

Coleoptera – Beetles

CHEONG LOONG FAH, WAN F.A. JUSOH, ONG XIN RUI, SEAN YAP

Scientific Name:
Parena nigrolineata
(Chaudoir, 1852)

Common Name:
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Order/Family:
Coleoptera: Carabidae

National Status: Data Deficient (DD)

Habitat and Ecology: Species of this genus (e.g. *P. perforata* (Hondo, 2003)) are reported as specialist predators of Tiger Moth at both the adult and larval stages and play an important role in regulating the Tiger Moth population. Similar associations might apply to this species.

Distribution: India, Sri Lanka, Burma, Vietnam, Japan, China, Andaman Islands, Singapore, Krakatoa. Found in the Bukit Timah Nature Reserve.

Threats: Co-extinction risk might exist for this species, but without detailed knowledge of its ecology we can



Photo: Cheong Loong Fah

only assign the status as DD. So far, there is only a sole 2015 record for this species from the Bukit Timah Nature Reserve. There is no doubt the arboreal habit of this species contributes to the scarcity of its records.

Scientific Interest and Potential Value: *Parena* species could play important roles in regulating the Tiger Moth or other moths during years of peak population.

Conservation Measures: The known locality in Singapore is a protected area. Knowledge for the local *Parena* is poor but protection of the entire forest ecosystem should help.

Scientific Name:
Stenaptinus occipitalis (Macleay, 1825)

Common Name:
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Order/Family:
Coleoptera: Carabidae



Photo: Cheong Loong Fah

Stenaptinus occipitalis specimen in LKCNHM.

National Status: Critically Endangered (CR)

Habitat and Ecology: Known as the ‘Bombardier beetles’ as they release a defensive gland secretion which is extremely hot. *Stenaptinus* species are said to feed on mole crickets and their eggs (Frank et al., 2009), but they also may eat other crickets, other small insects, and worms. During the daytime they hide in earth cracks, in grass, under debris, and under stones.

Distribution: China, Japan, Taiwan, Sri Lanka, India, Myanmar, Malaysia, Indonesia, Borneo, Philippines, Singapore. Found in the Nee Soon Swamp Forest.

Threats: Only two records in Singapore. The first was a 1918 record from Katong, probably still a coastal area then. Despite extensive works in the coastal habitats by D.H. Murphy, there is no further record from the coastal areas. Its prey (various species of mole crickets) are

mostly under threat (pp 55-56, Tan, 2012) and this might have led to the disappearance of this species from the coastal habitats. The second *Stenaptinus occipitalis* specimen was collected from Nee Soon swamp forest around 1990.

Scientific Interest and Potential Value: It has potential as a charismatic flagship species, due to its infamous ability to synthesize and release rapid bursts of stinky, burning-hot liquid from their rear ends.

Conservation Measures: The only recent locality in Singapore is within a protected area. A predatory habit increases the extinction risk, which is consistent with the fact that, in general, predators are more imperiled than prey. In this case, protection of the prey mole crickets would probably help the survival of *Stenaptinus occipitalis*.

Scientific Name:

Cryptocephalomorpha gaverei
Ritsema, 1875

Common Name:

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Order/Family:

Coleoptera: Carabidae

National Status: Data Deficient (DD)

Habitat and Ecology: Known larvae are physogastric due to their myrmecophilous habit. They dig holes in the ground around ant nests, and prey on ants in a similar manner to the larvae of Cicindelinae. Very few adult specimens of the majority of species in this genus have ever been captured, with most samples attracted to light. It is therefore not established where the species of this genus actually live and whether they are regularly tree-living or not. Similarly, their mode of reproduction is unknown.

Distribution: Laos, Singapore, Indonesia, Borneo, Philippines. In Singapore, it is known from Bukit Timah Nature Reserve and Central Catchment Nature Reserve.

Threats: Only two records in Singapore, both collected from lights: a 1967 record at Bukit Timah and a 1986

record at Central Catchment Nature Reserve. The scarcity of records is no doubt due to the fact that the identity of the host ant species is as yet unknown.

Scientific Interest and Potential Value: *Cryptocephalomorpha* species are characterized by a unique facies with an almost completely oval body, and are not recognizable as carabid beetles at first glance. Their morphology is assumed to be related to a myrmecophilous lifestyle, but little biological data exist to confirm their associations with ants, nor is much known about the degree of acceptance and integration in their host ant colony.

Conservation Measures: The two known localities are both within protected areas. We lack sufficient knowledge of the biology of *Cryptocephalomorpha gaverei* to be able to say anything concrete about the conservation of this species.

Photo: Cheong Loong Fah



Cryptocephalomorpha gaverei specimen in LKCNHM.

Scientific Name:

Catascopus cupripennis Thomson,
1858

Common Name:

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Order/Family:

Coleoptera: Carabidae

National Status: Presumed Nationally Extinct (NEx)

Habitat and Ecology: The species of the genus *Catascopus* are semi-nocturnal in their habits, never flying except at night. Most species and individuals from this genus are found under the decaying bark of fallen trees. Larger species like *Catascopus cupripennis* are usually seen coursing along the surface of some immense fallen trees.

Distribution: Malaysia, Singapore, Indonesia, Borneo.

Threats: With the loss of over-mature old trees, dead-wood development is restricted to the die-off of typically small diameter trees, producing less diverse dead wood. Decreasing quantity of fallen big tree trunks that provide long term habitat probably contributes to its demise.

Scientific Interest and Potential Value: The type locality is in Singapore; there is thus scientific interest



Photo: Cheong Loong Fah

in protecting the "typical place" from which the species was described.

Conservation Measures: Big forest trees provide potential habitat in the protected nature reserves. Dead trees should be left, as much as possible, in their original assorted conditions of standing and fallen states, subject to a range of different abiotic conditions. This will increase the diversity of available dead wood microhabitats and microclimates necessary to ensure the long-term stability and preservation of the saproxylic community. For big old trees that have fallen on or near forest trails, consider, wherever possible, rerouting the trail or even closing off access to the tree with fencing or other barriers. These big old dead trees are often referred to as "habitat trees" or "keystone structures," which are particularly important as they contain slowly developing microhabitats, such as cavities.

Scientific Name:

Therates fleutiauxi Horn, 1898

Common Name:

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Order/Family:

Cicindelidae



Photo: Cheong Loong Fah

Therates fleutiauxi specimen in LKCNHM.

National Status: Critically Endangered (CR)

Habitat and Ecology: *Therates* adults prefer moist, shady places at the edge of pristine forest streams. They hunt on low foliage, but also on the forest floor or on stones in the stream bed. Larval stages usually occur in a narrower range of microhabitats than adults and appear to tolerate less variation of many physical factors, especially soil moisture, soil composition and temperature.

Distribution: Malaysia, Singapore. In Singapore, found in Bukit Timah Nature Reserve.

Threats: Not only has there been an outright loss of habitat, but there has been substantial alteration in the microclimatic conditions of forest interior too. In particular, soil humidity decreases and air temperature increases with increasing fragmentation. Tiger Beetle larvae are sensitive to these changes. The last recorded

location of this species is at Taban valley (in 1976), where the drying is particularly obvious on the outward facing slope of the valley. There might also be increased mortality due to widespread fumigation in the adjacent condominiums and predators like Tiger Beetles catch preys weakened by insecticides. A change in abundance of predators like Long-legged Flies in this sector of the reserve has also been reported (Grootaert, pers. comm.).

Scientific Interest and Potential Value: As *Therates* species are sensitive to environmental changes, they are well-suited as bioindicators of the riverine ecosystems. Tiger beetles are also popular with many amateurs and can be considered as flagship species.

