: Norman Lim T-Lon).





Fig. 6.29. *Urothemis signata insignata* (Selys, 1872). Adult male, TBL = 42–45 mm, HWL = 34–35 mm. (Photograph by: Norman Lim T-Lon).

## DISCUSSION

Out of the 124 species of damselflies and dragonflies recorded for Singapore (Tang et al., 2010), 25 species from four families were observed at the Native Garden @ HortPark. The most common family represented was the Libellulidae, with 19 species. The second most commonly encountered family was the Coenagrionidae with four species, and lastly, the families Aesnidae and Gomphidae, with only a single species each.

Many of the species recorded at the Native Garden @ HortPark are commonly encountered in urban and suburban areas, although some species such as the blue adjutant (*Aethriamanta aethra*; Fig. 6.2), the scarlet adjutant (*Aethriamanta brevipennis*; Fig. 6.3), the emperor (*Anax guttatus*; Fig. 6.6), and the common blue skimmer (*Orthetrum glaucum*; Figs. 6.15, 6.16) were indeed rather surprising, as these are only normally observed around well-vegetated areas including marshes, open swamp forest, and lowland forest (Tang et al., 2010). From the onset of the plot's establishment, it was quite apparent that the plot's stagnant waterbodies immediately attracted damselflies and dragonflies, even before the pump had been switched on. Newly arrived species included the blue dasher (*Brachydiplax chalybea*; Fig. 6.7), the common scarlet (*Crocothemis servilia*; Fig. 6.9), the common flangtail (*Ictinogomphus decorates melaenops*; Fig. 6.10), the common parasol (*Neurothemis fluctuans*; Figs. 6.12, 6.13), the pine-tufted skimmer (*Orethrum chrysis*; Fig. 6.14), the green skimmer (*Orthetrum sabina*; Fig. 6.17), and the wandering glider (*Pantala flavescens*; Fig. 6.19). It was not until the water circulated and the vegetation along the waters edge planted in that more odonate recruitment was observed. The increase was in both number of species and abundance of each species. After a six month period, streamside and pond vegetation reached maturity and emergent aquatic plants were added to the aquascape (Figs. 6.30–6.33), and a change in the odonate assemblage was observed. Species such as the blue adjutant (*Aethriamanta aethra*), the scarlet adjutant (*Aethriamanta brevipennis*), the pond adjutant (*Aethriamanta gracilis*; Fig. 6.4), the variable wisp (*Agriocnemis femina*; Fig. 6.5), the emperor (*Anax guttatus*), the spine-tufted skimmer (*Orthetrum chrysis*), the common blue skimmer (*Orthetrum glaucum*), the saddlebag glider (*Tramea transmarina euryale*; Fig. 6.24), and the crimson dropwing (*Trithemis aurora*; Figs. 6.25, 6.26) began to appear in the plot, some of which are usually not found in open and disturbed habitats.