Conservation Measures: The known locality in Singapore is within a legally protected nature reserve. Knowledge of *Therates* is poor but protection and restoration of riverine habitats in forest interior may help.

Scientific Name:

Lophyra fuliginosa (Dejean, 1826)

Common Name:

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Order/Family:

Coleoptera: Cicindelidae

National Status: Vulnerable (VU)

Habitat and Ecology: They are found on sandy shores near ocean, and sandy areas bordering rivers. Attracted to lights.

Distribution: Sri Lanka, Burma, Thailand, Laos, Vietnam, Cambodia, Southern China, Malaysia, Singapore, Indonesia, Borneo. Found on the sandy shores of the southern islands in Singapore, but historically recorded from Changi coast (1916) and possibly from the sandy coasts of inland rivers too.

Threats: Though *L. fuliginosa* has been lost from some localities (e.g. Changi coast, the sandy coasts of inland

Photo: Cheong Loong Fah



rivers) in the past, there is no evidence of a continuing decline into the modern period. However, the long-term effects of climate change on the remaining sandy shore habitats in the southern islands cannot yet be foreseen and require careful monitoring.

Scientific Interest and Potential Value: This sand-dwelling species could be considered as a bioindicator to evaluate the quality of sandy shore ecosystems, in the face of threats such as climate change and further anthropogenic pressure.

Conservation Measures: This is a vulnerable species requiring robust protection of its remaining sites (the sandy shores of the southern islands) from development pressures and from coastal engineering (e.g. in response

to climate change), as well as ongoing sympathetic habitat management and management of recreational pressures.

Scientific Name:
Agrilus lancifer Deyrolle, 1864

Common Name:
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Order/Family:
Coleoptera: Buprestidae

National Status: Presumed Nationally Extinct (NEx)

Habitat and Ecology: Of the 3000+ species (worldwide) in the hyperdiverse genus *Agrilus*, only 22% have at least one host plant recorded, mostly for species in the Palearctic and Nearctic region (Jendek and Poláková, 2014). We are ignorant of the true causes of the *Agrilus* diversity. What we do know is that the vast majority of saproxylic beetles cannot digest lignin or cellulose, the main constituents of wood; they can only derive nutrition from wood after fungi have begun the decay process. In contrast, *Agrilus* species are able to steal a march on the fungi and feed on fresh wood, albeit they seem to be restricted to trunks or branches that are already stressed by drought, shading or physical damage.

Distribution: Borneo, Singapore.

Threats: Wallace collected a relatively large number of *Agrilus* species in a short two-month period in the



Photo: Cheong Loong Fah

Agrilus lancifer holotype in Muséum national d'Histoire naturelle (MNHN), Paris.

1850s, including 15 holotypes and 2 paratypes from Singapore; this suggests that the *Agrilus* species have been much more widespread in the past. The fact there are no subsequent records by C.F. Baker and C.J. Saunders in the 1920s and 1930s suggests that there is a substantial decline between the two periods and there is no reason to think that this decline is not continuing to the recent few decades. Of the 15 holotypes, 13 of them have not been recorded since the 1850s. It must mean that many formerly abundant *Agrilus* species are greatly reduced in number or even already extinct in Singapore due to the loss of forest habitat.

Scientific Interest and Potential Value: Type locality of the synonym *Agrilus dajakorum* Obenberger 1924 is Singapore.

Conservation Measures: We need to gather sufficient knowledge of these beetles' biology to determine exactly what measures will be most beneficial.

Scientific Name:
Endelus baumi Obenberger, 1929

Common Name:
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Order/Family:
Coleoptera: Buprestidae

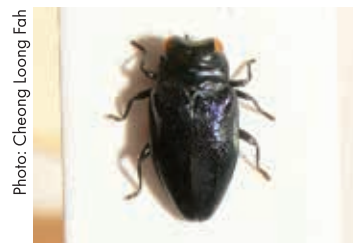


Photo: Cheong Loong Fah

Endelus baumi holotype in Prague Museum.

National Status: Presumed Nationally Extinct (NEx)

Habitat and Ecology: There is a general impression, perhaps only anecdotal, that species of *Endelus* are associated with ferns. The author (CLF) has also collected various *Endelus* species from different fern hosts.

Distribution: Singapore.

Threats: The sole record is the specimen collected by J. Baum in 1929. With the loss of many shade-loving fern species due to the clearing of the original forests,

coextinction risk might be a cause for the demise of this *Endelus* species which depends on these shade-loving ferns.

Scientific Interest and Potential Value: The type locality for this species is Singapore.

Conservation Measures: We need to gather sufficient knowledge of these beetles' biology like their host association to determine exactly what measures will be most beneficial.

Scientific Name:
Chrysobothris nigripennis
Deyrolle, 1864

Common Name:
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Order/Family:
Coleoptera: Buprestidae

National Status: Presumed Nationally Extinct (NEx)

Habitat and Ecology: *Chrysobothris* species are considered to be secondary attackers of trees that have been stressed by age, fire, and water and are often collected on recently cut or injured plants. Many *Chrysobothris* species as adults are rather elusive, very quick to escape, and probably most of the tropical forest species are usually arboreal unless when coming down to fallen trees for oviposition. Malaise and upper canopy traps have been shown to be good methods in collecting these large buprestids as *Chrysobothris* can be active at both the ground and upper canopy levels.

Distribution: Singapore, Indonesia, Malaysia.

Threats: While many *Chrysobothris* species are possibly arboreal, very quick to escape, and thus might have escaped detection by visual means, even substantial Malaise trap surveys in the post-2000 period failed to rediscover *Chrysobothris nigripennis*. Likely case of its demise is a long-term, continuing decline in quality of microhabitat due to fragmentation resulting in lower dead wood connectivity and drier microhabitat, loss of habitat and possibly its suitable tree hosts.

Photo: Cheong Loong Fah



Chrysobothris nigripennis specimen in Prague Museum.

Scientific Interest and Potential Value: Many *Chrysobothris* species are colourful and can be considered as flagship species.

Conservation Measures: Increased effort on targeted survey for these charismatic species is recommended, with optimally designed traps set up with the objective of capturing these Buprestids in mind.

Scientific Name:

Anthaxia (Merocratus) miranda
Deyrolle, 1864

Common Name:

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Order/Family:

Coleoptera: Buprestidae

National Status: Presumed Nationally Extinct (NEx)

Habitat and Ecology: Some *Anthaxia* species are inhabitants of canopy, while the rest are flower visitors. For the subgenus *Merocratus*, almost nothing is known about their bionomy; adults are flower-visitors often collected on flowers of *Castanopsis* (Fagaceae).

Distribution: Singapore, Malaysia, Borneo.

Threats: No further record in Singapore since the two specimens collected by Wallace. In the neighbouring countries, this species still seems to be occasionally collected in large number (Bily & Plachetka, 2019:

Photo: Cheong Loong Fah



Anthaxia (Merocratus) miranda holotype in Muséum national d'Histoire naturelle (MNHN), Paris.

9 specimens from Johor in 2001, 9 specimens from Kalimantan in 2018). Likely extirpated in Singapore, or at least in severe decline.

Scientific Interest and Potential Value: The type locality for this species is Singapore.

Conservation Measures: We need to gather sufficient knowledge of these beetles' biology to determine exactly what measures will be most beneficial.

Scientific Name:

Megaloxantha hemixantha
(Vollenhoven, 1864)

Common Name:

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Order/Family:

Coleoptera: Buprestidae

National Status: Presumed Nationally Extinct (NEx)

Habitat and Ecology: There appears to be little published information on habitats used by this species. In Malaysia, it was commonly seen during the early months of the year (Tung, 1983). According to Baudon (1966), the imagines of the Laotian species *Megaloxantha mouhoti* (Saunders) are most frequently found very high on trees of *Bombax albicum* Gagn.