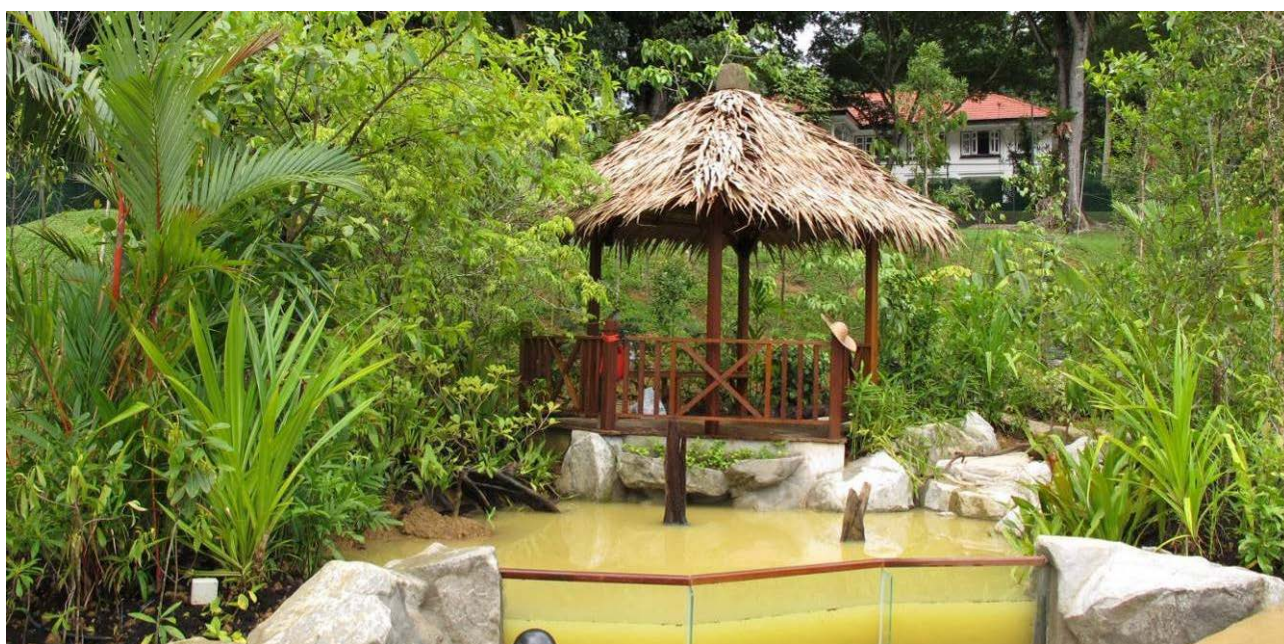


Fig. 6.30. Pond and the freshwater swamp forest area as of September 2010. (Photograph by: Alvin Francis Lok Siew Loon).





Fig. 6.31. Pond and freshwater swamp forest area as of December 2010. (Photograph by: Alvin Francis Lok Siew Loon).



Fig. 6.32. Section of the stream as of September 2010. (Photograph by: Alvin Francis Lok Siew Loon).





Fig. 6.33. Lush emergent aquatic vegetation in a section of the streamline as of December 2010. (Photograph by: Alvin Francis Lok Siew Loon).

Comparing the damselfly and dragonfly diversity in the Native Garden @ HortPark with that in Kent Ridge Park is a way to assess the success of the plot at attracting these organisms. Kent Ridge Park is a reasonable comparison because it is the closest stretch of continuous vegetation, and is somewhat connected to HortPark via the Pasir Panjang Nursery. Kent Ridge Park is a 47-ha park (see [http://www.nparks.gov.sg/cms/index.php?option=com\\_visitorsguide&task=parks&id=20&Itemid=73](http://www.nparks.gov.sg/cms/index.php?option=com_visitorsguide&task=parks&id=20&Itemid=73)) which has a variety of habitats that are suitable for odonates. It has a large lake with much shoreline vegetation, but little of the semi-submergent and aquatic vegetation that is required by the odonate larvae. There is also a much smaller pond, with a depth of less than 1 m. This pond is bordered by *adinandra belukar* (secondary forest on degraded soil) as well as an extensive stand of *susum* (*Hanguana malayana*; a native species) to the eastern end of the pond, and is also filled with a *Cabomba* species (fanwort) which is fully aquatic. Besides these two species that form the majority of the marsh and aquatic plant species, the powdery thalia (*Thalia dealbata*), fire flag (*Thalia geniculata*), papyrus (*Cyperus papyrus*), water banana (*Typhonodorum lindleyanum*), and the water snowflake (*Nymphoides indica*; a native species) are also found around the pond. Together with the copious amounts of aquatic/marsh vegetation as well as the large amounts of submerged dead leaves, this pond is not only a suitable habitat for odonate larvae, but also for the adults to hunt. Close proximity of the *adinandra belukar* to this pond and the larger lake also make these very suitable habitats for large forest odonates to access and utilise, giving them the option of seeking cover/shelter in the forest when needed. Besides the ponds and lakes mentioned, the park also has extensive secondary forest cover in the park area proper, as well as the area adjacent to the South Buona Vista Road which is quite extensive, stretching all the way to the junction with Lower Kent Ridge Road. This forest, like those found within the park area proper, are mainly *adinandra belukar* which mainly consists of *Adinandra dumosa* trees, but also more open degraded areas with