Photo: Cheong Loong Fah



Megaloxantha hemixantha specimens from the Milanowec collection, Poland.

and *B. cambodiense* P., being well-known to the local population and sought every year for food.

Distribution: Malay Peninsula, Sumatra, Nias, Bangka Is., Singapore.

Threats: The sole Singapore record was collected from Mandai area in 1912.

Scientific Interest and Potential Value: In this genus belongs the largest jewel beetle (females of *Megaloxantha bicolor gigantea*, approaching 80mm in length).

Conservation Measures: We need to gather sufficient knowledge of these beetles' biology to determine exactly what measures will be most beneficial.

Scientific Name:
Glenea pulchella Pascoe 1858

Common Name:
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Order/Family:
Coleoptera: Cerambycidae

National Status: Presumed Nationally Extinct (NEx)

Habitat and Ecology: *Glenea* species are diurnal; they need to undergo maturation feeding and to chew the host plant in preparation for oviposition.

Distribution: Malaysia, Singapore, Indonesia, Borneo, Philippines.

Threats: *Glenea* as a group has been in severe decline, based on these observations: (1) *Glenea* species must have been rather common in the 1850s, so much so that Wallace collected 21 *Glenea* species in a two-month period. Of the 24 *Glenea* species recorded in Singapore in the 19th century, only five have been recorded in the past few decades! (2) *Glenea* species are diurnal, mostly eye-catching with colorful pattern. Thus it is unlikely that so many of them would have been missed if still present. The main threat facing these saproxylic beetles is the loss of host tree species, in particular trees from the Dipterocarpaceae family, with the result that most native dipterocarp trees are critically



Photo: Cheong Loong Fah

Glenea pulchella specimen in Muséum national d'Histoire naturelle (MNHN), Paris.

endangered (Chong et al., 2009). The resultant loss of habitat continuity and spatial dead-wood connectivity mean that the beetles are not able to find an alternative habitat within their reach at the right time.

Scientific Interest and Potential Value: Many *Glenea* species are colourful and can be considered as flagship species. Hopefully, the extant *Glenea* species can contribute to education of the public in the conservation process.

Conservation Measures: Dead trees should not be removed from the forest and should be left, as much as possible, in their original assorted conditions of standing and fallen states, with a range of different abiotic conditions such as different branch thickness (not sawn into small stockpiles). This will increase the diversity of available dead wood for the *Glenea* species.

Scientific Name:

Aegolipton marginale (Fabricius, 1775)

Common Name:

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Order/Family:

Coleoptera: Cerambycidae



Aegolipton marginale specimen from FRIM, Malaysia.

National Status: Presumed Nationally Extinct (NEx)

Habitat and Ecology: Members of the Prioninae (prionines) are characteristically sedentary: newly emerged females need not disperse in search of food (because they do not feed) or to find males (because they can attract males with a pheromone). They are thus often disinclined to fly or even incapable of flight. As adults do not feed, their lifespan is not long, and the time available for dispersal may be short, further limiting their ability to disperse.

Distribution: India, Taiwan, China, Bangladesh, Indochina, Borneo, Singapore, Indonesia, Philippines.

Threats: While many saproxylic insect species are able to track dead wood, as they are naturally adapted to search for their ephemeral resources, there are specialized insect species with low mobility, such as some associated with tree hollows or those whose adult

stage does not feed, including many prionines. They might be sensitive to an interruption of habitat continuity because they are not able to find an alternative habitat within the reach in their distribution range in a timely manner. Furthermore, the large larvae may require very large host trees, and such trees are increasingly uncommon. Lastly, as some prionine adults are attracted to light, pervasive artificial lights at night constitute a further threat, acting as an ecological trap.

Scientific Interest and Potential Value: Due to their great size and popular appeal, the prionine species can be a tool to educate the public about the conservation process.

Conservation Measures: We need to gather sufficient knowledge of these beetles' biology to determine exactly what measures will be most beneficial. With knowledge of host associations, it may then become possible to "reintroduce" these beetles.

Scientific Name:

Luciola singapura Jusoh & Ballantyne, 2021

Common Name:

Singapore Firefly (Kunang-kunang Singapura)

Order/Family:

Coleoptera: Lampyridae



Luciola singapura.

National Status: Critically Endangered (CR)

Habitat and Ecology: Only known from the type locality – the Nee Soon Swamp Forest (NSSF), in Central Catchment Nature Reserve. The habitat is a freshwater swamp forest adjacent to the water pipeline system with dense vegetation, damp leaf litter, and high soil moisture. At night, a few adult fireflies of this species were observed flying around or perching on ferns.

Distribution: Possibly endemic to Singapore.

Threats: Habitat destruction and water pollution might threaten this rare and small population of *L. singapura* if the forest and water catchment are not maintained and managed well.

Scientific Interest and Potential Value: *Luciola singapura* was described in 2021 based on a handful of specimens collected from three different time series:

1989–90, 2008–9 and 2018–19. It was the first time since 1909 that a new species of luminous firefly was described from Singapore. The discovery emphasizes the significance of natural history collections. It also highlights the need for continued biodiversity research, even in small, relatively well-studied, and highly developed countries like Singapore.

Conservation Measures: *Luciola singapura* is a rare species that can be found only in the Nee Soon Swamp Forest (NSSF), the last remnant of Singapore's freshwater swamp forest. The population size and the habitat of *L. singapura* are constrained within a small area in NSSF. The legal status of NSSF within the nature reserve has directly protected the habitat from being encroached, thus allowing the species to thrive. However, this species' long-term protection still requires a deeper understanding of its ecology and distribution, particularly its immature life stage which is not yet known.

Scientific Name:

Pteroptyx bearni Olivier, 1909

Common Name:

The Comtesse's Bent-winged Firefly

Order/Family:

Coleoptera: Lampyridae

National Status: Nationally Extinct (NEx)

Habitat and Ecology: Estuarine mangrove zones. Adult fireflies of this species gather in a high number of individuals on selected mangrove plants at night and flash non-synchronously.

Distribution: Exclusive to mangrove estuaries in Peninsular Malaysia and Borneo. Singapore's record is based on museum specimens collected in 1908.

Threats: Habitat loss, light pollution

Photo: Wan F.A. Jusoh



Pteroptyx bearni specimen in Muséum national d'Histoire naturelle (MNHN), Paris.

Scientific Interest and Potential Value: A lectotype male and a non-type female specimen of *Pteroptyx bearni* from Singapore are deposited in Muséum National d'Histoire Naturelle (MNHN), Paris and they are the only known evidence of the presence of this species in Singapore. The specimens were collected from Singapore in 1908 by E. Cordier during an expedition funded by Comtesse de Béarn. Based on two nationwide surveys on fireflies in Singapore (2008–2009 and 2001–2022), the Comtesse's firefly is no longer sighted, which means that the last time this species was sighted was over 100 years ago.

Conservation Measures: *Pteroptyx bearni* was once a native species in Singapore. This species is still a common sight in many parts of the east coast of Malaysia, such as in Sg Pendas, Johor, which is just a few kilometres away from Singapore. Species re-

introduction might be an option to bring a population of the Comtesse's firefly back to Singapore. However, prior to that, it is more critical and urgent that future scientific studies focus on a deeper understanding of the habitat requirements of fireflies in mangrove forests.

Scientific Name:
Pteroptyx valida Olivier, 1909

Common Name:
Non-synchronous Bent-winged Firefly

Order/Family:
Coleoptera: Lampyridae

National Status: Endangered (EN)

Habitat and Ecology: Commonly observed flashing non-synchronously while congregating on trees along mangrove intertidal zones and other trees in swampy areas such as *Ficus* sp. This firefly species can be easily recognised by the slower flash frequency (about a 6-second flash interval).

Distribution: This species has been reported to occur in Malaysia, Thailand, Indonesia, and Singapore.

Threats: Habitat loss, pesticide use, light pollution

Photo: Cheong Loong Fah



Scientific Interest and Potential Value: Based on recent field observations, the population of *P. valida* is not restricted to only mangrove habitats but can extend to other swampy areas in Singapore. Further studies should focus on understanding of life cycle and habitat requirement of each stage of this firefly species.

Conservation Measures: *Pteroptyx valida* is the only firefly species evaluated under the previous Red Data Book. The population is severely fragmented, and population reduction is suspected based on the apparent decrease in the number of individuals spotted in several sites using direct observations. Habitat enhancement and long-term monitoring are helpful to ensure the survival of this species in Singapore.

Scientific Name:
Catharsius renaudpauliani Ochi & Kon, 1996

Common Name:
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Order/Family:
Coleoptera: Scarabaeidae

Photo: TEE Lab



Catharsius renaudpauliani, dorsal.

National Status: Near Threatened (NT)

Habitat and Ecology: *Catharsius* adults are classified as large nocturnal tunnellers under the common dung beetle functional clades that group species by time of activity and mode of dung removal. As tunnellers, they remove dung from the forest floor by burying dung directly below source dung pats. Males possess horns on the head and thorax that are used in male-male competition over access to mates. Females tunnel deep beneath the ground to construct brood chambers, where they deposit eggs in brood balls made from dung within which the larvae will hatch and develop, feeding upon the provisioned dung.

Distribution: Peninsular Malaysia, Borneo, Singapore.

Threats: This species is sensitive to habitat loss, as well as decreases in mammal abundance and diversity. Even though *Catharsius* appears to be a generalist in terms of dung preference, being attracted to omnivore and herbivore dung in local survey efforts, their relatively large size may make them more sensitive to dung abundance and the decrease of mammal biomass. In 2009, this species was thought to have been extirpated from Bukit Timah Nature Reserve (Lee et al., 2009), but subsequent survey efforts in 2013 (Ong et al., 2013) and 2018-present have found them in adjacent forests in decent numbers. Resurveys of BTNR have not been conducted at this time.

Scientific Interest and Potential Value: Dung beetles are sensitive to environmental changes and changes in the diversity and abundance of mammals, the source of dung that the beetles rely upon. For these reasons, they are commonly used as bioindicators of forest disturbance and as a proxy in mammal monitoring. *Catharsius renaudpauliani* has recently even been used as a model for mammalian DNA detection via iDNA (invertebrate-derived DNA) sequencing of dung beetle gut contents (Drinkwater et al., 2021), and currently similar trials are being conducted with *C. renaudpauliani* in Singapore. Even among Southeast Asian dung beetles, *Catharsius* beetles are known to contribute disproportionately to the dung removal process in tropical rainforests, being a potential keystone group with regards to this ecosystem service (Slade et al., 2011). Dung beetles are also popular with many amateurs due to their impressive horn morphology and interesting behaviour and can be considered as flagship species. In past literature, *Catharsius* individuals from Singapore have been identified as *Catharsius molossus*, but recent DNA barcoding evidence has confirmed that individuals from Singapore belong to the same species as *C. renaudpauliani* from Peninsular Malaysia and Borneo.

Conservation Measures: Protection of forest habitats and mammal diversity, especially larger mammal species, are likely to help protect this species.

Scientific Name:

Onthophagus deliensis Lansberge,
1885

Common Name:

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Order/Family:

Coleoptera: Scarabaeidae

Photo: TEE Lab



Onthophagus deliensis dorsal.

National Status: Near Threatened (NT)

Habitat and Ecology: *Onthophagus* adults are classified as small diurnal tunnellers under the common dung beetle functional clades that group species by time of activity and mode of dung removal. As tunnellers, they remove dung from the forest floor by burying dung directly below source dung pats. While males of many *Onthophagus* species possess horns on the head and/or thorax that are used in male-male competition over access to mates, some species such as *O. deliensis* are monomorphic, with indistinguishable males and females. Females tunnel deep beneath the ground to construct brood chambers, where they deposit eggs in brood balls made from dung within which the larvae will hatch and develop, feeding upon the provisioned dung. In general, *Onthophagus* take about a month to develop from larvae to adult. *O. deliensis* differs from other local *Onthophagus* in its arboreal lifestyle. A recent study in Singapore examining the niche partitioning of local dung beetles between ground and canopy strata found that *O. deliensis* was a major contributor to the community level differences between strata, being the dominant species at the canopy level while rarely being found at the ground level (Abdul Rahman et al., 2021). Further analysis of their physical traits found that compared to other *Onthophagus*, *O. deliensis* had significantly larger wing loading, larger exposed eye area, and longer legs, traits associated with unique dung manipulation behaviour in arboreal dung beetle species (Davis et al. 1997). This evidence supports the notion that *O. deliensis* is an arboreal specialist dung beetle that may exploit dung resources in the canopy.

Distribution: Peninsular Malaysia, Borneo, Singapore.

Threats: This species is sensitive to habitat loss, as well as decreases in mammal abundance and diversity. In particular, this species may have a tighter correlation with arboreal mammal diversity and abundance, and the protection of arboreal mammal species is likely to be beneficial for *O. deliensis*. In 2009, this species was thought to have been extirpated from Bukit Timah Nature Reserve (Lee et al., 2009), but recent survey efforts have found them in decent numbers from canopy traps (Abdul Rahman et al., 2021), which Lee et al did not deploy in their study. It is likely that previous surveys have underestimated the abundance of this species due to the lack of canopy surveys. Resurveys of BTNR have not been conducted at this time.

Scientific Interest and Potential Value: Dung beetles are sensitive to environmental changes and changes in the diversity and abundance of mammals, the source of dung that the beetles rely upon. For these reasons, they are commonly used as bioindicators of forest disturbance and as a proxy in mammal monitoring. As the only arboreal specialist detected thus far in local dung beetle surveys, *O. deliensis* may play an important role in the dung removal, seed dispersal and nutrient recycling ecosystem functions especially pertaining to dung of arboreal mammals.

Conservation Measures: Bukit Timah Nature Reserve is legally protected.

Scientific Name:

Paragymnopleurus maurus
(Sharp, 1875)

Common Name:

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Order/Family:

Coleoptera: Scarabaeidae



Photo: Leong Yong Xu

Paragymnopleurus maurus, rolling a dung ball.

National Status: Near Threatened (NT)

Habitat and Ecology: *Paragymnopleurus* adults are classified as diurnal rollers under the common dung beetle functional clades that group species by time of activity and mode of dung removal. As rollers, they remove dung from the forest floor by carving out balls of dung from dung pats and rolling them some distance away before eventually burying them. *Paragymnopleurus maurus* is the only “roller” dung beetle left in Singapore and appears to be restricted to the forests in the Central Catchment area.

Distribution: Peninsular Malaysia, Borneo, Singapore.

Threats: This species is sensitive to habitat loss, as well as decreases in mammal abundance and diversity. The rolling behaviour of this species may imply a larger foraging/dispersal range, and that larger continuous/connected forested areas may be important for the survival of this species.