*Dicranopteris linearis* (resam fern), *Nepenthes* species (pitcher plants), as well as *Ploiarium alternifolium* (cicada tree). Both habitat types are important for odonate life. The open, degraded areas are mainly inhabited by open country species that can be seen hovering around during the hotter parts of the day, while the forest areas are home to species that require more cover. As such, owing to the varied habitat types available at Kent Ridge Park, odonate species richness is likely to be much higher than those found at the Native Garden @ HortPark. A total of 33 odonate species has been recorded in Kent Ridge Park through a survey carried out by the National Parks Board (NParks; R. W. J. Ngiam, pers comm.).

Amongst the species recorded at Kent Ridge Park, 20 species (60.6%) were the same as those found in the Native Garden @ HortPark. Most of the species found in Kent Ridge Park that were not found in the Native Garden @ HortPark are associated with large marshy or forested areas with shaded streams and are usually found in or near the Central Catchment Nature Reserve (CCNR). Some of these species include *Acisoma panorpoides*, *Agrionoptera insignis*, *Diplacodes nebulosa*, *Epophthalmia vittigera*, *Gynacantha subinterrupta*, *Hydrobasileus croceus*, *Lathrecista asiatica*, *Onychargia atrocyana*, *Rhyothemis obsolescens*, and *Rhyothemis triangularis*. Besides the 10 species of odonates listed above, three other species—*Camacinia gigantea*, *Pseudothemis jorina*, and *Rhodothemis rufa*—were also encountered at Kent Ridge Park and not at the Native Garden @ HortPark. *Camacinia gigantea* is a species that prefers large open lakes and quarries near forest edges, but its absence at the plot could have been overlooked because of its superficial resemblance to *Neurothermis fluctuans* (Figs. 6.12, 6.13), although it is almost twice as large. *Pseudothemis jorina* is usually found hovering over large water bodies as it prefers large lakes and reservoirs, so it is very unlikely to occur at the plot which only has a small area of open water (<5 m<sup>2</sup>). *Rhodothemis rufa* is also another species that is likely to be overlooked owing to its superficial resemblance to other medium-sized red libellulid dragonflies such as the common scarlet (*Crocothemis servilia*; Fig. 6.9), spine-tufted skimmer (*Orethrum chrysis*; Fig. 6.14), scarlet skimmer (*Orethrum testaceum*; Fig. 6.18), and the scarlet basker (*Urothemis signata insignata*; Fig. 6.29).

Generally, it was noticed that at the Native Garden @ HortPark, inclusion of emergent aquatic plants added a further dimension to the aquatic habitat, making it more “odonate-friendly”. Addition of plants such as *Eleocharis dulcis* (water chestnut; Fig. 6.34) and *Hanguana malayana* (Fig. 6.35) to the marsh area not only provided perches for adult odonates, but the increased emergent aquatic foliage also provided more cover for large odonates to ambush their prey and for smaller odonates such as the variable wisp (*Agriocnemis femina*), to hide from their predators (larger odonates). Water chestnut is also important for oviposition. Some odonate species use water chestnut leaves as a perch during oviposition in water, while other species like *Anax guttatus* (emperor) insert their eggs into plant tissue such as the hollows of *Eleocharis* leaves with their well-developed ovipositors. Emergent aquatic vegetation also provides ecological services to the odonate larvae, such as being a cover from fish and acting as a means to ambush their prey. Emergent vegetation also serves as a means for mature odonate larvae to climb out of the water, providing a suitable surface where they emerge as adults (Fig. 6.36).