Scientific Interest and Potential Value: Dung beetles are sensitive to environmental changes and changes in the diversity and abundance of mammals, the source of dung that the beetles rely upon. For these reasons, they are commonly used as bioindicators of forest disturbance and as a proxy in mammal monitoring. *Paragymnopleurus maurus* is the only “roller” dung beetle left in Singapore, since *Sisyphus thoracicus* is nationally extinct, with only known records from the time of Wallace. The persistence of *Paragymnopleurus*

Photo: TEE Lab



Paragymnopleurus maurus, dorsal.

in Singapore despite the extirpation of *Sisyphus* is interesting, since the latter is usually considered the more resilient genus, being present in many disturbed forests in Malaysia where *Paragymnopleurus* is often absent, while *Sisyphus* is often still detected in areas where *Paragymnopleurus* occur. The persistence of *P. maurus* in local mature forests may thus have implications for the importance of old growth forests as strongholds of diversity in Singapore. As a relatively large species (and the only local species) that exhibits the famous dung ball rolling behaviour associated with dung beetles in media that is often perceived as “cute”, *P. maurus* has good potential as a flagship species for insect conservation in the local context.

Conservation Measures: Protection of mature forest habitats and mammal diversity as can be found in the Central Catchment Nature Reserve are likely to help protect this species.

Scientific Name:
Chalcosoma atlas (Linnaeus, 1758)

Common Name:
Atlas Beetle

Order/Family:
Coleoptera: Scarabaeidae

Photo: Sean Yap



Chalcosoma atlas specimen from LKCNHM, lateral.

National Status: Critically Endangered (CR)

Habitat and Ecology: *Chalcosoma atlas* belongs to the rhinoceros beetle subfamily Dynastinae and is one of the most famous representatives of the group. Like most rhinoceros beetles, this species is strongly sexually dimorphic, with males possessing an impressive set of horns – one on the head and two on the thorax. These work together to create a grappling, pincer-like motion that males use in intrasexual competitions over access to females in the canopy. Males are also separated into two morphs – majors and minors, with major morph males possessing much longer horns than the minor males. The lifespan of this species lasts about a year. Adult Atlas Beetles are known to feed on tree sap, fruits and leaves, while the larvae feed on rotting wood and decaying plant material. Though mostly restricted to forested habitats, they are considered minor crop pests of oil palm in Indonesia (Pradana et al., 2020).

Distribution: Most of Southeast Asia.

Threats: This species is sensitive to habitat loss. Poaching may also play a large role in population declines of this species, as its charismatic appearance makes it popular among collectors and exotic pet breeders.

Scientific Interest and Potential Value: Apart from various accounts in oral history, the existence of this species in Singapore is only known from three

museum specimens. Two specimens collected by Ridley are housed in the London NHM, a female collected in 1899, and a male in 1904. The third specimen is housed in LKCNHM ZRC, from Murphy student collection 1981. However, the Murphy specimen lacks a collector name and specific location, the only location label being "Singapore". Assuming the Murphy specimen was really collected in Singapore, no official records have been made since 1981 (40 years ago). Based on the technicality of IUCN definitions, this species is thus listed as "critically endangered" but is likely to be locally extinct. The likely extinction of this species makes *Xylotrupes gideon* the largest extant rhinoceros beetle in Singapore. *Chalcosoma atlas* and *X. gideon* are known to have similar behaviours, life history and host plants, often overlapping in the same habitats in Malaysia, so it is unclear why *C. atlas* has declined while *X. gideon* persists, though based on anecdotal accounts *X. gideon* is also less abundant now as compared to the past. The larger size of *C. atlas* may imply a larger suitable habitat area requirement, while also making it easier to be collected/poached. In terms of conservation interest/value, this species is famous worldwide and a good candidate as a flagship for insect conservation, and potentially for reintroduction efforts.

Conservation Measures: The Central Catchment Nature Reserve provides protected habitat, should the species recolonise.

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Diptera – Flies

ANG YUCHEN

Scientific Name:
Heligmonevra fuscinalonga
Tomasovic & Grootaert, 2008

Common Name:
Assassin fly

Order/Family:
Diptera: Asilidae

National Status: Vulnerable (VU)

Habitat and Ecology: This is a large, robust predator that actively hunts for prey in flight. It likely has specific ecological requirements to thrive, thus far less than 5 specimens have been found in the more undisturbed terrestrial forests in Singapore.

Distribution: This species is described from Singapore and has only been found in Nee Soon Swamp Forest and Bukit Timah Nature Reserve. Some specimens have also been collected in Cambodia at one locality.

Threats: Loss, scarcity and changes/degradation of our more pristine nature reserves, especially Nee Soon Swamp Forest (e.g., the general drying up of the



Photo: Maimon Hussin

habitat), where the majority of specimens have been found. Due to its large size, and as one of the (insect) apex predators, its survival is also dependent on a healthy insect ecosystem to support its population.

Scientific Interest and Potential Value: As an apex insect predator, it can be considered a keystone species that indicates the general health of the insect community in an area.

Conservation Measures: Conservation and monitoring of the remaining terrestrial forested areas will be important for the survival of this species.

Scientific Name:
Allocanace gibba Munari 2018

Common Name:
Gibba beach fly

Order/Family:
Diptera: Canacidae



Photo: Maimon Hussin

National Status: Endangered (EN)

Habitat and Ecology: First collected in 2012, this very rare monotypic species has only been found in old-growth mangroves (none found in newer mangroves), and likely an obligate mangrove habitat specialist, where larvae are likely microbial grazers in mangrove microhabitats.

Distribution: It has only been found in low numbers on Pulau Semakau's old mangroves and is endemic to Singapore. Extensive surveys on other mangroves in Singapore have not revealed this species.

Threats: Overall, loss and scarcity of the original mangrove habitats in Pulau Semakau. More specifically, while there are no immediate threats to the mangrove

site in Semakau, it is not under any legal protection to protect it from any potential future developments.

Scientific Interest and Potential Value: This species is described within a new monotypic genus, which is itself from another rare monotypic subtribe Canacina, previously only distributed from the Mediterranean and Northeastern Atlantic Coast. It has highly derived features which are not found in other canacids, which makes it even more valuable as a species for morphological and evolutionary research in this taxon.

Conservation Measures: Conservation and monitoring of the old mangrove sites on Pulau Semakau is crucial to this species, and some form of legal/official protection should be considered as well.

Scientific Name:
Sigaloethina phaia Munari, 2004

Common Name:
Phaia beach fly

Order/Family:
Diptera: Canacidae

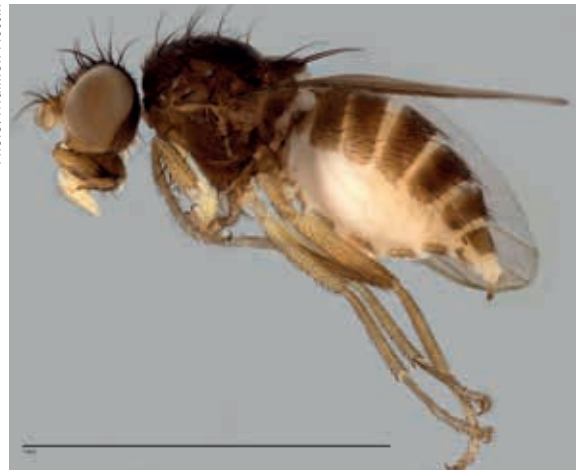
National Status: Vulnerable (VU)

Habitat and Ecology: First collected in 2012, this very rare monotypic species has only been found in old-growth mangroves (none found in newer mangroves), and likely an obligate mangrove habitat specialist, where larvae are likely microbial grazers in mangrove microhabitats.

Distribution: This is a rare species was known to be limited to Australasia; it was more recently found specimen from Chek Jawa Mangroves (Pulau Ubin, Singapore) representing a new Oriental record. This species is not found in any other Singaporean mangrove despite extensive surveys.

Threats: Loss, scarcity and changes/degradation of mangrove habitats within Pulau Ubin.

Photo: Maimon Hussin



Scientific Interest and Potential Value: This species represents a new genus and species record to the Oriental region, having previously only been recorded in Australasia. It is of research interest for investigating biogeography patterns in mangrove/coastal insects.

Conservation Measures: Conservation of mangrove habitats is crucial for this and many other mangrove specialist species.

Scientific Name:
Coelopa orientalis Macquart,
1843

Common Name:
Oriental kelp fly

Order/Family:
Diptera: Coelopidae

National Status: Endangered (EN)

Habitat and Ecology: Oriental kelp flies are large, hairy flies whose larvae breed exclusively on beach-stranded kelp (Phaeophyceae). Adults are cursorial and disinclined to fly, preferring to burrow into kelp wracks when disturbed. Life within decaying kelp is the likely reason for the robust and streamlined build of the adults. This allows ease to burrow into kelp and also resist strong winds to cling on to substrates.

Distribution: This is an Oriental species. In Singapore, they are only recorded very infrequently from small kelp wracks that have escaped the clearing by workers on beaches in Labrador Park and Pulau Semakau since the 2000s.

Threats: This species is extremely reliant on kelp wracks for feeding and breeding. As most beaches are regularly maintained, kelp wracks are constantly removed, thus resulting in the loss of the resources and habitat required for the survival of these flies.



Photo: Miteshravin S/O Ravindran

Scientific Interest and Potential Value: Kelp flies are important decomposers of kelp wracks and aid in nutrient cycling in the ecosystem; due to their large size, they are known to be important food sources for other animals such as birds and reptiles. They are also model organisms for sexual selection studies due to their large intraspecific size variability which is linked to a chromosomal inversion system, and their mating behaviour is well studied in a number of species.

Conservation Measures: Measures can be taken to preserve sections of beaches where kelp wracks are allowed to accumulate, albeit away from the general public. While they are not attracted to synanthropic trash and food sources and are not known and unlikely to be zoonotic vectors, they may on occasion be a nuisance to beach visitors by their presence.

Scientific Name:
Corethrella calathicola
Edwards, 1930

Common Name:
Frog-biting midge

Order/Family:
Diptera: Corethrellidae

Photo: Robyn JY Lim



Larva (left) and Adult Female (right) *Corethrella calathicola*.

National Status: Vulnerable (VU)

Habitat and Ecology: This species, like most corethrellids, are tiny midges with specific ecological niches. Larvae are aquatic inquiline predators in *Nepenthes* pitchers, largely preying on smaller-sized mites and other insect larvae. Adults require a blood meal to acquire enough protein from eggs, and specialise in feeding on anurans, locating them through their calls. They are largely found in more undisturbed mature forested areas where more *Nepenthes* and anurans can be found.

Distribution: This is an Oriental species. In Singapore, records are only from Nee Soon Swamp Forest and Kent Ridge.

Threats: This species is reliant on two other hosts for survival: *Nepenthes* for larval habitats and anurans for adult blood-feeding. Any harm to either host groups would result in a threat to the survival of this species in Singapore.

Scientific Interest and Potential Value: Being reliant on two host groups for survival, this species can function as a highly sensitive indicator to the general health of the forest ecosystem.

Conservation Measures: The continued monitoring and conservation of existing forest habitats in Singapore.

Scientific Name:

Teleopsis dalmanni
(Wiedemann, 1830)

Common Name:

Malayan stalk-eyed fly

Order/Family:

Diptera: Diopsidae

National Status: Vulnerable (VU)

Habitat and Ecology: These large, elegant flies are restricted to undisturbed forests, especially around forest streams, where they hang on root threads overhanging the streams or resting on low herbage. The eye-stalks are sexually-dimorphic. Males have much longer eye-stalks and they are used in mating competitions. They have a lekking system where a dominant male will defend a desirable root thread and females form harems around the male. Both adults and larvae are saprophagous.

Distribution: Widespread in Southeast Asia. In Singapore they are uncommon and are restricted to more undisturbed forest with moving waterbodies – these habitats are largely within and surrounding the Central Catchment area.

Photo: Su Yanle



Threats: This uncommon species requires more pristine forest habitats (specifically those with streams) and are sensitive and adversely affected by changes in the environment (e.g. drying of habitats).

Scientific Interest and Potential Value: This large and unique-looking species can be used as an indicator for the health of inland forests, and they are an important model organism for studies in sexual selection and sex-linked morphological evolution. Note that this species was inaccurately named as *Achias maculipennis* in the second edition Red Data Book (RDB2), which is an obsolete name for another species in the Peacock fly family (Tephritidae).

Conservation Measures: Continued monitoring and conservation of existing inland forest habitats.

Scientific Name:

Ngirhaphium caeruleum Evenhuis
& Grootaert, 2002

Common Name:

Cerulean long-legged fly

Order/Family:

Diptera: Dolichopodidae

National Status: Endangered (EN)

Habitat and Ecology: An obligate mangrove habitat specialist, they are closely associated with the muddy substrate of mangrove floors and are often found perching on shoots and roots of mangrove trees at low tide to search for small invertebrate prey on the mangrove mud surface.

Distribution: This species has two allopatric populations of colour morphs: the normative 'blue' morph (which lends its name to '*caeruleum*') is found in abundance but only in the mangroves of Pulau Semakau. A small population of 'green' morphs were found in the mangroves of Pulau Ubin. Additional populations of the green morph have also been found in the mangroves of Brunei.

Threats: Loss, scarcity and changes/degradation of mangrove habitats, especially the reduction of muddy

Photo: Rene Ong Sheue Ling



Green morph

Photo: Yuchen Ang & Jayanthi Puniamoorthy



Blue morph

microhabitats in the mangroves. Furthermore, the blue morph is endemic to Pulau Semakau, which has no legal protection to protect this habitat from any potential future developments.

Scientific Interest and Potential Value: This large and charismatic species can be used as an indicator species for the health of mangrove habitats, specifically the muddy microhabitats. Its allopatric populations of different colour morphs are also of interest to research in biogeographical patterns and potential incipient speciation.

Conservation Measures: Conservation and monitoring of the mangrove habitats on Pulau Semakau and Pulau Ubin is crucial to this species, and some form of legal/official protection should be considered as well.

Scientific Name:

Ngirhaphium murphyi Evenhuis & Grootaert, 2002

Common Name:

Murphy's long-legged fly

Order/Family:

Diptera: Dolichopodidae

National Status: Endangered (EN)

Habitat and Ecology: This rare species was first collected by Professor D.H. Murphy, from Mandai mangrove, in 1978. Subsequently, it was found in several mangroves along Singapore's northern coastline. An obligate mangrove habitat specialist, they are closely associated with the muddy substrate of mangrove floors and are often found perching on shoots and roots of mangrove trees at low tide to search for small invertebrate prey on the mangrove mud surface.

Distribution: This Singaporean-endemic species is only found in the mangroves of Singapore's northern coastline.

Threats: While it is found in several mangroves along Singapore's northern coastline, only one site (Sungei Buloh Wetland Reserve) is under legal protection from future developments. Furthermore, since its inclusion in the previous, second edition Red Data Book (then assessed with a category of threat status of Vulnerable), subsequent surveys show them turning up in declining numbers. This is likely due to changes in the mangrove habitats, especially the observed reduction of muddy microhabitats in Sungei Buloh, which is probably applying more pressure on this Singaporean endemic species.

Photo: Jayanthi Puntamoorthy & Yuchen Ang



Scientific Interest and Potential Value: This large and charismatic species can be used as an indicator species for the health of mangrove habitats, specifically the muddy microhabitats.