To date, most if not all odonate habitats created in Singapore employ exotic species. Such habitats include the artificial wetlands at Kranji Reservoir, Bishan Park, and the newly opened Lor Halus Wetlands. The non-native plants used in these include *Cyperus papyrus*, *Neptunia plena*, *Nelumbo nucifera*, *Nymphaea* cultivars, *Thalia dealbata*, and *Thalia geniculata*, even though native marsh and aquatic plants can maintain the ecological integrity of these habitats in addition to fulfilling the same outcome. However, more work is needed to look into what native plants can be used for such odonate habitats, instead of using the easiest most available plants in plant nurseries. Our diverse odonate fauna has been around way before the introduction of such exotics, a living testament that we do not need these exotics to increase odonate diversity in artificially-created habitats.



Fig. 6.34. *Eleocharis dulcis* (water chestnut) in a section of the stream. (Photograph by: Alvin Francis Lok Siew Loon).

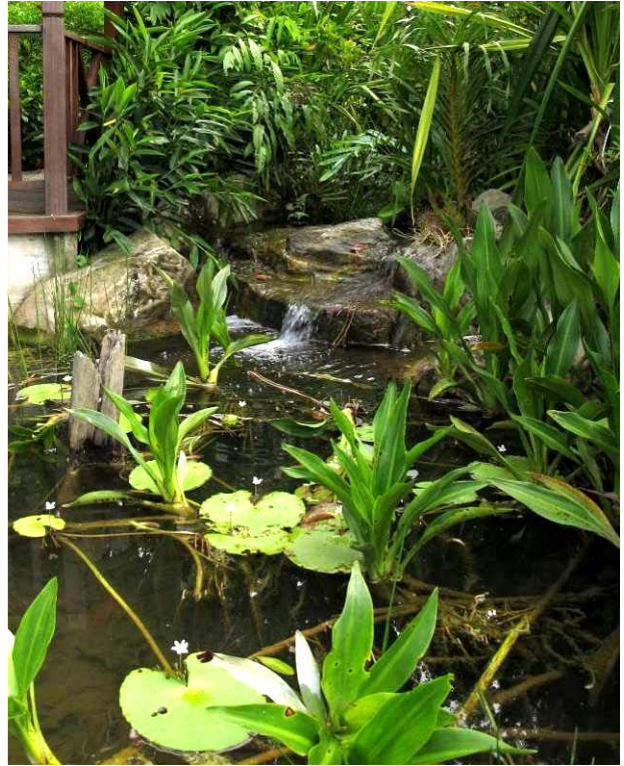


Fig. 6.35. *Hanguana malayana* at the pond's edge. (Photograph by: Alvin Francis Lok Siew Loon).



Fig. 6.36. An odonate exuviae seen here on a water chestnut leaf (*Eleocharis dulcis*). (Photograph by: Alvin Francis Lok Siew Loon).



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## CONCLUSIONS

From the surveys for birds, fishes, amphibians, reptiles, butterflies, moths, damselflies, and dragonflies, researchers have found the Native Garden @ HortPark to be reasonably successful in demonstrating how planting native plant species in a dense, mixed, multi-layered, and ecological manner can attract native fauna even in a suburban area. Despite the small dimensions of the plot, 13 bird species, 16 herptile species (four amphibian and 12 reptile species), 38 lepidopteran species (26 butterfly and 12 moth species), and 25 odonate species (four damselfly and 21 dragonfly species) were observed. We have also found that all 13 native fish species introduced to the plot are thriving, with at least two species (*Aplocheilichthys panchax* and *Trichopodus trichopterus*) found breeding.

Although the Native Garden @ HortPark demonstrates one way by which cultivation of native plant species can enhance native urban biodiversity, it must be emphasized that this is by no means a substitute for pristine natural forests which harbour an unsurpassed faunal and floral biodiversity that will never be found in an urban setting. Most of Singapore's native faunal species are still restricted to the rainforest areas because of their elusive habits and reliance on rare host plants with narrow ecological niches. Removing the natural forest will no doubt spell doom for many native species, some of which have yet to be discovered.

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