Conservation Measures: Conservation and monitoring of the mangrove habitats (especially the muddy microhabitats) Singapore's northern coastal mangroves. Legal protection from future developments should also be considered for the other mangroves on the northern coast other than those in Sungei Buloh.

Scientific Name:
Thinophilus superbus Grootaert,
2018

Common Name:
Superb long-legged fly

Order/Family:
Diptera: Dolichopodidae

National Status: Endangered (EN)

Habitat and Ecology: A relatively rare front mangrove specialist, where adults prowl the sandier mudflats during low tide for invertebrate prey. They are found in low numbers throughout the year.

Distribution: This relatively rare species was described from and is only recorded in the mangroves of Pulau Semakau within Singapore. It has subsequently been recorded in low numbers in Southern Thailand.

Threats: Loss, scarcity and changes/degradation of mangrove habitats on Pulau Semakau.

Scientific Interest and Potential Value: This large and charismatic species can be used as an indicator species for the health of front mangrove habitats. Given its beauty, this species has the potential to be



Photo: Jayanthi Puniamoorthy & Yuchen Ang

an ambassador for mangrove biodiversity for science communication purposes.

Conservation Measures: Conservation and monitoring of the mangroves on Pulau Semakau is crucial to this species, and some form of legal/official protection should be considered as well.

Scientific Name:
Elaphropeza bakau Grootaert &
Shamshev 2015

Common Name:
Bakau dance fly

Order/Family:
Diptera: Hybotidae

National Status: Vulnerable (VU)

Habitat and Ecology: These Singaporean-endemic species are tiny, active hunters that can be found prowling on the leaves and branches of mangrove trees hunting for other smaller invertebrate prey.



Photo: Igor Shamshev

Distribution: This relatively abundant species was described from and is only recorded within the mangroves of Pulau Semakau, Singapore.

Threats: While relatively abundant, this species is endemic to the mangroves of Pulau Semakau; extensive surveys in other mangroves failed to reveal this species. As such, the loss, scarcity and changes/degradation of mangrove habitats here could have drastic effects on the survival of this species.

Scientific Interest and Potential Value: While most *Elaphropeza* species have a strong preference for terrestrial habitats, a small group of species represented by *E. bakau* seem to be mangrove specialists. The comparative study of these species can yield important insights into habitat adaptations within a taxon.

Conservation Measures: Conservation and monitoring of the mangroves on Pulau Semakau is crucial to this species, and some form of legal/official protection should be considered as well.

Scientific Name:
Xenoplatyura beaveri Matile,
1979

Common Name:
Nepenthes predatory fungus gnat

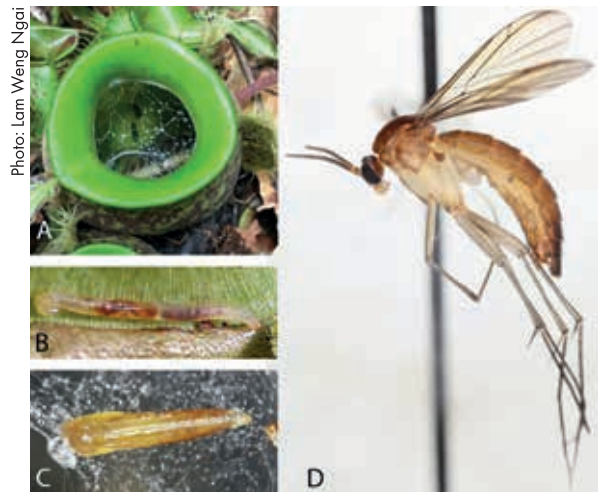
Order/Family:
Diptera: Keroplatidae

National Status: Vulnerable (VU)

Habitat and Ecology: While most fungus gnats feed on fungi, this species is a specialised inquiline predator in *Nepenthes* pitchers. Larvae spin sticky webs over the entrance of a pitcher to trap other inquiline prey that emerge from pitcher fluid (usually, mosquitoes). Adults are likely reverting back to more stereotypical fungus-feeding behaviours.

Distribution: This species is known throughout Southeast Asia. Within Singapore, they are only found in *Nepenthes* pitchers within the Nee Soon Swamp Forest.

Threats: This species is reliant on *Nepenthes* for larval habitats, and it is likely that the adults require more pristine habitats for the fungi that they would feed on. Any damage to the host plant population as well as



(A: Larval web woven by *X. beaveri* larva within *Nepenthes ampullaria* pitcher, B: Larva, C: Pupa, D: Adult male)

changes in the locality habitat would result in a threat to the survival of this species in Singapore.

Scientific Interest and Potential Value: This species can likely be utilized as an easy indicator of ecosystem health, as larval webs on pitchers can be easily recorded. They also perform regulating ecosystem services in controlling mosquito populations that may breed within *Nepenthes* pitchers.

Conservation Measures: The continued monitoring and conservation of existing forest habitats in Singapore.

Scientific Name:***Sepsis silvicola* Iwasa 2011****Common Name:****Mangal sepsid fly****Order/Family:****Diptera: Sepsidae****National Status:** Vulnerable (VU)

Habitat and Ecology: This species was first collected from Changi Mangrove in 1976, which has since been severely impacted; subsequent surveys failed to reveal any more specimens. However, this species has very recently been found in the mangroves of Pulau Ubin. They are closely associated to mangrove habitats, and they are likely feeding and breeding on wild boar and macaque dung.

Distribution: This species was previously collected from Changi Mangroves, but now can only be found in Pulau Ubin. It has also been recorded from the mangroves of Southern Vietnam.

Threats: Loss and degradation of mangrove habitats. The reduction in populations of macaques and wild boars can also reduce the quantity of dung which the species feeds/breeds on.

Photo: Maimon Hussin



Scientific Interest and Potential Value: This species was collected by Professor Murphy in 1976, who recognised it as a new species and genus, but did not publish its description. In 2011, this species was also found in Vietnam and described under an existing genus *Sepsis*. However, its morphology suggests it being an entirely new and monotypic genus (as recognised by Prof. Murphy), which will be revised subsequently. Morphological and molecular analysis of this species could then be important in resolving some phylogenetic instabilities in the systematics of Sepsidae.

Conservation Measures: Preservation and monitoring of mangrove sites in Pulau Ubin is important. Monitoring the populations of Eurasian wild boars and Long-tailed macaques will also be important for safeguarding the survival of this species.

Scientific Name:***Eosmallota singularis* (Walker, 1857)****Common Name:****Singular flower fly****Order/Family:****Diptera: Syrphidae**

Photo: Rene Ong Sheue Ling



National Status: Vulnerable (VU)

Habitat and Ecology: This extremely rare species was known from two female specimens from Singapore (1857) and Sabah (1913). They remained undetected until another specimen was collected from Bukit Timah Nature Reserve in 2019. Their life history is largely unknown, but they seem to be associated with more undisturbed lowland rainforests.

Distribution: This extremely rare species has thus only been found in Bukit Timah Nature Reserve. They have also been recorded in pristine forest plots in Sabah, Malaysia.

Threats: Lack of life-history data for this species makes it hard to determine what threats it faces, but changes

in habitats that the species might be reliant upon within Bukit Timah Nature Reserve might be a threat.

Scientific Interest and Potential Value: This species has been studied for its hornet mimicry. It is also a large, charismatic species that has been featured prominently on Singapore's national news media, which could play a role as an ambassador species for Singapore's insect biodiversity.

Conservation Measures: This extremely rare species is only known from Bukit Timah Nature Reserve, which is a lowland rainforest habitat for which it is very likely associated with. Other than habitat monitoring and preservation, more research into their life history is needed to determine what kind of specific conservation measures should be applied.

Scientific Name:
Milesia vespoides Walker 1857

Common Name:
Hornet-mimicking hover fly

Order/Family:
Diptera: Syrphidae

National Status: Vulnerable (VU)

Habitat and Ecology: This species was first collected in Singapore by A.R. Wallace in the early 1850s and remained undetected in Singapore until 2019 when a second specimen was collected in Pulau Ubin. Subsequently, a few other specimens have been recorded in and around urban parks. It is unclear why specimens are only starting to turn up in observable numbers after >150 years of non-detection. While not much is known about their life history, these large flies are excellent mimics of the Greater Banded Hornet *Vespa tropica*.

Distribution: This rarely recorded species has thus far been found in and around urban parks in Sentosa, Admiralty, Bukit Batok and Bukit Timah. It is also rarely collected around the Oriental region, usually in forested areas.

Threats: This is a rare fly which was not found for >150 years but is now being recorded in urban parks.

Photo: Joseph Lim



However, due to its rarity and ephemerality, it would be prudent to assign it a Vulnerable category of threat status. More targeted life-history research can provide data for a more accurate assessment.

Scientific Interest and Potential Value: This species has been studied for its hornet mimicry. It is also a large, charismatic species that has been featured prominently on Singapore's national news media, which could play a role as an ambassador species for Singapore's insect biodiversity.

Conservation Measures: A puzzling question is why this species, that had apparently 'disappeared' for over a century, is now suddenly turning up again, in urban

parks. More research into their life history is needed to further determine its national status and what kind of conservation measures should be applied.

Scientific Name:
Themara ampla Walker, 1857

Common Name:
Hammerhead peacock fly

Order/Family:
Diptera: Tephritidae

National Status: Nationally Extinct (NEx)

Habitat and Ecology: A few species of hammerhead peacock flies are known to occur in Singapore, most of them confined to dense, more undisturbed forest areas where they require fermenting logs to breed on. Males have enlarged 'hammerheads' which they use for displaying and fighting off other males from prime breeding spots on a rotting log. This species is easily distinguishable from the others by the absence of a clear spot near the tip of the wing (see *T. maculipennis*).

Distribution: This is an Oriental species. The lectotype of this species is a Singaporean specimen collected by naturalist Alfred Russell Wallace in the 1850s and remains the only known Singaporean specimen. It likely had a similar distribution pattern within Singapore i.e., in the forested regions of Singapore. Despite targeted samplings in modern times since 1960s, only specimens of other species (e.g., *T. maculipennis*) have been found. As such it is likely that this species is extirpated from Singapore.



Lectotype female *Themara ampla* specimen with associated labels.

Threats: It is likely that the loss of forest habitat and subsequent loss of suitable host species of tree (for breeding) to have caused its extirpation locally.

Scientific Interest and Potential Value: The mating behavioural ecology of hammerhead flies and other peacock flies are relatively well-studied, and some serve as models for investigating mating systems such as leks. Their specific requirements for breeding also means that they can function as an indicator for forest health.

Conservation Measures: More studies may need to be done to perhaps figure out the specific requirements (e.g., fermenting rot of a tree species) for breeding in this species, where a reintroduction of the putative host tree species may induce a revival of the species.

Scientific Name:
Themara maculipennis
(Westwood, 1847)

Common Name:
Hammerhead peacock fly

Order/Family:
Diptera: Tephritidae



Adult male *Themara maculipennis*, dorsal profile.

National Status: Vulnerable (VU)

Habitat and Ecology: A few species of hammerhead peacock flies occur in Singapore. Most are confined to dense forest where they require fermenting logs to breed on. Males have enlarged ‘hammerheads’ which they use for displaying and for fighting off other males from prime breeding spots on a log. This species is easily recognised by a clear wing spot near the tip of the wing.

Distribution: This is an Oriental species. In Singapore, records are only from the Bukit Timah and Central Catchment Nature Reserve. They are rarely collected in malaise traps. However, they can be found in relatively high numbers where there are rotting tree logs at a specific stage of fermentation.

Threats: Loss of forest habitat leading to the loss of suitable host tree species required for breeding.

Scientific Interest and Potential Value: The mating behavioural ecology of hammerhead flies and other peacock flies are relatively well-studied, and some serve as models for investigating mating systems such as leks. Their specific requirements for breeding means that they are very ephemeral and can function as indicators of forest health.

Conservation Measures: Continued conservation of forested areas.

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Hemiptera – Freshwater Aquatic Bugs

TRAN ANH DUC, CHOO RUISHENG, MARC CHANG JIA JIN, HWANG WEI SONG

Scientific Name:
Hebrus mangrovensis

Common Name:
Mangrove velvet bug

Order/Family:
Hemiptera/Hebridae

National Status: Vulnerable (VU)

Habitat and Ecology: This species is known to inhabit logs in mangrove swamps, and likely to be adapted to be fully submerged during high tide.

Distribution: This species is only known from Kranji mangroves in Singapore and nowhere else in the world.

Threats: Coastal mangroves are one of the most threatened habitats in Singapore, with a fragmented and much reduced area coverage. Given its highly limited distribution and mangrove habitat requirements, this species is vulnerable from any perturbations to its local environment, especially since Kranji mangrove is not within a nature reserve.

Scientific Interest and Potential Value: This species belongs to the velvet bug family (Hebridae) which is one of the smallest types of aquatic bugs in the world. It is one of only four velvet bugs species that are known to occur in Singapore. It is also one of the first two velvet bug species that were recorded to inhabit mangrove swamps, instead of the usual freshwater or moist terrestrial habitats. Both males and females of this species have very reduced wings (micropterous), which means they are flightless, a rare phenomenon for this

Photo: Tran Anh Duc



Preserved specimen of *Hebrus mangrovensis*.

group of velvet bugs. Given its strong association to the mangrove ecosystem and limited dispersal ability, this is a potential bioindicator species for environmental assessments.

Conservation Measures: Information about this species is poor due to the general inaccessibility of its mangrove habitat, its cryptic microhabitat in rotting logs, and its tiny size. Species information is only so far derived from the original specimens collected between 1985 and 1986. No recent records of this species are available since then and an update is sorely needed to assess its current status.

Scientific Name:

Ventidius malayensis

Common Name:

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Order/Family:

Hemiptera/Gerridae

National Status: Vulnerable (VU)

Habitat and Ecology: This species is a semi-aquatic insect that skims on the water surface in freshwater streams. Its preferred habitat is slower-flowing streams in hilly or lowland areas. It is only recorded in Nee Soon Freshwater Swamp within Singapore. It is a predatory insect that hunts and scavenge small insects that fall onto the water surface.

Distribution: This species has a relatively widespread distribution that includes Thailand, Peninsular Malaysia, Singapore and Borneo.

Threats: Given its restricted range within Nee Soon Freshwater Swamp locally, this species is likely to be highly sensitive to microclimatic conditions such as water and food availability. Any habitat modification or loss will significantly impact the already limited local population further.

Scientific Interest and Potential Value: This species is one of three species of water striders from the genus *Ventidius* present in Singapore. Each species resides in a slightly different microhabitat in the local freshwater



Photo: Yang Chang Man

Preserved specimen of *Ventidius malayensis* (front legs obscured). Live colouration is black and green, turning yellow upon death.

ecosystem, with *Ventidius harrisoni* slightly overlapping with *Ventidius malayensis* within the Central Catchment Nature Reserve. Its preference for shaded forested water bodies such as lakes and streamlets suggest it can be a useful bioindicator species.

Conservation Measures: The last specimen record for this species dates back to 1984 and is in need of an update on its current status within the Nee Soon Freshwater Swamp forest.

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